CURRICULUM

UNDER GRADUATE PROGRAMME

B.Tech.

NATIONAL INSTITUTE OF TECHNOLOGY KARNATAKA, SURATHKAL
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2016

MOTTO

* Work is Worship

VISION

* To Facilitate Transformation of Students into- Good Human Beings, Responsible Citizens and Competent Professionals, focusing on Assimilation, Generation and Dissemination of Knowledge.

MISSION

* Impart Quality Education to Meet the Needs of Profession and Society and Achieve Excellence in Teaching-Learning and Research.

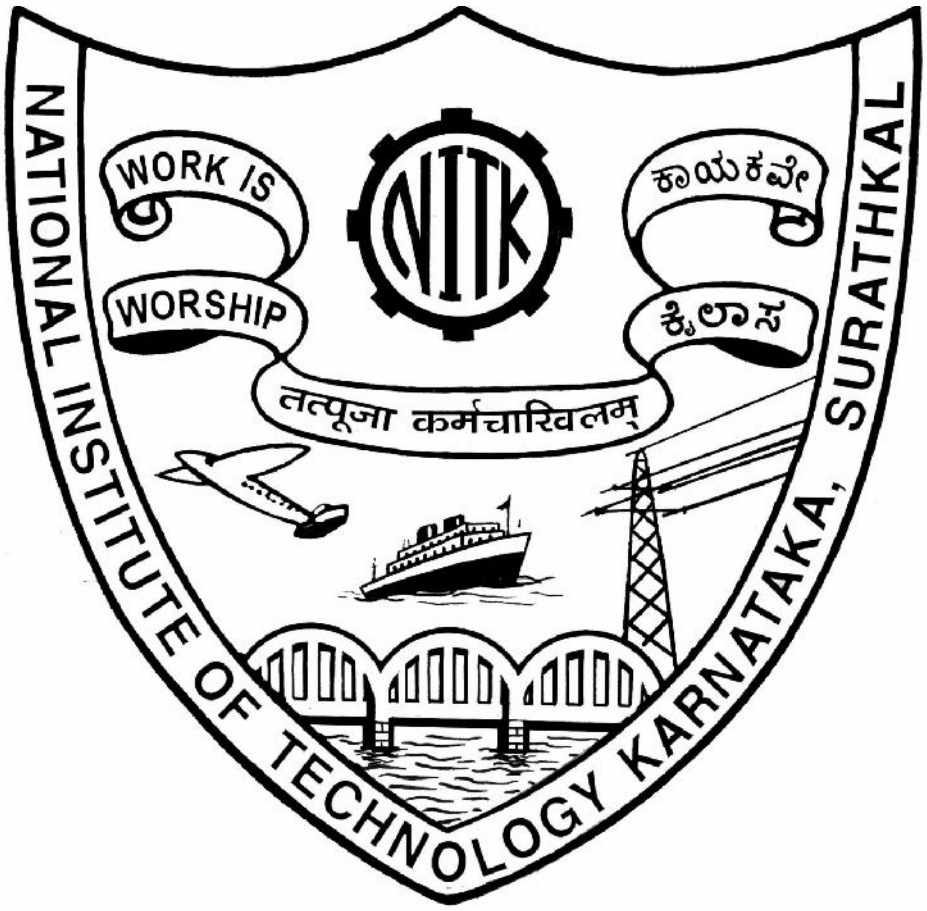
* Attract and Develop Talented and Committed Human Resource and Provide an Environment Conducive to Innovation, Creativity, Team-spirit and Entrepreneurial Leadership

* Facilitate Effective Interactions Among Faculty and Students and Foster Networking with Alumni, Industries, Institutions and Other Stake-holders.

* Practice and Promote High Standards of Professional Ethics, Transparency and Accountability.

CURRICULUM

UNDER GRADUATE PROGRAMMES



2016

CURRICULUM 2016

UNDER GRADUATE PROGRAMME

B.Tech.

SECTIONS

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REGULATIONS (General)

Common to all Degree Programmes

NATIONAL INSTITUTE OF TECHNOLOGY KARNATAKA, SURATHKAL
Post Srinivasnagar, Mangalore - 575025, India.
2016

CONTENTS

REGULATIONS (General)
Common to all Degree Programmes

{also refer: REGULATIONS specific to the Degree Programmes}

G1. INTRODUCTION:

G1.0 The General Regulations that are common to all Degree Programmes of NITK Surathkal, are presented here. Specific aspects of the Regulations pertaining to a particular Degree Programme are given separately along with the corresponding Curriculum.

G1.1 The provisions contained in this set of Regulations govern the policies and procedures, on the admission of students, imparting instructions of courses, conducting of the examinations and evaluation and certification of students' performance leading to the said Degree Programme(s).

G1.2 This set of Regulations, on approval by the Senate, may supersede all the corresponding earlier sets of Regulations of the Institute, along with all the amendments thereto, and shall be binding on all students undergoing the said Degree Programme(s).

G1.3 This set of Regulations may evolve and get revised/refined or updated or amended or modified or changed through appropriate approvals from the Senate, from time to time, and shall be binding on all parties concerned, including the Students, Faculty, Staff, Departments, Institute Authorities.

G1.4 In order to *guarantee fairness and justice* to all the parties concerned, in view of the periodic evolutionary refinements, any specific issues or matters of concern shall be addressed separately, by the *appropriate authorities*, as and when found necessary.

G1.5 The effect of year-to-year (periodic) refinements in the Academic Regulations & Curriculum, on the students *admitted in earlier years*, shall be dealt with appropriately and carefully, so as to ensure that *those* students are not subjected to any unfair situation whatsoever, although they are required to conform to these revised set of Regulations & Curriculum, without any undue favour or considerations.

G1.6 The Senate may consider any issues or matters of concern relating to any or all the Academic Activities of the Institute, for appropriate action, irrespective of whether a reference is made (or the nature and extent of any reference if so present) here in this set of Regulations or otherwise.

G1.7 Whenever outside Experts need to be co-opted and/or invited for any of the Academic Committee Meetings, prior approval from the Chairman of the Senate/BOS shall be obtained, justifying the need, based on the agenda items of such Academic Committee Meetings. The outside experts shall be entitled for TA/DA/etc as per the prevailing Institute Rules.

G1.8 All disputes arising from this set of Regulations must be addressed to the Senate. The decision of the Senate is final and binding on all parties concerned. Further, any legal disputes arising from this set of Regulations shall be limited to the legal jurisdiction determined by the location of the Institute and not that of any other parties.

G2. DEFINITIONS: Unless the context otherwise requires –

- **"Institute"/"NITK"/"NITKS"** means, National Institute of Technology Karnataka, Surathkal.
- **"BOG"** means, the Board of Governors (BOG) of the Institute.
- **"MHRD"** means, the Ministry of Human Resources Development, GOI.
- **"JEE"** means, Joint Entrance Examination.
- **"GATE"** means, Graduate Aptitude Test in Engineering.
- **"Senate"** means, the Faculty Senate of the Institute.
- **"Director"** means, the Director of the Institute.
- **"BOS"** means, the Board of Studies of the Institute.
- **"Dean (A)"** means, the Dean (Academic).
- **"Dean (FW)"** means, the Dean (Faculty Welfare)
- **"Dean (P&D)"** means, the Dean (Planning and Development)
- **"Dean (R&C)"** means, the Dean (Research & Consultancy)
- **"Dean (SW)"** means, Dean (Students Welfare).
- **"Dean (AA&IR)"** means, Dean (Alumni Affairs & Institutional Relations).
- **"NITKS Hostels"** means, NITK-Surathkal Hostels.
- **"HOD"** means, the Head of the Department.
- **"Programme Co-ordinator"** means, a faculty in charge of an academic programme, particularly in case of PG and/or Research degree programmes.
- **"Parent Department"** or **"Degree Awarding Department"** means, the department that offers the degree programme that a student undergoes, or the department to which the Research-Guide/Programme-Coordinator belongs.
- **"DAC" or "PAC"** means, the Departmental/Programme Academic Committee.
- **"DUGC"** means, the Departmental Under Graduate Committee.
- **"DPGC"** means, the Departmental Post Graduate Committee.
- **"PWEC"** means, the Project Work Evaluation Committee.
- **"DRPC"** means, Doctoral Research Programme Committee.
- **"RPAC"** means, Research Progress Assessment Committee.
- **"MTAC"** means Master's Thesis Assessment Committee.
- "**DTAC**" means, Doctoral Thesis Assessment Committee.
- **"DAAB"** means, the Departmental Academic Appeals Board.
- **"Faculty Advisor"** means the Faculty Advisor or the Panel of Faculty Advisors, in a Parent Department, for a group(admission-batch) of students.
- **"Course"** means, a specific *subject* usually identified by its *course-number* and *course-title*, with a specified *syllabus*/course-description, a set of *references*, taught by some *teacher*(*s*)/course-instructor(s) to a specific *class* (group of students) during a specific *academic-session*/semester.
- **"Course Instructor"** means, the teacher or the Course Instructor of a Course.
- **"Class/Course Committee"** means, the Class/Course Committee of a class/course.
- **"Project Guide"** means, the faculty who guides the Major Project of the student.
- **"Research Guide"** means, the faculty who guides the Research student/scholar, including the Additional Guide.
- **"He"** includes both genders he and she; similarly "his" and/or "him" includes "her" as well, in all the cases.
- **"Regulations"** means, this set of Academic Regulations.
- **"Curriculum"** includes the set of Academic Regulations, Course-Structure and Course-Contents.
- **"MOU"** means, Memorandum Of Understanding.

G3. ACADEMIC CALENDAR:

G3.1 The normal duration of the course leading to B.Tech degree will be *EIGHT* semesters.

G3.2 The normal duration of the course leading to M.Tech. degree will be *FOUR* semesters.

G3.3 The normal duration of the course leading to M.C.A. degree will be *SIX* semesters.

G3.4 The normal duration of the course leading to M.B.A. degree will be *FOUR* semesters.

G3.5 The normal duration of the course leading to M.Sc. degree will be *FOUR* semesters.

G3.6 Each academic year shall be divided into 2 semesters, each of *20 weeks* duration, including evaluation and grade finalization, etc. The Academic Session in each semester shall provide for at least *70 Teaching Days*, with at least 40 hours of teaching contact periods in a five-days session per week. The semester that is typically from Mid July to November is called the *ODD SEMESTER*, and the one that is from January to Mid-May is called the *EVEN SEMESTER*. Academic Session may be scheduled for the *Summer Session/Semester* as well.

G3.7 The schedule of academic activities for a Semester, including the dates of registration, mid-semester examination, end-semester examination, inter-semester vacation, etc. shall be referred to as the Academic Calendar of the Semester, which shall be prepared by the Dean (Academic), approved by the Senate, and announced at least TWO weeks before the Closing Date of the previous Semester.

G3.8 The Academic Calendar must be strictly adhered to, and all other activities including co-curricular and/or extra-curricular activities must be scheduled so as not to interfere with the Curricular Activities as stipulated in the Academic Calendar.

G3.9 Under any circumstances when any of the Teaching Days gets declared as a Holiday or otherwise when the classes get suspended, irrespective of whatsoever be the reasons, appropriate makeup for such loss shall be made by having the class/lab/teaching sessions conducted on a suitable Saturday by following the particular Class Time Table of that Teaching Day which was so lost.

G4. REGISTRATION:

G4.1 Every Student after consulting his Faculty-Advisor/Research-Guide is required to register for the approved courses with the DUGC/DPGC/DRPC of Parent Department at the commencement of each semester on the days fixed for such registration and notified in the academic calendar.

G4.2 **Lower and Upper Limits for Course Credits Registered in a Semester, by a Full-Time Student of a Degree Programme:**
A full time student of a particular degree programme shall register for the appropriate number of course credits in each semester/session, that is within the minimum and maximum limits specific to that degree programme as stipulated in the specific Regulations pertaining to that degree programme.

G4.3 **Mandatory Pre-Registration for higher semesters:**
In order to facilitate proper planning of the academic activities of a semester, it is essential for the students to *declare their intent to register* for an elective course well in advance, before the actual start of the academic session, through the process of Pre-Registration, which is mandatory for all students of second or higher semesters.

G4.4 All students (other than the freshly admitted students) intending to register for the next higher semester are required to have completed the *Mandatory Pre-Registration* of elective courses, at least TWO weeks before the Last Day of Classes in the current semester. To facilitate this Pre-registration all teaching departments shall announce the list of courses to be offered for the next higher semester, at least FOUR weeks before the Last Day of Classes in the current semester.

G4.5 PhD students can register for any of PG/PhD courses and the corresponding rules of evaluation will apply. Under Graduate students may be permitted to register for a few selected Post Graduate courses, in exceptionally rare circumstances, only if the DUGC/DPGC is convinced of the level of the academic achievement and the potential in a student.

G4.6 ***Course Pre-Requisites:***

In order for a student to register for some courses, it may be required either to have exposure in, or to have completed satisfactorily, or to have prior *earned credits* in, some specified courses. In such instances, the DUGC/DPGC/DRPC shall specify clearly, any such course pre-requisites, as part of the curriculum.

G4.7 Students who do not register on the day announced for the purpose may be permitted *LATE REGISTRATION* up to the notified day in academic calendar on payment of late fee.

G4.8 *REGISTRATION IN ABSENTIA* will be allowed only in exceptional cases with the approval of the Dean (A) after the recommendation of DUGC/DPGC/DRPC through the authorized representatives of the student.

G4.9 A student will be permitted to register in the next semester only if he fulfills the following conditions:

(a) satisfied all the Academic Requirements to continue with the programme of Studies without termination (refer Clause No: G10);
(b) cleared all Institute, Hostel and Library dues and fines (if any) of the previous semesters;
(c) paid all required advance payments of the Institute and hostel for the current semester;
(d) not been debarred from registering on any specific ground by the Institute.

G4.10 Medium of Instruction/Evaluation/etc. shall all be : English.

G5. EVALUATION SYSTEM:

G5.1 ***Course Credit Assignment:***

Every Course comprises of specific Lecture-Tutorial-Practical (L-T-P) Schedule. The Course Credits are fixed based on the following norms:

Lectures/ Tutorials :	One hour per week is assigned one Credit.
Practicals :	(i) a 3-hour session per week is assigned two Credits; OR (ii) a 2-hour session per week is assigned one Credit.

For example, a theory course with a L-T-P schedule of 3-1-0 will be assigned 4 credits; a laboratory practical course with a L-T-P schedule of 0-0-3 will be assigned 2 credits.

G5.2 The Academic Performance Evaluation of a Student shall be according to a ***Letter Grading System***, based on the ***Class Performance Distribution***, and *not* based upon any fixed apriori mappings or any absolute scale conversions from the Raw-Scores Scale (e.g. percentage-marks) to the Grade-Points Scale. The entire evaluation system (including these *Regulations) comprising of the Policies*, *Procedures*, *Mechanisms*, *Guidelines*, etc., have-been/shall-be designed, developed, evolved, implemented and adhered to, in order to meet the most fundamental/basic *quality* characteristics of being: fair/justifiable, objective/unbiased, reliable/precise, robust/resilient, while also being flexible/responsive and transparent/verifiable. It is equally essential to maintain appropriate level of *confidentiality* in terms of certain specific details, in order to achieve the above *quality* characteristics.

G5.3 The *double-letter grade* (AA, AB, BB, BC, CC, CD, DD, FF) indicates the level of academic achievement, assessed on a decimal (0-10) scale.

G5.4 ***Letter-Grades and Grade-Points****:*

LETTER-GRADE	GRADE-POINTS	REMARKS
AA AB BB BC CC CD DD	10 9 8 7 6 5 4	
FF	0	Fail due to poor performance
FA	0	Fail due to attendance shortage
I	-	Incomplete
U	-	Audited
W	-	Withdrawal
S	-	Satisfactory
N	-	Unsatisfactory

G5.5 The *double-letter grade* awarded to a student in a course other than a 0-0-P (Practical) course, for which he has registered shall be based on his performance in quizzes, tutorials, assignments etc., as applicable, in addition to one mid-semester examination and one end-semester examination. The distribution of weightage among these components may be as follows:

End-Semester Examination	: 40 to 50% (3 - 4 hours duration)
Mid-Semester Examination	: 20 to 25% (1 – 1½ hours duration)
Quizzes, Tutorials, Assignments, etc. (*continuous evaluation*)	: 25 to 40% (to make up for 100%)

Any variation, other than the above distribution, requires the approval of the pertinent DUGC/DPGC/DRPC.

G5.6 For any Undergraduate/ Postgraduate course offered to more than one section/ Department a common question paper, scheme of evaluation and grading has to be followed for both mid semester and end semester examinations. The respective DUGC/DPGC may decide about the weightage to be given to each individual component, viz tutorials, assignments, mid semester and end semester examination etc.

G5.7 The *double-letter grade* awarded to a student in a 0-0-P (Practical) course, is based on an appropriate continuous evaluation scheme that the course instructor shall evolve, with the approval of the pertinent DUGC/DPGC/ DRPC.

G5.8 The Course Instructor shall communicate clearly to the students, by announcements in the class, and/or by displaying prominently in the departments notice boards /website, and also report in writing to the DUGC/DPGC/DRPC the course plan and the details of the *Evaluation Scheme*, including the distribution of the weightage for each of the components, as well as the requirements for receiving a 'U' grade for auditing the course; within the first week of the semester in which the course is offered; so that there would be no ambiguities in this regard at the end of the semester while finalizing the grades.

G5.9 For courses offered exclusively for the PhD programme, the method of evaluation will be decided by pertinent DRPC. It may be similar to PG course evaluations, or it may be based on combinations of (a) Report submitted by the student (under the guidance of the Instructor for that course), (b) an open seminar, (c) viva-voce examination. An appropriate letter grade shall be awarded after the completion of the evaluation.

G5.10 ***Earned Credits***

This refers to the credits assigned to the course in which a student has obtained either 'S' grade, or any one of the *double-letter grades* 'AA', 'AB', 'BB', 'BC', 'CC', 'CD', 'DD' (but not 'FF' and 'FA').

G5.11 ***Cutoff Marks for 'AA' & 'FF' and the Scale-Differential:***

The *minimum cutoff* marks for 'AA' grade as well as the *maximum cutoff* marks for 'FF' grade will be decided by the Course Instructor based on the specific relevant details of the Class Performance Distribution (using appropriate class performance statistics parameters, like the Class-Mean, Class-Standard-Deviation, etc). However as a general guideline approved by the senate the minimum cutoff marks for 'AA' and 'DD' grade have been fixed as 70% and 20% respectively. Faculty members who intend to give a 'AA' grade to those students getting marks less than 70% and 'DD' grade for those students who get marks less than 20% are required to give justification for the same to the DUGC/ DPGC /DRPC of their respective department.

The *Scale-Differential* is defined as the difference between the minimum cutoff marks for the 'AA' grade and the maximum cutoff marks for the 'FF' grade (normally expressed as a multiple of the class-standard-deviation parameter).

An appropriate value for the Scale-Differential shall be decided by the Course Instructor after having studied the specific relevant details of the Class Performance Distribution.

The *minimum/maximum cutoff* marks for the intermediate grades are determined by appropriate *partitioning/clustering method* based on the specific relevant details of the Class Performance Distribution.

G5.12 ***Description of Grades:***

AA Grade:

An 'AA' grade stands for outstanding achievement, relative to the class, and the Course Instructor is supposed to take *utmost care* in awarding of this highest double-letter grade.

DD Grade:

The 'DD' grade stands for marginal performance and is the minimum passing double-letter grade.

FF and FA Grades:

The 'FF' grade denotes very poor performance, i.e. *failure* in a course due to poor performance and FA grade denotes poor attendance i.e. failure in a course due to attendance shortage (i.e. < 75%) and the Course Instructor is supposed to take *utmost care* while awarding these lowest double-letter grades. The students who have been awarded 'FF' grade in a course in any semester may be allowed to appear for a make-up end-semester examination. The make- up end- semester examination will be conducted possibly along with that arranged for those students who were awarded the 'I' grade, within the period announced in the academic calendar. If after considering make-up end-semester examination a student passes, then a minimum passing grade of 'DD' only be awarded, and if a student fails then a 'FF' grade will be awarded. Only regular registrants of a given course during a given academic semester who have obtained FF grade in the course will be permitted to appear for the makeup examination. Students who continue to have FF grade after the makeup examination are required to re- register for the course whenever it is offered subsequently. All the 'FF' (other than the courses for which 'DD' grade is obtained by the student in the make-up end-semester examinations conducted prior to the starting of next semester) and 'FA' grades secured in any course stay permanently on the grade card.

A student who obtains 'FA' grade in any course has to necessarily re-register for the course in the subsequent semesters/sessions whenever the course is offered until a passing grade is obtained.

However, for an elective course in which 'FA' or 'FF' grade has been obtained, the student may either repeat the same course or register for any other elective course.

Only first year and final year courses may be offered during the summer session.

I Grade:

An 'I' grade denotes incomplete performance in any course due to absence at the end semester examination (see also Clause No: G7.3). When the 'I' grade is converted to a regular double-letter grade, a penalty of ONE Grade-Point is imposed, by awarding the double-letter grade that is immediately below the one that the student would have otherwise received.

U Grade:

This grade is awarded in a course that the student opts to register for audit. It is not mandatory for the student to go through the entire regular process of evaluation in an audit course. However, the student has to go through some process of minimal level of evaluation and also the minimum attendance requirement, as stipulated by the Course Instructor and approved by the corresponding DUGC/DPGC/DRPC, for getting the "U" grade awarded in a course, failing which that course will not be listed in the Grade Card.

W Grade:

A 'W' grade is awarded when the student withdraws from the course. Withdrawal from a course is permitted only under extremely exceptional circumstances (like medical emergencies, family tragedies and/or other unavoidable contingencies) and has to be recommended by the DUGC/DPGC/DRPC and approved by the Dean (Academic). However, no withdrawal is permitted after the finalization of the grades in the semester. Also, the 'W' grade once recorded remains permanently in the Grade Card.

S and N grades:

These grades are awarded for the Mandatory Learning Courses. The 'S' grade denotes satisfactory performance and completion of a course. The 'N' grade is awarded for non-completion of course requirements and the student will have to register for the course until he obtains the 'S' grade. The 'N' grade secured in a course stays permanently on the Grade Card.

G5.13 ***Evaluation of Performance:***

The overall performance of a student will be indicated by two indices: SGPA which is the Semester Grade Point Average and CGPA which is the Cumulative Grade Point Average.

SGPA for a semester is computed as follows:

$$\text{SGPA} = \frac{[\sum (\text{Course credits}) \times (\text{Grade Point})] \text{ for all courses with double-letter grades, including 'FF' and 'FA' (in that semester).}}{[\sum (\text{Course credits})] \text{ for all courses with double-letter grades, including 'FF' and 'FA' (in that semester).}}$$

CGPA is computed as follows:

$$\text{CGPA} = \frac{[\sum (\text{Course credits}) \times (\text{Grade Point})] \text{ for all courses with double-letter grades, including all 'FF' and 'FA' grades.}}{[\sum (\text{Course credits})^{*}] \text{ for all courses with double-letter grades, including all 'FF' and 'FA' grades.}}$$

***** Whenever a student reappears for a course in which he / she has been awarded 'FF' or 'FA' grade, the CGPA computations will not once again include the course credits for the failed courses in the denominator.

***** There is no equivalence between the CGPA scale and percentage. However, CGPA $\geq$ 6.5 can be considered as equivalent to first class and 5.5 $\leq$ CGPA < 6.5 can be considered as equivalent to second class. Notionally, CGPA may be multiplied by a factor of 10 to obtain the numerical percentage.

G5.14 ***Report of Marks, Grades and Class Performance Statistics:***

(a) The final grades shall be displayed for at least *ONE* working-day, during which period a student can approach the concerned course instructor(s) for any clarification. The process of evaluation shall be transparent and the students shall be made aware of all the factors included in the evaluation. In case of any correction, the course instructor shall have to incorporate the same before finalization of the grades.

(b) The course instructors shall submit the Report of Marks & Grades for each of the students in his course, along with the Summary Report of Marks & Grades containing the Class Performance Statistics, in the prescribed format, to the Chairman, DUGC/DPGC/DRPC by the stipulated date, for possible moderation (if and only when found necessary) and approval.

(c) The DUGC/DPGC/DRPC shall submit the final approved Report of Marks & Grades along with Summary Report of Marks & Grades containing the class performance statistics, in the prescribed format, to the office of the Dean (Academic) within the stipulated date.

(d) The Student Progress Report shall contain the Letter-Grade for each course; along with the SGPA, and the CGPA.

G5.15 ***Appeal for review of Grades:***

(a) The entire process of evaluation shall be made transparent, and the course instructor shall explain to a student why he gets whatever grade he is awarded, if and when required. A mechanism for review of grades is incorporated in the evaluation system. However, before appealing for such review, a student shall first approach the concerned Course Instructor and then the concerned DUGC/DPGC/DRPC, with the request to do the needful; and only in situations where satisfactory remedial measures have not been taken, the student may then appeal to the Departmental Academic Appeals Board (DAAB).

(b) In case of any such grievances about the grades, the student may appeal for review of grades to the Departmental Academic Appeals Board (DAAB) before the date specified in Academic Calendar.

(c) The fee for such an appeal will be decided by the Senate from time to time. If the appeal is upheld by DAAB, then the fee amount will be refunded to the student.

G6. ADD / DROP / cU -options:

G6.1 ***ADD-option:***
A student has the option to ADD courses for registration till the date specified for late registration in the Academic Calendar.

G6.2 ***DROP-option:***

On recommendation of the Teaching Department as well as the Parent Department, a student has the option to DROP courses from registration *until 2 weeks after the commencement of the classes in the semester*, as indicated in the Academic Calendar.

G6.3 ***cU-option:***

A student can register for auditing a course, or a course can even be converted from Credit to Audit or from Audit to Credit, with the consent of the Faculty Advisor and Course Instructor

until 2 weeks after the commencement of the classes in the semester as indicated in the Academic Calendar. However, CORE Courses shall not be made available for audit.

G7. ATTENDANCE REQUIREMENTS:

7.1 All students must attend every lecture, tutorial and practical classes.

7.2 To account for approved leave of absence (eg. representing the Institute in sports, games or athletics; placement activities; NCC/NSS activities; etc.) and/or any other such contingencies like medical emergencies, etc., the attendance requirement shall be a *minimum of 75%* of the classes actually conducted.

7.3 A student with less than 75% attendance in a course during a semester, in lectures, tutorials and practicals taken together as applicable, will not be permitted to appear in the End Semester Examinations of the course in which the shortfall exists, irrespective of his academic performance, and irrespective of nature of his absence . He shall be awarded 'FA' grade in that course .

7.4 The course instructor handling a course must finalise the attendance 3 calendar days before the last day of classes in the current semester and communicate clearly to the students by displaying prominently in the department and also in report writing to the head of the department concerned.

7.5 The attendance records are to be maintained by the course instructor and he shall show it to the student, if and when required.

G8. ABSENCE DURING THE SEMESTER:

G8.1 ***Leave of Absence:***

(a) If the period of leave is more than two days and less than two weeks, prior application for leave shall have to be submitted to the HOD concerned, with the recommendation of the Faculty-Advisor/Research-Guide stating fully the reasons for the leave requested, along with supporting documents.

(b) If the period of leave is two weeks or more, prior application for leave shall have to be made to the Dean (Academic) with the recommendations of the Faculty-Advisor/ Research Guide, HOD concerned stating fully the reasons for the leave requested, along with supporting documents. The Dean (Academic) may, on receipt of such application, grant leave or also decide whether the student be asked to withdraw from the course for that particular semester because of long absence.

(c) It will be the responsibility of the student to intimate the Course Instructors, and also the Dean (Students Welfare) as well as the Chief Warden of the hostel, regarding his absence before availing leave.

G8.2 ***Absence during Mid-Semester Examination:***

A student who has been absent from a Mid Semester Examination due to illness and other contingencies may give a request for make-up examination within two weeks after the Mid Semester Examination to the HOD with necessary supporting documents and certifications from authorized personnel. The HOD may consider such requests depending on the merits of the case, and after consultation with the course instructor, may permit the make up Mid Semester Examination for the concerned student.

G8.3 ***Absence during End-Semester Examination:***

In case of absence for an End Semester Examination, on medical grounds or other special circumstances, the student can apply for 'I' grade in that course with necessary supporting documents and certifications by authorized personnel to the HOD. The HOD may consider the request, depending on the merit of the case, and after consultation with the Course Instructor, permit the make up End Semester Examination for the concerned student (possibly arranged along with those students who were awarded the 'FF' grade). The student may subsequently complete all course requirements within the period announced in Academic Calendar (which may possibly be

extended till first week of next semester under special circumstances) and 'I' grade will then be converted to an appropriate Double-letter grade, as per Clause No: G5.11 (Description of Grades: "I" Grade, above). All the particulars of such a decision with date of finalizing the grade shall be communicated to Dean (Academic). If such an application for the 'I' grade is not made by the student then a double-letter grade will be awarded based on his in-semester performance.

G9. TRANSFER OF CREDITS

The courses credited elsewhere, in Indian or foreign University/Institutions/ Colleges by students during their study period at NITK may count towards the credit requirements for the award of degree. The credits transferred will reduce the number of courses to be registered by the student at NITK. The guidelines for such transfer of credits are as follows:

a) B.Tech students with consistent academic performance and CGPA ≥7.5 can credit courses approved by the concerned DUGC of the program, in other Institutions during 3rd and 4th year and during summer breaks.

b) PG students with consistent academic performance and CGPA ≥7.5 can credit courses, approved by the concerned DPGC of the program in other Institutions during the summer vacation /project work.

c) Credits transferred will not be used for SGPA/CGPA computations. However, credits transferred will be considered for overall credits requirements of the programme.

d) Students can earn external credits only from IISC/IITs/NITs/IIMs and other Indian or foreign Universities/Institutes /Colleges with which NITK has an MOU (and that MOU must have a specific clause for provision of credit transfer by students)

e) Credits transfer can be considered only for the course at same level i.e UG, PG etc.

f) A student must provide all details (original or attested authentic copies)such as course contents, number of contact hours, course instructor /project guide and evaluation system for the course for which he is requesting a credits transfer. He shall also provide the approval or acceptance letter from the other side. These details will be evaluated by the concerned departmental academic bodies (DUGC or DPGC)before giving approval. These academic bodies will then decide the number of equivalent credits the student will get for such course(s) in NITK. The complete details will then be forwarded to Dean (A) for approval.

g) The maximum number of credits that can be transferred by a student shall be limited to 20.

h) In case of major project for PG student, the External Guide will evaluate for only 50% credits (which will account for credits transfer)and the internal PWEC will evaluate for the remaining 50% credits.

i) A students has to get minimum passing grades/ marks for such courses for which the credits transfer are to be made.

j) Credits transfers availed by a student shall be properly recorded on academic record(s)of the student.

G10. WITHDRAWAL FROM THE PROGRAMME:

G10.1 ***Temporary Withdrawal:***

(a) A student who has been admitted to a degree programme of the Institute may be permitted to withdraw temporarily, for a period of one semester or more, on the grounds of prolonged illness or grave calamity in the family, etc., provided:

(i) He applies to the Institute stating fully the reasons for withdrawal together with supporting documents and endorsement from his parent/guardian;
(ii) The Institute is satisfied that, without counting the period of withdrawal, the student is likely to complete his requirements of the degree within the time specified (refer: "Degree Requirements") ;
(iii) There are no outstanding dues with the Departments / Institute / Hostels / Library / etc.;
(iv) Scholarship holders are bound by the appropriate Rules applicable to them.
(v) The decision of the Director of the Institute regarding withdrawal of a student is final and binding.

(b) Normally, a student will be permitted only one such temporary withdrawal during his tenure as a student and this withdrawal will not be counted for computing the duration of study.

G10.2 ***Permanent Withdrawal:***

Any student who withdraws admission before the closing date of admission for the Academic Session is eligible for the refund of the all the fees and deposits, after a deduction of a processing fee.

Once the admission for the year is closed, the following conditions govern withdrawal of admissions:

(a) A student who wants to leave the Institute for good, will be permitted to do so (and take Transfer Certificate from the Institute, if needed), only after clearing all the dues, if any. Also, all the fees and charges already paid will not be refunded on any account.

(b) Those Students who have received any scholarship, stipend or other forms of assistance from the Institute shall repay all such amounts in addition to those mentioned in Clause No: G10.2(a) above.

(c) The decision of the Director of the Institute regarding all aspects of withdrawal of a student shall be final and binding.

G11. CONDUCT AND DISCIPLINE:

G11.1 Students shall conduct themselves within and outside the premises of the Institute in a manner befitting the students of an Institution of National Importance.

G11.2 As per the order of Honorable Supreme Court of India, ragging in any form is considered as a criminal offence and is banned. Any form of ragging will be severely dealt with.

G11.3 The following acts of omission and/or commission shall constitute gross violation of the code of conduct and are liable to invoke disciplinary measures:

(a) Ragging.
(b) Lack of courtesy and decorum; indecent behavior anywhere within or outside the campus.
(c) Willful damage or stealthy removal of any property/belongings of the Institute/Hostel or of fellow students/citizens.
(d) Possession, consumption or distribution of alcoholic drinks or any kind of narcotics or hallucinogenic drugs.
(e) Mutilation or unauthorized possession of library books.
(f) Noisy and unseemly behavior, disturbing studies of fellow students.
(g) Hacking in computer systems (such as entering into other person's area without prior permission, manipulation and /or damage of computer hardware and software or any other cyber crime etc.)
(h) Plagiarism of any nature.

(i) Any other act of gross indiscipline as decided by the Senate from time to time.

Commensurate with the gravity of offense, the punishment may be: reprimand, fine, expulsion from the hostel, debarring from an examination, disallowing the use of certain facilities of the Institute, rustication for a specified period or even outright expulsion from the Institute, or even handing over the case to appropriate law enforcement authorities or the judiciary, as required by the circumstances.

G11.4 For an offence committed in (i) a hostel (ii) a department or in a class room and (iii) elsewhere, the Chief Warden, the Head of the Department and the Dean (Students Welfare), respectively, shall have the authority to reprimand or impose fine.

G11.5 Cases of adoption of unfair means and/or any malpractice in an examination shall be reported to the Dean (Academic) for taking appropriate action.

G11.6 All cases of serious offence, possibly requiring punishment other than reprimand, shall be reported to the Director.

G11.7 The Institute Level Standing Disciplinary Action Committee constituted by the Director, shall be the authority to investigate the details of the offence, and recommend disciplinary action based on the nature and extent of the offence committed.

G12. RESIDENCE:

G12.1 Institute is wholly residential and all full-time students shall be required to reside in the hostels.

G12.2 Under special circumstances, the Dean (Students Welfare) may permit a student to reside with his parent/guardian in the Institute campus or within a reasonable distance from the Institute.

G12.3 Students shall be required to abide by the Rules and Regulations of the NITKS Hostels as established by the Board of NITKS Hostels Management.

G13. GRADUATION REQUIREMENTS AND CONVOCATION:

G13.1 A student shall be declared to be eligible for the award of the degree if he has:
(a) Fulfilled Degree Requirements
(b) No dues to the Institute, Departments, Hostels, Library, CCC, and any other centers
(c) No disciplinary action pending against him.

G13.2 The award of the de gree must be recommended by the concerned Departmental/Programme Academic Committee (DUGC/DPGC/DRPC) to the Senate, for approval and for further recommendation to the BOG.

G13.3 ***Convocation:***

Degrees will be awarded in person for the students who have graduated during the preceding academic year. Degrees will be awarded in absentia to such students who are unable to attend the Convocation. Students are required to apply for the Convocation along with the prescribed fee, after having satisfactorily completed all the degree requirements (refer "Degree Requirements") within the specified date in order to arrange for the award of the degree during convocation.

G14. COMMITTEES / FUNCTIONARIES:

The following committees shall be constituted common for the various degree programmes:

G14.1 ***Departmental Academic Appeals Board (DAAB):***

Constitution:

(a)	HOD of the teaching/parent Dept	…	Chairman
(b)	Three faculty members (1P + 1Asso.P + 1Asst.P)	…	Members

(c)	One Professor from outside the Department nominated by Dean (Academic)	…	Member
(d)	Faculty Advisor(s) of the Class from where the Appeal originates	…	Member(s)

Note:

- There shall be one DAAB for every department.
- The Chairman may co-opt and/or invite more members.
- Depending on the prevailing circumstances, a Senior Professor of the Department, nominated by the Dean (Academic), shall act as Chairman instead of Head of the Department.
- If the concerned instructor is a member of DAAB then he shall keep himself out of the Board during deliberations.

Functions (Highlights):

i. To receive grievance/ complaints in writing from the students regarding anomaly in award of grades due to bias, victimization, erratic evaluation, etc. and redress the complaints.

ii. To interact with the concerned course instructor and the student separately before taking the decision.

iii. The decision of the DAAB will be based on simple majority.

iv. The recommendations of the DAAB shall be communicated to the Dean (Academic) for further appropriate action as required.

G14.2 ***Class/Course Committee:***

Every Class (group of students registered for a course) of the Degree Programme shall have a Class/Course Committee, consisting of Faculty and Students.

Constitution:

(a)	One Faculty of the Parent/Teaching Department, not associated with the class; nominated by the HOD.	…	Chairman
(b)	Faculty Advisor(s) for the Class	…	Member-Secretary
(c)	Course Instructor(s)	…	Member(s)
(d)	*FOUR* to *SIX* students from the Class/Course to be chosen by the students amongst themselves	…	Members

Functions (Highlights):

i. The basic responsibilities of the Class/Course Committees are to review periodically the progress of the classes, to discuss problems concerning curriculum and syllabi and the conduct of the classes.

ii. Each class/course committee will communicate its recommendations to the HOD/DUGC/DPGC/DRPC of the Parent/Teaching Department.

iii. There shall be minimum one class committee meeting at the middle of every semester as indicated in the academic calendar. However additional class committee meetings may be convened as decided by DUGC/DPGC/Course Instructor.

iv. During beginning of the semester, the Course Instructors shall present the method of evaluation and distribution of weightages for the various components.

v. The minutes of each class/course committee meeting shall be recorded in a separate minutes register maintained in the Parent/Teaching Department.

vi. Any appropriate responsibility or function assigned by the DUGC/DPGC or the Chairman of the DUGC/DPGC.

G14.3 ***Faculty Advisor(s):***

The Faculty Advisor(s) will be appointed by the HOD of the parent department, who will be assigned a specific group (admission-batch) of students of the concerned parent department, and will be valid throughout their duration of study.

Functions (Highlights):

i. To help the students in planning their courses and related activities during their study period.

ii. To monitor, guide, advise and counsel the students on *all* academic matters.

iii. To coordinate the activities regarding mandatory learning courses.

G14.4 ***Course Instructor:***

Functions (Highlights):

i. He shall follow all the Regulations related to teaching of a course and evaluation of students.

ii. He shall be responsible for all the records (i.e., course registration, answer books, attendance, etc.) of the students registered for the course.

iii. He shall conduct classes as prescribed in the Academic Calendar and as per the teaching assignment time table issued by the HOD.

iv. He will arrange to distribute a course plan and the evaluation plan together with the course objectives, background materials to all the students within the first week of each semester.

v. He will prepare an evaluation plan showing details of how the student's performance will be evaluated in the course.

vi. He will properly document the students' performance and announce to the students (including on the notice board) as stipulated in the Regulations.

vii. He will report to the HOD on a periodic (*monthly*) basis, the potential cases of very poor academic performance as well as those of low attendance, that would possibly result in a 'FF' or 'FA' grade at the end of the semester.

G14.5 ***Departmental/Programme Academic Committee(s):***

Constitution:

The Departmental/ Programme Academic Committees are specific academic committees for each of the programmes/departments, like DUGC, DPGC, DRPC as given in the Regulations specific to such programmes/departments.

Functions (Highlights):

i. Specific functions as given in the Regulations specific to the concerned academic programme.
ii. Recommend to the BOS/Senate, appropriate measures to deal with the specific issues of concern, arising because of the effect of the year-to-year (periodic) refinements in the Academic Regulations & Curriculum, on the students *admitted in earlier years* (so as to ensure that *those* students are not subjected to any unfair situation whatsoever, although they are required to conform to these revised set of Regulations & Curriculum, without any undue favor or

considerations) like the specific details of the credit requirements, etc., as and when such cases arise or need to be addressed, considering the nature and extent of the refinements, and implement the same with the appropriate approval of the BOS/Senate.

iii. Any appropriate responsibility or function assigned by the Senate or the Chairman of the Senate or the BOS or the Chairman of the BOS.

* * * * *

REGULATIONS

SPECIFIC TO

UNDER GRADUATE PROGRAMMES

B.Tech.

NATIONAL INSTITUTE OF TECHNOLOGY KARNATAKA, SURATHKAL
Post Srinivasnagar, Mangalore - 575025, India.
2016

CONTENTS

REGULATIONS
specific to
B.Tech. Degree Programme

{also refer: REGULATIONS (General) – Common to all Degree Programmes}

1. DEGREE PROGRAMMES:

1.1 Under Graduate B.Tech. Degree Programmes are offered in the following disciplines by the respective programme hosting departments listed below:

i.	Chemical Engineering	(CH)
ii.	Civil Engineering	(CV)
iii.	Computer Engineering	(CO)
iv.	Electrical and Electronics Engineering	(EE)
v.	Electronics and Communication Engineering	(EC)
vi.	Information Technology	(IT)
vii.	Mechanical Engineering	(ME)
viii.	Metallurgical and Materials Engineering	(MT)
ix.	Mining Engineering	(MN)

Other teaching departments are:

x.	Applied Mechanics & Hydraulics	(AM)
xi.	Mathematical and Computational Sciences	(MA)
xii.	Physics	(PH)
xiii.	Chemistry	(CY)
xiv.	School of Management	(HU)

1.2 The provisions of these Regulations shall be applicable to any new disciplines that may be introduced from time to time and appended to the above list.

2. ADMISSION:

2.1 Admission to NITK, Surathkal will be made in accordance with the instructions received from MHRD from time to time. Seats are reserved for candidates belonging to Scheduled Castes and Scheduled Tribes, Other Backward Classes (OBC), Physically challenged candidates, children of defence personnel and other categories as per the guidelines issued by MHRD.

2.2 Admission to all courses will be made in the odd semester of each session at the first year level based on the relative performance in the Joint Entrance Examination Main (JEE-Main) and qualifying examination as per the guidelines issued by the MHRD, New Delhi from time to time. The candidates should have successfully passed 10+2 examination with the combination of subjects prescribed by the Competent Authority.

2.3 A limited number of admissions is offered to Foreign Nationals and Indians living abroad in accordance with the rules applicable for such admission issued, from time to time, by MHRD.

2.4 In special cases the Institute may admit students to the THIRD semester of the B.Tech. programme, on transfer, only from other NITs, observing the Guidelines applicable and subject to approval from MHRD. However, any such transfer to Third Semester at NITK from any other NIT shall be subject to the condition that no commitment shall be made on any Branch request, until after exhausting the chances for NITK students to avail the branch change facility, and provided there are clear vacancies.

2.5 Student Exchange Programmes and the Transfer of Credits, shall be as per the corresponding MOU approved by Competent Authority.

2.6 If, at any time after admission, it is found that a candidate had not in fact fulfilled all the requirements stipulated in the offer of admission, in any form whatsoever, including possible misinformation etc., the Registrar shall report the matter to the Senate, recommending revoking the admission of the candidate.

2.7 The Institute reserves the right to cancel the admissions of any student and ask him to discontinue his studies at any stage of his career on the grounds of unsatisfactory academic performance or indiscipline or any misconduct.

2.8 The decision of the Senate regarding the admissions is final and binding.

2.9 Candidates must fulfil the medical standards required for admission as prescribed in the Institute Information Brochure or the Prospectus.

2.10 Every Under Graduate student of the Institute shall be associated with *Parent Department* (Degree Awarding Department) offering the degree programme that the student undergoes, *throughout* his study period, right from the very first day of admission into the program.

3. COURSE STRUCTURE :

3.1 The total course package for a B.Tech Degree Programme will typically consist of the following components.

(a) Foundation Courses	FC	45 –55 Credits

A Foundation Course can be any of the following:
Basic Science Core Courses (BSC),
Engineering Science Core Courses (ESC), and
Humanities and Social Science Core Courses (HSC)

(b) Programme Core Courses	PC	≥ 60 Credits
(c) Elective Courses	ELE	≥ 40 Credits

An Elective Course can be any of the following:

Programme Specific Electives (PSE), and
Open Electives (OE)

(d) Project (Mini Projects and Major Project)	MP	8 - 12 Credits
(e) Mandatory Learning Courses	MLC	5 Credits

The Minimum Credit Requirement for the B.Tech Degree is 170 to 180.

3.2 Open electives offered by any parent department are courses listed in the course structure under the open elective category and offered to students of any department including the parent department. The students of a particular programme have to complete the total credits required under the elective category by earning the minimum credits prescribed under the Programme Specific Elective (PSE) by registering for courses listed under the PSE category, for the remaining credits to be earned under the elective category, the students have the option to register for courses listed under the Open Elective (OE) category of other departments also.

Project (MP)

Project work may consist of Major Project and Mini Projects (optional) offered by parent department. The Major Project is a course with 8 credits and can comprise of Part I and Part II, spread over 1 or 2 semesters of final year, preferably during 7th and 8th semesters. DUGC may prescribe Mini Project as a requirement for the B. Tech Degree or in lieu of equivalent elective credits. The method of evaluation for major and minor projects shall be evolved by pertinent DUGC and appropriate double-letter grade is awarded which will be considered for SGPA and CGPA calculation

Mandatory Learning Courses:

These are courses that must be completed by the student at appropriate time. The 'S' grade is awarded for satisfactory completion of the course and 'N' grade is awarded for non-completion of the course. The 'S' and 'N' grades do not carry grade-points and hence not included in the SGPA, CGPA computations

Courses that come under this category are the following:

(a) ***Environmental Studies:***This is a 1 credit course, coordinated by Department of Civil Engineering and the student is required to complete this course during 1st / 2nd semester

(b) ***Professional Ethics and Human Values:*** This is a 1 credit course, coordinated by Department of Humanities, Social Sciences and Management and the student is required to complete this course during 1st / 2nd semester

(c) ***Seminar:*** The student will make presentations on topics of academic interest

(d) ***Practical Training:*** The student may complete the training before the beginning of the 7th semester (or as stipulated by the DUGC) and register for it in 7th Semester. The duration and the details shall be decided by the Faculty Advisor with approval from DUGC

3.3 The Department Under Graduate Committee (DUGC) will discuss and recommend the exact credits offered for the programme for the above components 'a' to 'e'; the semester-wise distribution among them, as well as the syllabi of all undergraduate courses offered by the department from time to time before sending the same to the Board of Studies (BOS). The BOS will consider the proposals from the departments and make recommendations to the Senate for consideration and approval.

3.4 ***Co-curricular and/or Extra-curricular activities***:

These are noncredit courses, with multiple options, to be completed at student's convenience. The student shall complete *a total of at least 2* items (with *at least one from each of the two groups*) described below. On successful completion, a ***certificate*** regarding the activity that a student has participated in, may be issued by the Faculty in-charge of that particular activity. With the recommendation of the Faculty in-charge of Co-Curricular / Extra-Curricular Activities, the Dean (Students Welfare) may approve the ***Report of Satisfactory Completion of such Co-Curricular and Extra-Curricular Activities.***

The Co-curricular/Extra-curricular Activities are compulsory degree requirements.

Group 1: Co-Curricular Activities, which includes activities in professional societies like IEEE, ISTE, IE, CSI, Department Associations, Lab Development, Participation in Paper Presentation, Model Building, etc.

Group 2: Extra-Curricular Activities, such as NSS, NCC, NSO, Community Services, Social work, Yoga, Meditation, Language Course, Health Care Services, Activities in Alumni

Association, Activities in *INCIDENT*, *Engineer*, Participation in Sports, Games, Various Clubs of Institute, SPICMACAY, etc.

3.5 ***Lower and Upper Limits for Course Credits Registered in a Semester/Session, by a Full-Time Student of the B.Tech. Degree Programme:***

A full time student of the B.Tech. degree programme must register for a minimum of 12 credits, and up to a maximum of 30 credits. However the minimum/maximum credit limit can be relaxed by the Dean (Academic) on the recommendations of the DUGC, only under extremely exceptional circumstances. The maximum credits that a student can register in a summer session is 16.

3.6 ***B.Tech. Students registering for Post Graduate courses as electives:***

In exceptional situations, with prior approval of the concerned DUGC, a B.Tech. student can register for a post graduate course as elective.

4. DEGREE REQUIREMENTS:

The degree requirements of a student for the B.Tech programme are as follows:

(a) Institute Requirements:

(i) Minimum Earned Credit Requirement for Degree is 170 to 180.
(ii) Satisfactory completion of all Mandatory Learning Courses
(iii) Completion of the requirements on Co-curricular and/or Extra-curricular activities

(b) Programme Requirements:

Minimum Earned Credit Requirements on all Core Courses, Elective Courses and Major Project as specified by the DUGC and conforming to Clause No: 3 (Course Structure) above.

(c) The Maximum duration for a student for complying to the Degree Requirement is EIGHT years from date of first registration for his first semester.

5. TERMINATION FROM THE PROGRAMME:

A student shall be required to leave the Institute without the award of the Degree, under the following circumstances:

(a) If a student fails to earn the minimum credit specified below:

Check Point	Credit Threshold
End of FIRST year	15
End of SECOND year	40
End of THIRD year	65
End of FOURTH year	90

Note: The period of temporary withdrawal is not to be counted for the above Credit Threshold.

(b) If a student is absent for more than 6 (Six) weeks at a stretch in a semester without sanctioned leave.

(c) Based on disciplinary action suggested by the Senate, on the recommendation of the appropriate committee.

NOTE: Under any circumstances of termination, the conditions specified in Permanent Withdrawal (refer: Clause No: G10.2) shall also apply.

6. CHANGE OF BRANCH:

6.1 Normally a student admitted to a particular branch of the undergraduate programme will continue studying in that branch till completion. However, the Institute may permit a student admitted through JEE (Main) /DASA quota, to change from one branch of studies to another after the first two semesters. Such changes will be permitted, in accordance with the provisions laid down hereinafter, by the concerned competent authority.

6.2 Normally, only those students will be eligible for consideration of a change of branch, after the second semester, who have –

a) completed all the common credits required in the first two semesters of their studies, in their first attempt;

b) obtained a SGPA of not less than 8.00 (7.00 for SC/ST) in both the FIRST as well as the SECOND semester;

6.3 Application for change of branch must be made by the intending eligible students in the prescribed form and to be submitted before the last working day of the second semester as announced in the academic calendar.

6.4 Change of branch shall be strictly in order of merit of the applicants. For this purpose the CGPA obtained at the end of the second semester shall be considered. In case of a tie, the JEE (Main) rank / SAT Subject Test Score of the applicants will be considered. The change of branch is permitted only to vacancies as per eligibility and category of admission.

6.5 A common CGPA List shall be prepared at the end of the second semester, category wise to consider students for branch change.

6.6 The applicants may be allowed a change in branch, strictly in order of *inter se* merit, subject to the limitations as given below:

(a) The actual number of students in the third semester in any particular branch to which the transfer is to be made, should not exceed the sanctioned strength and the actual number of students in any branch from which transfer is being sought does not fall below 75% of the total sanctioned intake.

(b) If a student S1 is not permitted to change from branch A to B due to the clause 7.6 (a) above, any other student S2 from any branch with CGPA less than S1 will also not be permitted to change to branch B.

6.7 The process of change of branch shall be completed on the first day of registration for the third semester courses.

7. COMMITTEES / FUNCTIONARIES:

The following committees shall be constituted specifically for the Under Graduate (B.Tech.) degree programme:

7.1 Board of Studies (BOS-UG):

Constitution:

(a)	Dean (Academic)	…	*Chairman*
(b)	Dean (Faculty Welfare)	…	Member
(c)	Dean (Planning & Development)	…	Member
(d)	Dean (Students Welfare)	…	Member
(e)	Dean (R&C)	…	Member
(f)	Dean (AA&IR)	…	Member
(g)	Chairman of each DUGC/ his nominee	…	Member
(h)	BOG members representing the faculty	…	Members
(i)	Assistant Registrar (Academic)	…	*Convenor*
(j)	Dy. Registrar (Academic)	…	*Secretary*

Note:

- There shall be one BOS-UG for the entire Institute.
- The Chairman may co-opt and/or invite more members including outside experts.
- The quorum of each meeting will be *NINE*.

Functions (Highlights):

i. To consider the recommendations of the DUGC on matters relating to undergraduate programme and to make suitable recommendations to the Senate.

ii. To approve curriculum framed / revised by DUGC for the undergraduate courses of study.

iii. To ensure that all norms and Regulations pertaining to undergraduate programme are strictly followed.

iv. To make periodic review of these Regulations pertaining to undergraduate programme and to recommend to the Senate any modifications thereof.

v. To review the academic performance and make suitable recommendations to the Senate regarding declaration of results, award of degrees etc.

vi. To recommend to the Senate, the award of stipends, scholarships, medals & prizes etc.

vii. To draw up general time table for the undergraduate course and finalise the UG academic calendar to be put up to the Senate for approval.

viii. To review the cases of malpractice in examinations and to recommend to the Director the punishment in such cases.

ix. To constitute a sub-committee for monitoring the implementation of the academic curriculum provided by the BOS and to provide guidance in curriculum assessment, evaluation process.

x. To conduct at least one meeting each semester and send the Resolutions to the Chairman of the Senate, and also to maintain a record of the same in the Academic Section of the Dean (Academic).

xi. Any appropriate responsibility or function assigned by the Senate or the Chairman of the Senate.

7.2 Departmental Under Graduate Committee (DUGC):

Constitution:

(a)	H.O.D. / Programme Co-ordinator	…	Chairman
(b)	Two Professors (by rotation for one year)	…	Members
(c)	Two Associate Professors (by rotation for one year)	…	Members
(d)	Two Assistants Professors (by rotation for one year)	…	Members

Note:

- There shall be one DUGC for every department that is involved in the teaching for the B.Tech. degree programme.
- The Secretary (DUGC) shall be nominated by the Chairman on rotation basis for a period of one year.
- The Chairman may co-opt and/or invite more members including at most three outside experts.
- The quorum for each meeting shall be five.

Functions (Highlights):

i. To monitor the conduct of all undergraduate courses of the department.

ii. To ensure academic standard and excellence of the courses offered by the department.

iii. To oversee the evaluation each of the students in a class, for each of the courses.

iv. To develop/revise the curriculum for undergraduate courses offered by the department, and recommend the same to the BOS.

v. Moderation (only if and when found necessary) in consultation with the Course Instructor, and approval of the finalized grades, before submission of the same to the Academic Section of the Dean (Academic).

vi. To consolidate the registration of the student and communicate to Course Instructors, and also to the Academic Section of the Dean (Academic).

vii. To conduct performance appraisal of Course Instructors.

viii. To provide feedback of the performance appraisal to the Course Instructor and concerned authorities.

ix. To consider any matter related to the undergraduate programme of the department.

x. In cases where a course is taught by more than one faculty member, or by different faculty members for different sections of students, DUGC shall co-ordinate (only in case of need) among all such faculty members regarding the teaching and evaluation of such courses.

xi. To conduct at least two meetings each semester and send the Resolutions of the meeting to the Academic Section of the Dean (Academic), and also to maintain a record of the same in the department.

xii. Any appropriate responsibility or function assigned by the Senate or the Chairman of the Senate or the BOS or the Chairman of the BOS.

* * * * *

FORMS & FORMATS

Under Graduate Programmes

NATIONAL INSTITUTE OF TECHNOLOGY KARNATAKA, SURATHKAL
Post Srinivasnagar, Mangalore - 575025, India.
2016

CONTENTS

COURSE REGISTRATION FORM
(Instructor Copy)

Course Code: Course Title: L.T.P: Credits:

Course Instructor(s): Teaching Dept.:

Sl. No.	Register No.	Name of the student	Semester	Branch	Signature	D/U/cU/W
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						

D: Drop U: Audit cU: Credit-Audit Conversion W: Withdrawal

Note: The last column to be filled only if a student opts to drop / audit / credit-Audit conversion or withdrawal of the course.

Name & Signature of Course Instructor(s)
with date

Name & Signature of HOD
with date & Dept. seal

COURSE REGISTRATION FORM (FACULTY ADVISOR COPY)

Name of Faculty Advisor: **Dept.** **Semester:**

Sl. No.	Register No.	Name of the student	Course Number and Credits (Ex: CV372(3))										Signature
1													
2													
3													
4													
5													
6													
7													
8													
9													
10													
11													
12													
13													
14													
15													
16													
17													
18													
19													
20													
21													
22													
23													
24													
25													

A: ADD D: DROP* U: Audit* cU: Credit-Audit Conversion* W: Withdrawal*

* Use separate card/s to enter D-U-cU-W options

Note: Faculty advisor has to ensure that the entries in Course Instructors copy, Student copy and FA copy are matching

Name & Signature of Faculty Advisor
Date:

Name & Signature of HOD
with Dept. Seal

COURSE REGISTRATION FORM [#]
(Student Copy)

Reg. No.: Dept.: Semester & Programme:

Name of the student: Fee Receipt No:

Sl. No.	Course No.	Course Title	Credits	Course Instructor's Name	Signature of Instructor
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

Signature of Student[*] Signature of Faculty Advisor[*] Signature of HOD[*] with seal

Date:

D / U / cU / W – Options

Sl. No.	Course No.	Course Title	Credits	D/U/cU/W	Signature of Faculty Adviser	Signature of Instructor
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

D: Drop U: Audit cU: Credit-Audit Conversion W: Withdrawal

Signature of Student[**] Signature of Faculty Advisor[**] Signature of HOD[**] with seal

[#] It is mandatory for a student to preserve this card as a proof of his / her registration till the end of the programme.

[*] To be signed by the student as soon as he/she completes the registration of all the courses and by the faculty advisor, the HOD after the last day of late registration announced in the academic calendar.

[**] To be signed by the student, faculty advisor and the HOD at the end of each semester after verifying the options exercised by the student and to be returned to the student at the end of the semester.

Faculty Advisor has to ensure that the entries in the Faculty Advisor Copy, Course Instructor Copy, and Student Copy are matching.

STUDENT'S LEAVE APPLICATION

Name of the Student :

Reg. No./Admission-No./Roll-No.:

Programme / Branch / Semester / Class :

Period of Absence : From: To:

: Number-of-days of Leave =

Nature of Leave : Casual-Leave / Medical-Leave / special permission to attend - Sports/Cultural-meet/Conference, etc.

Reason for Leave-of-Absence :

Supporting Documents Attached :

Signature of Student :

Number of days of Leave : *already-availed* | *being-applied-now* | *still-available(un-availed)*

Forwarded by Faculty Advisor :

Remarks by Chairman (DUGC/DPGC/DRPC) :

Recommendation : ***Approval / No-approval***

Signature of the **Recommending Authority** with Date :

Decision : ***Approved / No-approved***

Signature of the **Approving Authority** with Date :

NOTE:

(i) Chairman DUGC/DPGC/DRPC can approve the leave upto 14 days.

(ii) If the leave is for more than 14 days, the leave application shall be forwarded to Dean(A) for approval.

Course Evaluation Form for Lecture Courses

PURPOSE: The objective of this feedback is to collect information for assessing and improving the course and the instructor's teaching effectiveness

Course Code: Course Title:

Type of Course: Core / Elective Class Size:

Academic Year: Semester & Programme:

Department: Instructor's Name:

(Mark ' √ ' in the appropriate box)

RATINGS							
5 - Strongly agree **4** - Agree **3** - Neither agree nor disagree **2** - Disagree **1**- Strongly disagree							
COURSE		5	4	3	2	1
1	The course plan provided sufficient information on the objectives and contents					
2	The distribution of marks (for tests, assignments, tutorials and exams) was clearly stated in the course plan					
3	I found the course materials (class notes, handouts, prescribed text books) useful					
4	The assignments, tutorials, quizzes etc. helped me to understand the course					
5	The tests and examinations covered to a large extent what was taught in the class					
6	I was satisfied with the course coverage					
7	The evaluation was fair and transparent					
8	The course helped me to acquire knowledge and skills					
9	This course motivated me to learn more					
10	Overall, the course was satisfactory					
INSTRUCTOR						
1	The instructor was generally well prepared for the classes					
2	The instructor presented the contents effectively					
3	The instructor generated interest in the subject					
4	The instructor delivered the lectures at an appropriate pace					
5	The instructor made use of appropriate teaching aids and methods					
6	The instructor encouraged students participation and interaction in the class					
7	The instructor provided timely and effective feedback regarding the assignments/tests/exams					
8	The instructor was available outside class hours for consultation					
9	The instructor was regular to the class					
10	Overall, the instructor was effective in his/her role as a teacher					

SUGGESTIONS / COMMENTS: Please turn over

Note: This course feedback form to be collected by any faculty member other than the course instructor and to be handed over to the concerned course instructor.

Please write below your suggestions/comments if any to improve the teaching-learning process:

Course Evaluation Form for Practical Courses

PURPOSE: The objective of this feedback is to collect information for assessing and improving the course and the instructor's teaching effectiveness

Course Code: Course Title:

Type of Course: Core / Elective Class Size:

Academic Year: Semester & Programme:

Department: Instructor's Name:

(Mark ' √ ' in the appropriate box)

RATINGS						
5 - Strongly agree **4** - Agree **3** - Neither agree nor disagree **2** - Disagree **1**- Strongly disagree						
LAB/PRACTICAL SESSIONS		5	4	3	2	1
1	The practical sessions/Experiments provided me an opportunity to understand the subject					
2	Handouts/laboratory manuals were available in advance					
3	Clear instructions to carryout the practical/Experiments were given in advance					
4	I was thoroughly prepared for all the practical/lab sessions					
5	The assistance given during the practical sessions was useful					
6	I was regular in submitting all my lab/practical reports					
7	The instructor's feedback on my report was prompt					
8	The instructor's feedback on my report was useful					
9	The evaluation was fair and transparent					
10	Overall, the lab/practical course was satisfactory					

SUGGESTIONS / COMMENTS: Please write below your suggestions/comments if any to improve the conduct of this lab/practical course

Note: This course feedback form to be collected by any faculty member other than the course instructor and to be handed over to the concerned course instructor.

SUMMARY REPORT OF MARKS and GRADES

Semester/Session & Year :

Course Number : Course Title : (L-T-P) Credits:

Name of the Instructor: Department:

CLASS PERFORMANCE DISTRIBUTION STATISTICS

Class – Size (No. of students)		=
Class – Max. Mark	(Xmax)	=
Class - Min. Marks	(Xmin)	=
Class – Mean Marks	(μ)	=
Standard – Deviation	(σ)	=

A detailed ***Histogram*** of the Raw-Scores data *is* attached.

Grades	Cutoff Marks %		Number of Students
AA	=>		
AB	=>		
BB	=>		
BC	=>		
CC	=>		
CD	=>		
DD	=>		
FF	<=		
FA	**Attendance less than 75%**		

==========

Course-Instructor(s)
Name & Signature
with Date

Secretary-DUGC/DPGC/DRPC
Name & Signature
with Date

Chairman-DUGC/DPGC/DRPC
Signature with Date
& Dept. Seal

REPORT of MARKS and GRADES

Semester/Session & Year :

Course Number : Course Title : (L-T-P) Credits :

Course Category : FC/BSC / *ESC / HSC / PC / PSE / OE / PMP / MLC*

Name of the Instructor : Department :

SL.No.	Reg. No.	Name	%Marks / % Attendance*	Letter-Grade
1.				
2.				
3				
4.				
5.				
6.				
7.				
8.				
9.				
10.				
11.				
12.				
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28.				
29.				
30.				

***** For those students having less than 75% attendance and awarded 'FA' grade.

FC: Foundation Course **BSC:** Basic Science Core; **ESC:** Engineering Science Core;
PC: Programme Core; **PSE:** Programme Specific Elective; **HSC:** Humanities & Social Sciences Core;
OE: Open Elective; **MP:** Project; **MLC:** Mandatory Learning Course

==========

Course-Instructor(s)
Name & Signature
with Date

Secretary-DUGC/DPGC/DRPC
Name & Signature
with Date

Chairman-DUGC/DPGC/DRPC
Signature with Date
& Dept. Seal

RECORD OF CO-CURRICULAR & EXTRA-CURRICULAR ACTIVITIES

1. Name (in Block Letters)_____
2. Admission No.: _____
3. Roll No. _____

GROUP-1 CO-CURRICULAR ACTIVITIES (at least One)

Activity	Period		* S/N	Name & Signature of Faculty in-charge	Students signature with date
	From	To			
Professional Societies (IE(I)/IEEE/CSI/ISTE/etc)					
Department Association					
Lab. Development					
Paper Presentation					
TechFest (ENGINEER)					

GROUP-2 EXTRA-CURRICULAR ACTIVITIES (at least One)

Activity	Period		* S/N	Name & Signature of Faculty in-charge	Students signature with date
	From	To			
NCC / NSS / NSO					
Science Education & Literacy					
SPICMACAY					
Community Services					
Social Work					
Yoga / Meditation					
Health Care Service					
Language course					
Sports (Mention Event)					
Alumni Association					
INCIDENT					

* S: Satisfactory; N: Non-Satisfactory

Dean (Students Welfare)
Signature with Date & Seal

D E C L A R A T I O N

by the B.Tech. Student

I/We hereby *declare* that the Project Work Report entitled

.....

.....

which is being submitted to the **National Institute of Technology Karnataka, Surathkal** for the award of the Degree of **Bachelor of Technology** in .....

.....

is a *bonafide report of the work carried out by me/us*. The material contained in this Project Work Report has not been submitted to any University or Institution for the award of any degree.

Register Number, Name & Signature of the Student(s):

(1)

(2)

(3)

(4)

Department of .....

Place: NITK, SURATHKAL

Date:

[declaration to be signed by the student(s) and incorporated as part of the Project Work Report]

C E R T I F I C A T E

This is to *certify* that the B.Tech. Project Work Report entitled

.....

..... submitted by :

Sl.No. Register Number & Name of Student(s)

(1)

(2)

(3)

(4)

as the record of the work carried out by him/her/them, is *accepted as the B.Tech. Project Work Report submission* in partial fulfillment of the requirements for the award of degree of **Bachelor of Technology** in .....

Guide(s)
(Name and
Signature with Date)

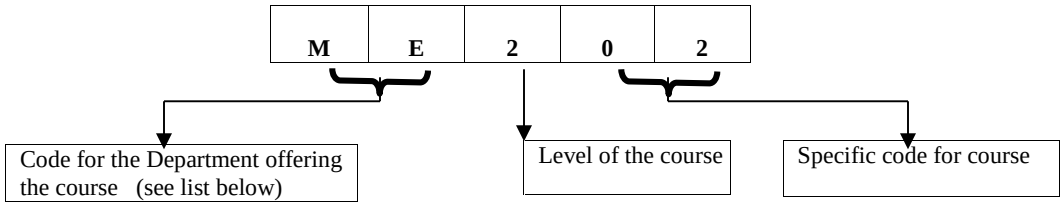
Chairman - DUGC
(Signature with Date and Seal)

STRUCTURE - UG

CONTENTS

Course Numbering Scheme

Course Numbers are denoted by character strings



Typically, courses whose three numerals are between 100 and 499 are taken by Under Graduate students and 600 to 999 by Post Graduate & Research students. Brief descriptions of courses for Under Graduate students are given in this booklet.

List of Codes for Departments

Department Code	Name of the Department
AM	Applied Mechanics and Hydraulics
CV	Civil Engineering
MN	Mining Engineering
CO	Computer Science & Engineering
EC	Electronics & Communication Engineering
EE	Electrical & Electronics Engineering
IT	Information Technology
CH	Chemical Engineering
ME	Mechanical Engineering
MT	Metallurgical & Materials Engineering
CY	Chemistry
MA	Mathematical & Computational Sciences
PH	Physics
HU	School of Management

Contact Hours and Credits

Every Course comprises of specific Lecture-Tutorial-Practical (L-T-P) Schedule. The Course Credits are fixed based on the following norms:

Lectures/Tutorials - One hour per week is assigned one credit.
Practicals - 3-hour session per week is assigned 2 credits OR 2-hour session per week is assigned 1 credit.

For example, a theory course with a L-T-P schedule of 3-1-0 will be assigned 4 credits; a laboratory practical course with a L-T-P schedule of 0-0-3 will be assigned 2 credits.

In this booklet, the number of credits and contact hours per week are given after the course number and course title.

Example: **ME202 FLUID MECHANICS AND MACHINERY (3-1-0) 4**

It is a 4 credit course consisting of : 3hr Lectures, 1hr Tutorial and 0hr Practical, per week.

List of Open Elective Courses Common to All or Many Programmes

CY201	Principles of Organic Synthesis	(3-0-0) 3
CY202	Unit Processes in Organic Synthesis	(3-0-0) 3
CY251	Polymer Science and Technology	(3-0-0) 3
CY252	Industrial Chemistry	(3-0-0) 3
CY300	Instrumental Methods of Analysis	(3-0-0) 3
HU400	Managerial Economics	(3-0-0) 3
HU401	Marketing Management	(3-0-0) 3
HU402	Management Information System	(3-0-0) 3
HU403	Human Resource management	(3-0-0) 3
HU450	Financial Management	(3-0-0) 3
HU451	Entrepreneurs Development and Management	(3-0-0) 3
HU452	Intellectual property Rights	(3-0-0) 3
HU453	Yoga Sutras of Patanjali	(3-0-0) 3
HU454	Introduction to Indian Classical Music	(3-0-0) 3
MA201	Concrete Mathematics	(3-0-0) 3
MA202	Discrete mathematical Structures	(3-0-0) 3
MA203	Graph Theory	(3-0-0) 3
MA204	Linear Algebra and Matrices	(3-0-0) 3
MA205	Modern Computer Algebra	(3-0-0) 3
MA206	Number Theory and Cryptography	(3-0-0) 3
MA207	Numerical Methods	(3-0-0) 3
MA208	Probability Theory and Applications	(3-0-0) 3
MA209	Theory of Complex Variables	(3-0-0) 3
MA301	Advanced Graph Theory	(3-0-0) 3
MA302	Data Analysis, Time Series Analysis & Non Parametric Methods	(3-0-0) 3
MA303	Integral Transforms and Applications	(3-0-0) 3
MA304	Linear Programming and Applications	(3-0-0) 3
MA305	Network Optimization	(3-0-0) 3
MA306	Operations Research	(3-0-0) 3
MA307	Optimization Techniques and Statistical Methods	(3-0-0) 3
MA308	Statistical Analysis and Applications	(3-0-0) 3
MA401	Computational Fluid Dynamics	(3-0-0) 3
MA402	Finite Element Methods	(3-0-0) 3
MA403	Mathematical Modelling	(3-0-0) 3
MA404	Nonlinear Optimization	(3-0-0) 3
MA405	Reliability Theory and Applications	(3-0-0) 3
MA406	Statistical Design and Analysis of Experiments	(3-0-0) 3
MA407	Statistical Quality Control	(3-0-0) 3
MA408	Stochastic Analysis and Applications	(3-0-0) 3
PH201	Quantum Mechanics for Engineers	(3-0-0) 3
PH202	Basic Nuclear Physics	(3-0-0) 3
PH203	Classical Mechanics	(3-0-0) 3
PH251	Electrical Properties of Materials	(3-0-0) 3
PH252	Electromagnetic Theory	(3-0-0) 3
PH301	Semiconductor Physics	(3-0-0) 3
PH302	X- Rays and Crystallography	(3-0-0) 3
PH351	Physics of Semiconductor Devices	(3-0-0) 3
PH352	Vacuum Technology and Thin Films	(3-0-0) 3
PH401	Opto Electronics	(3-0-0) 3
PH402	Experimental Techniques for Characterisation of Materials	(3-0-0) 3

First Year Bachelor of Technology

List of Courses Common to All Undergraduate Programmes

Foundation Courses (FC)

Basic Science Core (BSC)

MA110	Engineering Mathematics – I	(3-0-0) 3
MA111	Engineering Mathematics – II	(3-0-0) 3
PH110	Physics	(3-1-0) 4
PH111	Physics Laboratory	(0-0-2) 1
CY110	Chemistry	(3-0-0) 3
CY111	Chemistry Laboratory	(0-0-3) 2

Engineering Science Core (ESC)

AM110	Engineering Mechanics	(3-0-0) 3
EE110	Elements of Electrical Engg.	(3-0-0) 3
EC110	Elements of Electronics & Communication Engg.	(3-0-0) 3
ME110	Elements of Mechanical Engineering	(3-0-0) 3
ME111	Engineering Graphics	(1-0-3) 3
CO110	Computer Programming	(3-1-0) 4
CO111	Computer Programming Lab	(0-0-2) 1

Humanities and Social Science Core (HSC)

HU110	Professional Communication	(3-0-0) 3

Mandatory Learning Courses (MLC)

CV110	Environmental Studies	(1-0-0) 1
HU111	Professional Ethics and Human Values	(1-0-0) 1

Suggested Plan of Study:

GROUP – I (S1-S6)

Semester ⟶	I	II
	(Chemistry Cycle)	**(Physics Cycle)**
1	MA110	MA111
2	CY110	PH110
3	HU110	CO110
4	AM110	ME110
5	EE110	EC110
6	ME111	PH111
7	CY111	CO111
8	CV110	HU111

GROUP – II (S7-S12)

Semester ⟶	I	II
	(Physics Cycle)	**(Chemistry Cycle)**
1	MA110	MA111
2	PH110	CY110
3	CO110	HU110
4	ME110	AM110
5	EC110	EE110
6	PH111	ME111
7	CO111	CY111
8	HU111	CV110

Department of Civil Engineering (CV)
Bachelor of Technology in Civil Engineering

Basic Science Core (BSC)

MA110	Engineering Mathematics - I	(3-0-0) 3
PH110	Physics	(3-1-0) 4
PH111	Physics Lab	(0-0-2) 1
MA111	Engineering Mathematics - II	(3-0-0) 3
CY110	Chemistry	(3-0-0) 3
CY111	Chemistry Lab	(0-0-3)2

Engineering Science Core (ESC)

EC110	Elements of Electronics and Communication Engineering	(3-0-0) 3
AM110	Engineering Mechanics	(3-0-0) 3
ME110	Elements of Mechanical Engineering	(3-0-0) 3
ME111	Engineering Graphics	(1-0-3) 3
CV210	Elements of Civil Engineering	(1-0-0) 1
EE110	Elements of Electrical Engineering	(3-0-0) 3
CO100	Computer Programming	(3-1-0) 4
CO111	Computer Programming Lab	(0-0-2) 1

Humanities and Social Science Core (HSC)

HU110	Professional Communication	(3-0-0) 3
HU300	Engineering Economics	(3-0-0) 3
HU302	Principles of Management	(3-0-0) 3

Programme Core (PC)

AM200	Mechanics of Materials	(3-0-0) 3
AM216	Strength of Materials Lab	(0-0-3) 2
AM250	Mechanics of Fluids	(3-0-0) 3
AM300	Water Resources Engineering	(3-0-0) 3
AM316	Hydraulics Lab	(0-0-3) 2
CV200	Civil Engineering Materials and construction	(3-0-0) 3
CV201	Elements of Surveying	(3-0-0) 3
CV202	Engineering Geology	(3-0-0) 3
CV216	Civil Engineering Materials Lab	(0-0-3) 2
CV217	Surveying Practice	(0-0-3) 2
CV250	Structural Analysis-I	(3-0-0) 3
CV251	Design of RCC structures	(3-0-0) 3
CV252	Soil Mechanics	(3-0-0) 3
CV266	Geology Lab	(0-0-3) 2
CV267	Soil Mechanics Lab	(0-0-3) 2
CV300	Structural Analysis-II	(3-0-0) 3
CV301	Highway and Traffic Engineering	(3-0-0) 3
CV316	Building Design And Drawing	(1-0-3) 3
CV350	Environmental Engineering	(3-0-0) 3
CV351	Design of steel Structures	(2-1-0) 3
CV366	Environmental Engineering Lab	(0-0-3) 2
CV367	Highway Materials and Concrete testing Lab	(0-0-3) 2
CV400	Estimation Costing and Specifications	(3-0-0) 3
CV417	Structural Design and Drawing	(1-0-3) 3

Programme Specific Electives (PSE)

CV253	Architecture and Town Planning	(3-0-0) 3
CV 321	Applied Soil engineering	(3-0-0) 3
CV322	Concrete Technology	(3-0-0) 3
CV371	Railways, Tunnels, Harbours and Airports	(3-0-0) 3
CV372	Design of PSC Structures	(3-0-0) 3
CV373	Probability methods in Civil Engineering	(3-0-0) 3
CV385	Geoinformatics	(3-0-0) 3
CV386	Rock Mechanics	(3-0-0) 3
CV387	Applied Geology	(3-0-0) 3
CV388	Advanced Surveying	(3-0-2) 4
CV 389	Advanced Structural Analysis	(3-0-0) 3
CV401	Bridge Engineering	(3-0-0) 3
CV421	Transportation Project Planning and Evaluation	(3-0-0) 3
CV422	Advanced Design of Structures-I	(3-0-0) 3
CV423	Design of Foundations, Earth and Earth Retaining Structures	(3-0-0) 3
CV424	Advanced Environmental Engineering	(3-0-0) 3
CV425	Computer Aided Design and Applications in Civil Engineering	(2-0-3) 4
CV426	Solid Waste Management	(3-0-0) 3
CV438	Structural Dynamics and Wind Engineering	(3-0-0) 3
CV471	Advanced Design of Structures – II	(3-0-0) 3
CV472	Ground Improvement Techniques	(3-0-0) 3
CV473	FEM Applications in Civil Engineering	(3-0-0) 3
CV474	Elements of Earthquake Engineering	(3-0-0) 3
CV475	Oil and Natural Gas Exploration	(3-0-0) 3
CV476	Disaster Management and Mitigation	(3-0-0) 3
CV477	Seismoresistant Concrete Structures	(3-0-0) 3
CV485	Air Pollution and Noise Pollution	(3-0-0) 3
CV486	Environmental Impact Assessment	(3-0-0) 3
CV487	Construction and Project Management	(3-0-0) 3
CV 488	Ground water Development and Management	(3-0-0) 3
CV489	Retrofitting and Rehabilitation of Structures	(3-0-0) 3
AM371	Open Channel Flow and Sediment transport	(3-0-0) 3
AM372	Civil Engineering Systems	(3-0-0) 3
AM400	Geographic Information Systems	(3-0-0) 3
AM401	Satellite Digital Image Analysis	(3-0-0) 3
AM422	Fundamentals of Coastal Engineering	(3-0-0)3
AM423	Basics of Offshore Engineering	(3-0-0)3
AM424	Coastal Erosion and its Mitigation	(3-0-0) 3
AM435	Performance Appraisal of Large Projects	(3-0-0) 3
AM436	Disaster Management	(3-0-0) 3
AM437	Decision Making Under Risk and Uncertainty	(3-0-0) 3
AM438	Rural Infrastructure Development	(3-0-0) 3
AM439	Inverse Modeling	(3-0-0) 3
AM445	Fundamentals of Finite Element Method	(3-0-0) 3
AM455	Engineering Optimization	(3-0-0) 3
AM473	Water Resources Excess Management	(3-0-0) 3
AM474	Computational Methods in Hydrology	(3-0-0) 3
AM475	Ground Water Engineering	(3-0-0) 3

Open Electives (OE)

AM400	Geographic Information Systems	(3-0-0) 3
AM401	Satellite Digital Image Analysis	(3-0-0) 3
AM402	Principles of Geo-informatics	(3-0-0) 3
AM403	Global Positioning System	(3-0-0) 3
AM372	Civil Engineering Systems	(3-0-0) 3
AM435	Performance Appraisal of Large Projects	(3-0-0) 3
AM436	Disaster Management	(3-0-0) 3
AM437	Decision Making Under Risk and Uncertainty	(3-0-0) 3
AM438	Rural Infrastructure Development	(3-0-0) 3
AM439	Inverse Modelling	(3-0-0) 3
AM445	Fundamentals of Finite Element Method	(3-0-0) 3
AM455	Engineering Optimization	(3-0-0) 3
AM478	Theory of Isotropic Elasticity	(3-0-0)3
CV268	Advanced Mining Geology	(3-0-0) 3
CV475	Oil and Natural Gas Exploration	(3-0-0) 3
CV476	Disaster Management and Mitigation	(3-0-0) 3
CV485	Air Pollution and Noise Pollution	(3-0-0) 3
CV486	Environmental Impact Assessment	(3-0-0) 3
CV487	Construction and Project Management	(3-0-0) 3

Major Project (MP)

CV449	Major Project - I	(0-0-3) 2
CV499	Major Project - II	(0-0-9) 6
AM 380	Mini Project I	(0-0-3) 2
AM381	Mini Project II	(0-0-3) 2
CV380	Mini Project I	(0-0-3) 2
CV381	Mini Project II	(0-0-3) 2

Mandatory Learning Courses (MLC)

CV 110	Environmental Studies	(1-0-0) 1
HU 111	Professional Ethics and Human Values	(1-0-0) 1
CV390	Seminar	(0-0-2) 1
CV440	Practical Training	(0-0-3)2

Suggested Plan of Study:

Semester	III	IV	V	VI	VII	VIII
1	CV200	CV250	CV300	CV350	CV400	CV499
2	CV201	CV251	CV301	CV351	CV417	*Elective*
3	CV202	CV252	CV 316	CV366	CV440	*Elective*
4	CV216	CV266	AM300	CV367	CV449	*Elective*
5	AM200	CV267	AM316	HU300	*Elective*	*Elective*
6	AM216	AM250	HU302	CV 390	*Elective*	*Elective*
7	CV210	CV217	*Elective*	*Elective*	*Elective*	
8	*Elective*	*Elective*	*Elective*	*Elective*	*Elective*	
9	*Elective*	*Elective*	*Elective*			

Degree Requirements:

Category of Courses	**Minimum Credits to be Earned**
Basic Science Core (BSC)	16
Engineering Science Core (ESC)	21
Humanities and Social Science Core (HSC)	09
Programme Core (PC)	64
Electives Programme Specific Elective (PSE) and Open Elective (OE)	≥43
Project (MP) Major Project Mini Project	 08 0-04
Mandatory Learning Courses (MLC)	05
Total	170

Department of Mining Engineering (MN)
Bachelor of Technology in Mining Engineering

Basic Science Core Courses (BSC)

MA110 Engineering Mathematics-I	(3-0-0)3
PH110 Physics	(3-1-0)4
PH111 Physics Lab	(0-0-2)1
MA111Engineering Mathematics-II	(3-0-0)3
CY110Chemistry	(3-0-0)3
CY111 Chemistry Lab	(0-0-3)2

Engineering Science Core Courses (ESC)

EC 110 Elements of Electronics & Communication Engg.	(3-0-0)3
EE110 Elements of Electrical Engg	(3-0-0)3
ME110 Elements of Mechanical Engg	(3-0-0)3
CO110 Computer Programming	(3-1-0)4
CO111 Computer Programming Lab	(0-0-2)1
AM110 Engineering Mechanics	(3-0-0)3
ME111 Engineering Graphics	(1-0-3)3
ME200 Workshop	(0-0-2)1
ME270 Thermodynamic & Fluid Mechanics	(3-1-0)4
CV203 Mining Geology	(3-0-0)3
CV218 Mining Geology Lab	(0-0-3)2

Humanities and Social Science & Mgt. Core (HSC)

HU110 Professional Communication	(3-0-0)3
HU300 Engineering Economics	(3-0-0)3
HU302 Principles of Management	(3-0-0)3

Programme Specific Core (PSC)

MN201 Development of Mineral Deposits	(3-1-0)4
MN202 Mine Surveying	(3-1-0)4
MN203 Mine Surveying Lab	(0-0-3)2
MN204 Mining Machinery	(3-1-0)4
MN251 Mine Environmental Engineering - I	(3-1-0)4
MN252 Mine Environmental Engineering Lab - I	(0-0-3)2
MN253 Applied Mine Surveying Lab	(0-0-3)2
MN254 Industrial Training –I	1
MN301 Surface Mining	(3-1-0)4
MN302 Mine Environmental Engineering - II	(4-0-0)4
MN303 Underground Coal Mining	(3-1-0)4
MN304 Industrial Training -II	1
MN351 Underground Metal Mining	(3-1-0)4
MN352 Rock Mechanics	(3-1-0)4
MN353 Rock Mechanics Lab.	(0-0-3)2
MN354 Mine Systems Engineering	(3-1-0)4
MN355 Mine Camp	1
MN401 Mineral Processing	(4-0-0)4
MN402 Mineral Processing Lab.	(0-0-3)2
MN403 Industrial Training -III	1
MN451 Mine Legislation	(4-0-0)4

Programme Specific Elective (PSE)

MN210 Drilling & Blasting Engineering	(3-1-0)4
MN211 Seabed Mining	(3-0-0)3
MN260 Rock Excavation Engg.	(3-0-0)3
MN261 Applied Mine Surveying	(3-0-0)3
MN262 Electric Machinery in Mines	(3-0-0)3
MN310 Noise Pollution & Control Engg.	(3-0-0)3
MN311 Mine Mechanization	(3-0-0)3
MN312 Rock Reinforcement Engg.	(3-0-0)3
MN313 Mine Power Systems	(3-0-0)3
MN360 Advanced Underground Coal Mining	(3-0-0)3
MN361 Advanced Surface Mining Technology	(3-0-0)3
MN362 Production Drilling for oil wells	(3-0-0)3
MN410 Rock Fragmentation Engineering	(3-0-0)3
MN411 Strata Mechanics	(3-1-0)4
MN412 Mine Health and Safety Engg.	(3-0-0)3
MN413 Rock Slope Engineering	(3-0-0)3
MN460 Coal Washing and Handling	(3-0-0)3
MN461 Planning of Surface Mining Projects	(3-0-0)3
MN464 Computer Applications in Mining	(3-0-0)3
MN465 Environmental Management & Sustainable Development	(3-0-0)3
MN466 Mine Economics	(3-0-0)3

Open Elective (OE)

MN314 Maintenance and Reliability Engg.	(3-0-0)3
MN315 Financial Engineering	(3-0-0)3
MN363 Tunneling Engg.	(3-0-0)3
MN414 Numerical Modeling Techniques	(3-0-0)3
MN415 Industrial Engineering & Management	(3-0-0)3
MN467 Technology Management	(3-0-0)3
MN 468 Knowledge Management	(3-0-0)3

Project (MP)

MN449 Major Project-I	(0-0-6)3
MN499 Major Project-II	(0-0-9)5

Mandatory Learning Courses

CV110 Environmental Studies	(1-0-0)1
HU111 Professional Ethics and Human Values	(1-0-0)1
MN 452 Practical Training	(0-0-3)2
MN490 Seminar	(0-0-2)1

Suggested Plan of Study:

Semester →	III	IV	V	VI	VII	VIII
1	MN201	MN251	MN301	MN351	MN401	MN451
2	MN202	MN252	MN302	MN352	MN402	MN452
3	MN203	MN253	MN303	MN353	MN403	MN490
4	MN204	MN254	MN304	MN354	MN449	MN499
5	CV203	ME200	HU302	MN355	Elective	Elective
6	CV218	ME270	Elective	HU300	Elective	Elective
7	Elective	Elective	Elective	Elective	Elective	Elective
8	Elective	Elective	Elective	Elective	Elective	Elective

Degree Requirements:

Category of Courses	Minimum Credits to be Earned
Basic Science Core(BSC)	16
Engineering Science Core(ESC)	30
Humanities and Social Sciences Core(HSC)	09
Programme Core (PC)	62
Electives	50
Project (MP)	08
Mandatory Learning Courses (MLC)	05
Total	**180**

NATIONAL INSTITUTE OF TECHNOLOGY KARNATAKA, SURATHKAL

Department of Computer Science & Engineering (CO)

Bachelor of Technology in Computer Engineering

Basic Science Core (BSC)

MA110	Engineering Mathematics – I	(3-0-0) 3
PH110	Physics	(3-1-0) 4
PH111	Physics Lab	(0-0-2) 1
MA111	Engineering Mathematics – II	(3-0-0) 3
CY110	Chemistry	(3-0-0) 3
CY111	Chemistry Lab	(0-0-3) 2
MA201	Concrete Mathematics	(3-0-0) 3

Engineering Science Core (ESC)

EE110	Elements of Electrical Engg.	(3-0-0) 3
ME110	Elements of Mechanical Engg.	(3-0-0) 3
CO110	Computer Programming	(3-1-0) 4
CO111	Computer Programming Lab	(0-0-2) 1
EC110	Elements of Electronics Communication Engg.	(3-0-0) 3
AM110	Engineering Mechanics	(3-0-0) 3
ME111	Engineering Graphics	(1-0-3) 3

Humanities and Social Science Core (HSC)

HU110	Professional Communication	(3-0-0) 3
HU300	Engineering Economics	(3-0-0) 3
HU302	Principles of Management	(3-0-0) 3

Program Core (PC)

CO200	Computer Organization and Architecture	(3-1-0) 4
CO201	Theory of Computation	(3-1-0) 4
CO202	Design of Digital Systems	(3-1-0) 4
CO203	Data Structures and Algorithms	(3-1-0) 4
CO204	Design of Digital Systems Lab	(0-0-3) 2
CO205	Data Structures and Algorithms Lab	(0-0-3)2
CO250	Data Communication	(3-1-0) 4
CO251	Software Engineering	(3-1-0) 4
CO252	Operating Systems	(3-1-0) 4
CO253	Design and Analysis of Algorithms	(3-1-0) 4
CO254	Operating Systems Lab	(0-0-3) 2
CO255	Software Engineering Lab	(0-0-3) 2
CO300	Computer Networks	(3-1-0) 4
CO301	Database Management Systems	(3-1-0) 4
CO302	Computer Networks Lab	(0-0-3) 2
CO303	Database Management Systems Lab	(0-0-3) 2
CO350	Compiler Design	(3-1-0) 4
CO351	Compiler Design Lab	(0-0-3) 2
CO352	Computer Graphics Mini Project	(1-0-2) 2

Department Specific Elective (PSE) Courses

CO260	Principles of Programming Language	(3-0-0) 3
CO261	Information Systems	(3-0-0) 3
CO262	System Programming	(3-0-0) 3
CO263	Object Oriented Programming	(1-0-3) 3
CO310	Microprocessor Systems	(3-0-0) 3
CO311	Unix Network Programming	(3-0-0) 3
CO312	Computer Graphics and Multimedia	(3-0-0) 3
CO313	Number Theory and Cryptography	(3-0-0) 3
CO314	Simulation and Modeling(	(3-0-0) 3
CO315	Object Oriented Systems	(3-0-0) 3
CO316	Computer Architecture Lab	(1-0-3) 3
CO317	Introduction to Graph Theory	(3-0-0) 3
CO360	Advanced Data Structures	(3-0-0) 3
CO361	Logic for Computer Science	(3-0-0) 3
CO362	Information Security	(3-0-0) 3
CO363	Web Engineering	(3-0-0) 3
CO364	Soft Computing	(3-0-0) 3
CO365	Advanced Computer Networks	(3-0-0) 3
CO366	Formal Methods	(3-0-0) 3
CO367	Distributed Computing	(3-0-0) 3
CO368	Internet Technology and Applications	(1-0-3) 3
CO369	Quantitative Computer Architecture	(2-1-0)3
CO410	Artificial Intelligence and Expert Systems	(3-0-0) 3
CO411	Advances in Compiler Design	(3-0-0) 3
CO412	Distributed Database System	(3-0-0) 3
CO413	Game Theory	(3-0-0) 3
CO414	Digital Image Processing	(3-0-0) 3
CO415	Optimization Techniques in Computing	(3-0-0) 3
CO416	Wireless Networks	(3-0-0) 3
CO417	Software Project Management	(3-0-0) 3
CO418	Green Computing	(3-0-0) 3
CO419	Distributed Computing Lab	(0-0-3) 2
CO420	Soft Computing Lab	(0-0-3) 2
CO421	Software Testing	(1-0-3) 3
CO422	Combinatorial Optimization	(3-0-0)3
CO460	High Performance Computing	(3-0-0) 3
CO461	Data Warehousing and Data Mining	(3-0-0) 3
CO462	Network Management	(3-0-0) 3
CO463	Cloud Computing	(3-0-0) 3
CO464	Network Security	(3-0-0) 3
CO465	Distributed Algorithms	(3-0-0) 3
CO466	Information Retrieval	(3-0-0) 3
CO467	Software Quality Assurance	(3-0-0) 3
CO468	Computer Vision	(3-0-0) 3
CO469	Mobile Computing	(3-0-0) 3
CO470	Service Oriented Computing	(3-0-0) 3
CO471	Parallel Programming	(1-0-3) 3
CO472	Machine Intelligence	(3-0-0) 3
CO473	Algorithmic Graph Theory	(3-0-0) 3

Open Elective (OE)

CO280	Object Oriented Programming Concepts	(3-0-0) 3
CO310	Microprocessor Systems	(3-0-0) 3
CO330	Problem Solving Techniques in Computers	(3-0-0) 3
CO331	Bioinformatics	(2-1-0)3
CO332	Heterogeneous Parallel Computing	(3-0-0) 3
CO362	Information Security	(3-0-0) 3
CO364	Soft Computing	(3-0-0) 3
CO380	Internet Technologies	(3-0-0) 3
CO410	Artificial Intelligence and Expert Systems	(3-0-0) 3
CO417	Software Project Management	(3-0-0) 3
CO480	Management Information Systems	(3-0-0) 3
CO481	Decision Support Systems	(3-0-0) 3
CO482	High Performance Computing	(2-1-0)3

Programme Major Project (PMP)

CO449	Major Project - I	(0-0-6) 4
CO499	Major Project – II	(0-0-6) 4

Mandatory Learning Courses (MLC)

CV110	Environmental Studies	(1-0-0) 1
HU111	Professional Ethics and Human Values	(1-0-0) 1
CO390	Seminar	(0-0-3) 2
CO440	Practical Training/Educational Tour	(0-0-2) 1

NATIONAL INSTITUTE OF TECHNOLOGY KARNATAKA, SURATHKAL

Suggested Plan of Study:

Semester-ì	**III**	**IV**	**V**	**VI**	**VII**	**VIII**
1	CO200	CO250	CO300	CO350	*Elective*	*Elective*
2	CO201	CO251	CO301	CO351	*Elective*	*Elective*
3	CO202	CO252	CO302	CO352	*Elective*	*Elective*
4	CO203	CO253	CO303	HU302	*Elective*	*Elective*
5	CO204	CO254	HU300	*Elective*	*Elective*	*Elective*
6	CO205	CO255	*Elective*	*Elective*	*Elective*	CO499
7	MA201	*Elective*	*Elective*	*Elective*	CO440	
8				CO390	CO449	

Degree Requirements:

Category of Courses	**Minimum Credits to be Earned**
Basic Science Core (BSC)	19
Engineering Science Core (ESC)	20
Humanities and Social Science Core (HSC)	09
Program Core (PC)	60
Electives	50
Programme Major Project (PMP)	08
Mandatory Learning Courses (MLC)	05
Total	**171**

NATIONAL INSTITUTE OF TECHNOLOGY KARNATAKA, SURATHKAL

Department of Electronics and Communication Engineering (EC)

Bachelor of Technology in Electronics and Communication Engineering

Basic Science Core (BSC)

MA110	Engineering Mathematics – I	(3-0-0) 3
PH110	Physics	(3-1-0) 4
PH111	Physics Lab	(0-0-2) 1
MA111	Engineering Mathematics – II	(3-0-0) 3
CY110	Chemistry	(3-0-0) 3
CY111	Chemistry Lab	(0-0-3) 2

Engineering Science Core (ESC)

EE110	Elements of Electrical Engg.	(3-0-0) 3
ME110	Elements of Mechanical Engg.	(3-0-0) 3
CO110	Computer Programming	(3-1-0) 4
CO111	Computer Programming Lab	(0-0-2) 1
EC110	Elements of Electronics and Communication Engg.	(3-0-0) 3
AM110	Engineering Mechanics	(3-0-0) 3
ME111	Engineering Graphics	(1-0-3) 3

Humanities and Social Science Core (HSC)

HU110	Professional Communication	(3-0-0) 3
HU300	Engineering Economics	(3-0-0) 3
HU302	Principles of Management	(3-0-0) 3

Program Core (PC)

EC220	Digital Electronics and Computer Architecture	(3-1-0) 4
EC221	Linear Systems and Signals	(3-1-0) 4
EC222	Electromagnetic Waves	(3-1-0) 4
EC223	Analog Electronics	(3-1-0) 4
EC224	Mathematics for E&C Engineering.	(3-1-0) 4
EC225	Digital Electronics Lab	(0-0-3) 2
EC226	Analog Electronics Lab	(0-0-3) 2
EC270	Analog Communication	(3-1-0) 4
EC271	Microprocessors	(3-1-0) 4
EC272	Digital Signal Processing	(3-1-0) 4
EC273	Microprocessors Lab	(0-0-3) 2
EC274	Digital Signal Processing Lab	(0-0-3) 2
EC320	Analog Integrated Circuits	(3-1-0) 4
EC321	Digital Communication	(3-1-0) 4
EC322	Analog Integrated Circuits Lab	(0-0-3) 2
EC323	Communication Lab - I	(0-0-3) 2
EC370	VLSI Design	(3-1-0) 4
EC371	RF and Microwave Engg.	(3-1-0) 4
EC372	VLSI Design Lab	(0-0-3) 2
EC373	Communication Lab - II	(0-0-3) 2

Program Specific Electives (PSE)

EC230	Electronic Instrumentation	(3-0-0) 3
EC231	Biomedical Instrumentation & Imaging	(3-0-0) 3
EC232	Data structures and Algorithms	(3-0-2) 4
EC280	Digital System Design	(3-0-2) 4
EC281	Radiating Systems	(3-1-0) 4
EC282	Control Systems	(3-1-0) 4
EC330	Soft Computing	(3-0-0) 3
EC331	Satellite Communication	(3-0-0) 3
EC332	Radar & Electronic Navigation Systems	(3-0-0) 3
EC333	Communication Networks	(3-1-0) 4
EC334	Digital Processing of Speech and Audio Signals	(3-0-0) 3
EC335	Application of Signal Processing on Image and Video	(3-0-0) 3
EC336	Embedded Systems	(3-0-2) 4
EC380	Wireless Mobile Communication	(3-0-0) 3
EC381	Spread Spectrum Communications	(3-0-0) 3
EC382	Information Theory and coding	(3-0-0) 3
EC383	Error Control Coding	(3-0-0) 3
EC384	Adhoc and Sensor Networks	(3-0-0) 3
EC385	Optical Communication Systems and Networks	(3-1-0) 4
EC386	Cryptography and Data Security	(3-0-0) 3
EC387	Computer Arithmetic	(3-1-0) 4
EC388	Matrix Theory Stochastic Process	(3-1-0) 4
EC430	Advanced Topics in Communication Engineering	(3-0-0) 3
EC431	Advanced Digital Signal Processing	(3-0-0) 3
EC432	Mapping DSP Algorithms to Architecture	(3-0-0) 3
EC433	Multimedia Communication Techniques	(3-0-0) 3
EC434	Real Time Digital Signal Processing	(2-0-2) 3
EC435	VLSI Systems and Architecture	(3-0-0) 3
EC436	Synthesis and Optimization of Digital Circuits	(3-0-0) 3
EC437	Active Filters	(3-0-0) 3
EC438	Techniques in Low Power VLSI	(3-0-0) 3
EC439	Submicron Devices	(3-0-0) 3
EC440	VLSI CAD	(3-0-0) 3
EC441	MEMS and Nano Technology	(3-0-0) 3
EC442	RF IC Design	(3-0-0) 3
EC443	VLSI Testing and Testability	(3-0-0) 3
EC444	Advanced Topics in VLSI Design	(3-0-0) 3
EC445	Number Theory & Applications in in E&C Engg.	(3-1-0) 4
EC447	Pattern Recognition and Machine learning	(3-1-0)4
EC451	Detection and estimation theory	(3-0-0) 3
EC452	Dynamical systems, chaos and fractals	(3-0-0) 3
EC453	Statistical analysis and applications	(3-0-0) 3
EC454	Numerical analysis and applications	(3-0-0) 3
EC455	Stochastic processes and applications	(3-0-0) 3
EC456	Complex analysis with applications	(3-0-0) 3
EC457	Fourier and Wavelet Signal Processing	(3-1-0) 4
EC458	Mathematical algorithms for signal processing	(3-1-0) 4

Open Electives (OE)

EC230	Electronic Instrumentation	(3-0-0) 3
EC231	Biomedical Instrumentation & Imaging	(3-0-0) 3
EC330	Soft Computing	(3-0-0) 3
EC340	Digital Systems & Computer Organization	(3-0-0) 3
EC341	Principles of Communication Engineering	(3-0-0) 3
EC342	Computer Networks	(3-0-0) 3
EC343	Applications of Signal Processing	(3-0-0) 3
EC344	Microprocessors and Microcontrollers	(3-0-0) 3

Project (MP)

EC233	Mini Projects in Electrical Circuits	(0-0-3) 2

EC283	Mini Projects in Digital System Design	(0-0-3)	2
EC284	Mini Projects in Digital Signal Processing	(0-0-3)	2
EC337	Mini Projects in Communication Systems and Networks	(0-0-3)	2
EC338	Mini Projects in Microprocessor & Embedded Systems	(0-0-3)	2
EC339	Mini Projects in Analog System Design	(0-0-3)	2
EC391	Mini Projects in VLSI Design	(0-0-3)	2
EC392	Mini Projects in RF Design	(0-0-3)	2
EC448	Major Project - I	(0-0-6)	4
EC498	Major Project - II	(0-0-6)	4

Mandatory Learning Courses (MLC)

CV110	Environmental Studies	(1-0-0)	1
HU111	Professional Ethics and Human Values	(1-0-0)	1
EC390	Seminar	(0-0-2)	1
EC446	Practical Training	(0-0-3)	2

Suggested Plan of Study:

Semester →	III	IV	V	VI	VII	VIII
1	EC220	EC270	EC320	EC370	Elective	Elective
2	EC221	EC271	EC321	EC371	Elective	Elective
3	EC222	EC272	EC322	EC372	Elective	Elective
4	EC223	EC273	EC323	EC373	Elective	Elective
5	EC224	EC274	HU300	HU302	Elective	Elective
6	EC225	Elective	Elective	Elective	EC446	EC498
7	EC226	Elective	Elective	Elective	EC448	
8	Elective	Elective Mini Project	EC390			
9	Elective Mini Project		Elective Mini Project	Elective Mini Project		

Degree Requirements:

Category of Courses	Minimum Credits to be Earned
Foundation Courses: Basic Science Core (BSC) Engineering Science Core (ESC) Humanities and Social Sciences Core (HSC)	45
Program Core (PC)	64
Electives: Program Electives (PE) (Minimum of 24 credits) Open Electives (OE)	≥ 44
Project (MP): Major Project Mini Project	 08 0 - 4
Mandatory Learning Courses (MLC)	05
Total	**170**

Department of Electrical and Electronics Engineering (EE)
Bachelor of Technology in Electrical and Electronics Engineering

Basic Science Core (BSC)		
MA110	Engineering Mathematics – I	(3-0-0) 3
PH110	Physics	(3-1-0) 4
PH111	Physics Laboratory	(0-0-2) 1
MA111	Engineering Mathematics - II	(3-0-0) 3
CY110	Chemistry	(3-0-0) 3
CY111	Chemistry Laboratory	(0-0-3) 2
Engineering Science Core (ESC)		
EE 110	Elements of Electrical Engineering	(3-0-0) 3
ME110	Elements of Mechanical Engineering	(3-0-0) 3
CO110	Computer Programming	(3-0-0) 3
CO111	Computer Programming Laboratory	(0-0-3) 2
EC110	Elements of Electronics and Communication Engineering.	(3-0-0) 3
AM110	Engineering Mechanics	(3-0-0) 3
ME111	Engineering Graphics	(1-0-3) 3
Humanities and Social Science Core (HSC)		
HU110	Professional Communication	(3-0-0) 3
HU300	Engineering Economics	(3-0-0) 3
HU302	Principles of Management	(3-0-0) 3
Programme Core (PC)		
EE200	Circuit Theory	(3-1-0) 4
EE207	Electromagnetic Theory	(3-1-0) 4
EE213	Electrical Machines – I	(3-1-3) 6
EE224	Electrical Measurements and Measuring Instruments	(3-1-3) 6
EE226	Analog Electronic Circuits	(3-1-3) 6
EE256	Signals and Systems	(3-1-3) 6
EE258	Electrical Machines – II	(3-1-3) 6
EE265	Power System Engineering – I	(3-1-0) 4
EE276	Digital Electronic Circuits	(3-1-3) 6
EE308	Power Electronics	(3-1-0) 4
EE326	Linear and Digital Control Theory	(3-1-0) 4
EE350	Power System Engineering – II	(3-1-0) 4
Programme Specific Electives (PSE)		
EE229	Polyphase Systems and Component – Transformations	(3-1-0) 4
EE243	Mathematics for Electrical Engineers	(3-1-0)4
EE253	Commutator Machines	(3-1-0) 4
EE255	Introduction to Algorithms and Data Structures	(3-1-0) 4
EE260	Digital Computer Organization and Architecture	(3-1-0) 4
EE281	Commutator Machines Laboratory	(0-0-3) 2
EE295	Electrical Machine Winding Calculations I	(0-2-3)4
EE296	Electrical Machine Winding CalculationsII	(0-2-3)4
EE298	Elements of Analog and Digital Communication	(3-1-0) 4
EE303	Distribution Systems Planning and Control	(3-1-0) 4
EE311	Digital System Design	(3-1-0) 4
EE312	Power System Harmonics	(3-1-0) 4
EE313	Digital Signal Processing	(3-1-0) 4
EE321	Linear and Nonlinear Systems	(3-1-0) 4
EE324	Electronic Measurements and Instrumentation	(3-1-0) 4
EE328	Network Synthesis	(3-1-0)4
EE329	Traveling Waves on Transmission Systems	(3-1-0)4
EE331	Distribution Systems Laboratory	(0-0-3) 2
EE334	Power Electronics Laboratory	(0-0-3) 2
EE335	Digital System Design Laboratory	(0-0-3) 2
EE337	Power System Harmonics Laboratory	(0-0-3) 2
EE342	Electronic Measurement Laboratory	(0-0-3) 2
EE343	Statistical Foundation for Electrical Engineers	(3-1-0) 4
EE359	Energy Auditing	(3-1-0) 4
EE360	Microprocessors	(3-1-0) 4
EE361	Power System Communications	(3-1-0) 4
EE362	Optimal Operation of Power Systems	(3-1-0) 4
EE363	Advanced Digital Signal Processing	(3-1-0) 4
EE366	Special Machines and Drives	(3-1-0) 4
EE369	Embedded System Design	(3-1-0) 4
EE371	Power Electronic Applications to Power Systems	(3-1-0) 4
EE373	Electric Power Stations	(3-1-0) 4
EE374	Electric Energy Systems	(3-1-0) 4
EE376	Advanced Control Systems	(3-1-0) 4
EE377	Modeling and Simulation Techniques for Dynamic Systems	(3-1-0) 4
EE378	Shell Scripting with Bash	(3-1-0) 4
EE379	Incremental Motion Control	(3-1-0) 4
EE382	Virtual Instrumentation Laboratory	(0-0-3) 2
EE384	Energy Auditing Laboratory	(0-0-3) 2
EE385	Microprocessors Laboratory	(0-0-3) 2
EE386	Digital Signal Processing Laboratory	(0-0-3) 2
EE387	Advanced Digital Signal Processing Laboratory	(0-0-3) 2
EE389	Embedded System Design Laboratory	(0-0-3) 2
EE392	Power System Operation Laboratory	(0-0-3) 2
EE393	Dynamic System Simulation Laboratory	(0-0-3) 2
	HVDC Transmission	
EE402		(3-1-0) 4
EE404	Soft Computing	(3-1-0) 4
EE406	Electromagnetic Compatibility	(3-1-0) 4
EE408	Solid-State Drives	(3-1-0) 4
EE410	Power System Protection	(3-1-0) 4
EE411	Operation of Restructured Power Systems under Deregulation	(3-1-0) 4
EE412	Random Signal Processing	(3-1-0) 4
EE414	Non-Conventional Energy Systems	(3-1-0) 4
EE418	Advanced Power Electronics	(3-1-0) 4
EE420	Power System Dynamics	(3-1-0) 4
EE422	Switchgear and Protection	(3-1-0) 4
EE423	Switchgear and Protection Laboratory	(0-0-3)2
EE427	Computer Networks	(3-1-0) 4
EE428	The ARM Core: Architecture and Programming	(3-1-0) 4
EE430	Robot Dynamics and Control	(3-1-0)4
EE439	Advanced Power Electronics Laboratory	(0-0-3) 2

EE443	Mathematical Morphology & applications to signal processing	(3-1-0)4
EE445	Power System Simulation Laboratory I	(0-0-3) 2
EE454	Flexible AC Transmission Systems	(3-1-0) 4
EE456	High-Voltage Engineering	(3-1-0) 4
EE458	Photovoltaics and Applications	(3-1-0) 4
EE464	Power Generation and Economics	(3-1-0) 4
EE466	Utilization of Electrical Energy	(3-1-0) 4
EE468	Advanced Electric Drives	(3-1-0) 4
EE470	Computational Technique for large system analysis	(3-1-0) 4
EE471	Power System Simulation Laboratory II	
EE472	Insulation and Testing Engineering	(3-1-0) 4
EE476	Optimisation Techniques	(3-1-0) 4
EE478	An Introduction to the Intel IA-32 Architecture	(3-1-0) 4
EE489	Advanced Electric Drives Laboratory	(0-0-3) 2
EE491	Insulation and Testing Engineering Laboratory	(0-0-3) 2
EE500	System Analysis in Discrete Time	(3-1-0)4
EE501	Analysis of Nonlinear Circuits	(3-1-0)4

Open Electives (OE)

EE319	Neural Networks and Applications	(3-0-0) 3
EE320	Electrical Safety, Operations, Regulations	(3-0-0) 3
EE467	Industrial Electrical Systems	(3-0-0) 3
EE469	Renewable Energy Systems	(3-0-0)3

Project (MP)

EE449	Major Project – I	(0-2-3)4
EE499	Major Project – II	(0-2-3)4

Mini Projects

EE347	Design & Development Task in Control System	(0-0-3)2
EE348	Design &Development Task in Power Electronic & Drives	(0-0-3)2
EE397	Design &development task in Signal processing	(0-0-3)2
EE398	Design &development task in Power Systems	(0-0-3)2

Mandatory Learning Courses (MLC)

CV110	Environmental Studies	(1-0-0) 1
HU111	Professional Ethics and Human Values	(1-0-0) 1
EE448	Seminar	(0-0-2) 1
EE498	Practical Training	(0-0-3)2

Suggested Plan of Study:

Semester →	III	IV	V	VI	VII	VIII
1	EE200	EE256	HU300	HU302	Elective	Elective
2	EE207	EE258	EE308	EE350	Elective	Elective
3	EE213	EE265	EE326	Elective	Elective	Elective
4	EE224	EE276	Elective	Elective	EE498	EE499
5	EE226	Elective	Elective	Elective	EE449	Elective
6			Elective			EE448

Degree Requirements :

Category of Courses	Minimum Credits to be Earned
Basic Science Core (BSC)	16
Engineering Science Core (ESC)	20
Humanities and Social Sciences (HSC)	09
Programme Core (PC)	60
Electives	≥ 48
Project (MP): Major Project Mini Project (Optional)	 08 0-4
Mandatory Learning Courses (MLC)	05
Total	**170**

Department of Information Technology (IT)
Bachelor of Technology in Information Technology

Basic Science Core (BSC)		
MA110	Engineering Mathematics – I	(3-0-0) 3
PH110	Physics	(3-1-0) 4
PH111	Physics Lab	(0-0-2)1
MA111	Engineering Mathematics – II	(3-0-0) 3
CY110	Chemistry	(3-0-0) 3
CY111	Chemistry Lab	(0-0-3) 2
Engineering Science Core (ESC)		
EE110	Elements of Electrical Engg.	(3-0-0) 3
ME110	Elements of Mechanical Engg	(3-0-0) 3
CO110	Computer Programming	(3-1-0) 4
CO111	Computer Programming Lab	(0-0-2) 1
EC110	Elements of Electronics and Commn. Engg	3-0-0) 3
AM110	Engineering Mechanics	(3-0-0) 3
ME111	Engineering Graphics	(1-0-3) 3
Humanities and Social Science Core (HSC)		
HU110	Professional Communication	(3-0-0) 3
HU300	Engineering Economics	(3-0-0) 3
HU302	Principles of Management	(3-0-0) 3
Programme Core (PC)		
MA200	Mathematical Foundations of IT	(3-1-0)4
IT200	Data Structures and Algorithms	(3-1-0)4
IT201	Digital Design and Computer Organization	(3-1-0) 4
IT202	Unix Programming and Practice	(1-0-3) 3
IT203	Computer Systems Organization Lab	(1-0-3) 3
IT204	Data Structures and Algorithms Lab	(0-0-3) 2
IT250	Operating Systems	(3-0-2) 4
IT251	Computer Communication and Networking	(3-0-2) 4
IT252	Design and Analysis of Algorithms	(3-0-2) 4
IT300	Parallel Computing	(3-0-2) 4
IT301	Database Systems	(3-0-2) 4
IT302	Web Technologies and Applications	(3-0-2) 4
IT303	Automata and Compiler Design	(3-0-2) 4
IT350	Software Engineering	(3-0-2) 4
IT351	Human Computer Interaction	(3-0-2) 4
IT352	Information Assurance and Security	(3-0-2) 4
	Major Project (MP)	
IT399	Minor Project	(0-0-3) 2
IT449	Major Project –I	(0-0-3) 2
IT499	Major Project –II	(0-0-9) 6
	Mandatory Learning Courses (MLC)	
CV110	Environmental Studies	(1-0-0) 1
HU111	Professional Ethics and Human Values	(1-0-0) 1
IT290	Seminar	(0-0-2) 1
IT440	Practical Training	(0-0-3)2

Programme Specific Electives (PSE)		
IT205	Information Systems	(3-0-0) 3
IT206	Paradigms of Programming - I	(3-0-2) 4
IT253	Paradigms of Programming –II	(3-0-0)3
IT254	Computer Graphics	(3-0-2) 4
IT255	Microprocessors and Interfacing	(3-0-2) 4
IT304	Multimedia Signal Computing	(3-0-2) 4
IT305	Performance Modeling	(3-0-2) 4
IT306	Object Oriented Analysis & Design	(3-0-0) 3
IT307	Advanced Computer Networks	(3-0-0) 3
IT353	Perceptual Audio Processing	(3-0-2) 4
IT354	Perceptual Video Processing	(3-0-2) 4
IT355	Soft Computing	(3-0-2) 4
IT356	Genetic Algorithms	(3-0-2) 4
IT357	Artificial Intelligence	(3-0-0) 3
IT358	Artificial Neural Networks	(3-0-2) 4
IT359	Fuzzy System Models	(3-0-0) 3
IT360	Distributed Computing System	(3-0-0) 3
IT361	Advanced Database Systems	(3-0-0) 3
IT362	Information Retrieval	(3-0-0) 3
IT363	Simulation and Modeling	(3-0-2) 4
IT364	E-Commerce	(3-0-0) 3
IT365	Natural Language Processing	(3-0-2)4
IT367	Time Series Analysis	(3-0-0)3
IT400	Mobile Computing	(3-0-0) 3
IT401	Embedded Systems	(3-0-0) 3
IT402	Bioinformatics	(3-0-0) 3
IT403	Knowledge Management	(3-0-0) 3
IT404	System Integration	(3-0-0) 3
IT405	Data Warehousing & Data Mining	(3-0-2) 4
IT406	Middleware Technologies	(3-0-2) 4
IT407	Computer Vision	(3-0-2) 4
IT408	Pattern Recognition	(3-0-2) 4
IT409	Cloud Computing	(3-0-2) 4
IT410	Wireless Sensor Networks	(3-0-2) 4
IT411	Mobile Adhoc Networks	(3-0-2) 4
IT412	Semantic Web Technologies	(3-0-2) 4
IT413	Virtual Reality	(3-0-2) 4
IT414	Rich Internet Applications	(3-0-2) 4
IT450	Web Services	(3-0-0) 3
IT451	Software Architecture	(3-0-0) 3
IT452	Computer Architecture	(3-0-0) 3
IT453	Transaction Processing	(3-0-0) 3
IT454	Software Quality Assurance	(3-0-0) 3
IT455	Information Technology for Healthcare	(3-0-0) 3
IT456	Enterprise Resource Planning& Systems	(3-0-0) 3
Open Electives (OE)		
IT305	Performance Modeling	(3-0-2) 4
IT357	Artificial Intelligence	(3-0-0) 3
IT358	Artificial Neural Networks	(3-0-2) 4
IT359	Fuzzy System Models	(3-0-0) 3
IT405	Data Warehousing & Data Mining	(3-0-2) 4
IT456	Enterprise Resource Planning &Systems	(3-0-0)3

Suggested Plan of Study

Semester ì	III	IV	V	VI	VII	VIII
1	MA200	IT250	IT300	IT350	IT440	IT499
2	IT200	IT251	IT301	IT351	IT449	Elective
3	IT201	IT252	IT302	IT352	Elective	Elective
4	IT202	IT290	IT303	IT399	Elective	Elective
5	IT203	Elective	HU300	HU302	Elective	
6	IT204	Elective	Elective	Elective	Elective	
7	Elective	Elective	Elective	Elective		

Degree Requirements:

Category of Courses	Minimum Credits to be Earned
Basic Science Core (BSC)	16
Engineering Science Core (ESC)	20
Humanities and Social Sciences Core (HSC)	09
Programme Core (PC)	60
Electives (ELE): 1) Programme Specific Electives (PSE) ≥ 38 2) Open Electives (OE): 0-12 Credits	50
Major Project (MP)	08
Minor Project	02
Mandatory Learning Courses (MLC)	05
Total	**170**

Department of Chemical Engineering
Bachelor of Technology in Chemical Engineering

Basic Science Core (BSC)

MA110	Engg.Mathematics – I	(3-0-0) 3
PH110	Physics	(3-1-0) 4
PH111	Physics Lab	(0-0-2) 1
MA111	Engg.Mathematics – II	(3-0-0) 3
CY110	Chemistry	(3-0-0) 3
CY111	Chemistry Lab	(0-0-3) 2
CY205	Organic Chemistry	(3-0-0) 3
CY255	Technical Analysis Lab	(0-0-4) 2
CY305	Inorganic & Physical Chemistry	(3-0-0) 3

Engineering Science Core (ESC)

EE110	Elements of Electrical Engineering	(3-0-0) 3
ME110	Elements of Mechanical Engineering	(3-0-0) 3
CO110	Computer Programming	(3-1-0) 4
CO111	Computer Programming Lab	(0-0-2) 1
EC110	Elements of Electronics Engg.	(3-0-0) 3
AM110	Engineering Mechanics	(3-0-0) 3
ME111	Engineering Graphics	(1-0-3) 3
ME200	Workshop	(0-0-2) 1

Humanities and Social Science Core(HSC)

HU100	Professional Communication	(3-0-0) 3
HU300	Engineering Economics	(3-0-0) 3
HU302	Principles of Management	(3-0-0) 3

Programme Core (PC)

CH200	Process Calculations	(2-2-0) 4
CH201	Momentum Transfer	(3-1-0) 4
CH202	Particulate Technology	(3-1-0) 4
CH203	Transport Phenomena	(2-2-0) 4
CH250	Chemical Engg. Thermodynamics I	(2-1-0) 3
CH251	Heat Transfer	(3-1-0) 4
CH252	Mass Transfer-I	(3-1-0) 4
CH253	Chemical Reaction Engg.–I	(2-1-0) 3
CH254	Fluid & Fluid Particle Systems lab	(0-0-3) 2
CH 300	Chemical Engg. Thermodynamics II	(2-1-0) 3
CH301	Chemical Reaction Engineering – II	(3-1-0) 4
CH302	Mass Transfer – II	(3-1-0) 4
CH303	Heat Transfer Operations Lab	(0-0-3) 2
CH351	Process Dynamics & Control	(3-1-0) 4
CH352	Simultaneous Heat & Mass Transfer	(2-1-0) 3
CH354	Mass Transfer Operations Lab	(0-0-3) 2
CH355	Chemical Process Industries	(3-0-0) 3
CH402	Process Design of Chemical Equipments	(2-0-3) 4
CH403	C.R.E. & Process Control Lab	(0-0-3) 2

Programme Specific Electives (PSE)

CH211	Process Instrumentation	(3-0-0) 3
CH261	Energy Technology	(3-0-0) 3
CH311	Petroleum Engineering	(3-0-0) 3
CH312	Biochemical Engineering	(3-0-0) 3
CH361	Process Modeling & Simulation	(3-1-0) 4
CH362	Separation Processes	(3-1-0) 4
CH363	Fertilizer Technology	(3-0-0) 3
CH364	Risk and Safety Management in Process Industries	(3-0-0) 3
CH365	Introduction to Molecular Simulations	(2-0-2)3
CH366	Electrochemical Engg.	(3-0-0)3
CH367	Energy Conservation & Management in process Industries	(3-0-0)3
CH368	Fuel Cell Engineering	(3-0-0) 3
CH411	Fermentation Technology	(3-0-0) 3
CH412	Pollution Control & Safety in Process Industries	(3-0-0) 3

Project (MP)

CH449	Major Project - I	(0-0-3) 2
CH499	Major Project – II	(0-0-9) 6

Mandatory Learning Courses (MLC)

CV110	Environmental Studies	(1-0-0) 1
HU111	Professional Ethics and Human Value	(1-0-0) 1
CH440	Practical Training	(0--0-2)1
CH 448	Seminar	(0-0-3) 2

Open Electives (OE)

CH211	Process Instrumentation	(3-0-0) 3
CH261	Energy Technology	(3-0-0) 3
CH311	Petroleum Engineering	(3-0-0) 3
CH465	Air Pollution Control and Design of Equipments	(3-0-0) 3

Suggested Plan of Study:-

Semester →	III	IV	V	VI	VII	VIII
1	CH200	CH250	CH300	CH351	CH 402	*CH499*
2	CH201	CH251	CH301	CH352	CH403	*Elective*
3	CH202	CH252	CH302	CH354	CH440	*Elective*
4	CH203	CH253	CH303	CH355	CH448	*Elective*
5	CY 205	CH254	CY305	HU300	CH449	*Elective*
6	ME 200	*CY255*	HU302	*Elective*	*Elective*	*Elective*
7	*Elective*	*Elective*	*Elective*	*Elective*	*Elective*	*Elective*
8	*Elective*	*Elective*	*Elective*	*Elective*	*Elective*	*Elective*

Degree Requirements:

Category of Courses	**Minimum Credits to be Earned**
Foundation Courses	
Basic Science Core (BSC)	24
Engineering Science Core (ESC)	21
Humanities and Social Sciences Core (HSC)	09
Programme Core (PC)	63
Elective (Ele)	40
Project (MP)	08
Mandatory Learning Courses (MLC)	05
Total	**170**

Department of Mechanical Engineering
Bachelor of Technology in Mechanical Engineering
Basic Science Core(BSC)

MA110	Engineering Mathematics-I	(3-0-0)3
PH110	Physics	(3-1-0)4
PH111	Physics Lab	(0-0-2)1
MA111	Engineering Mathematics-II	(3-0-0)3
CY110	Chemistry	(3-0-0)3
CY111	Chemistry Lab	(0-0-3)2

Engineering Science Core (ESC)

EE110	Elements of Electrical Engineering	(3-0-0)3
ME110	Elements of Mechanical Engineering	(3-0-0)3
CO110	Computer Programming	(3-1-0)4
CO111	Computer Programming Lab	(0-0-2)1
EC110	Elements of Electronics and communication Engineering	(3-0-0)3
AM110	Engineering Mechanics	(3-0-0)3
ME111	Engineering Graphics	(1-0-3)3
AM201	Mechanics of Solids	(3-0-0)3
AM217	Mechanics of Solids Lab	(0-0-2)1
AM317	Fluid Mechanics & Machinery Lab	(0-0-2)1

Humanities and Social Science Core (HSC)

HU110	Professional Communication	(3-0-0)3
HU300	Engineering Economics	(3-0-0)3
HU302	Principles of Management	(3-0-0)3

Programme Core (PC)

ME201	Basic Engineering Thermodynamics	(3-1-0)4
ME202	Fluid Mechanics and Machinery	(3-1-0)4
ME203	Mechanics of Machines	(3-1-0)4
ME204	Basic Manufacturing Process	(3-1-0)4
ME205	Materials Science and Metallurgy	(3-0-0)3
ME206	Engineering Drawing	(1-0-3)3
ME207	Workshop Practice	(0-0-3)2
ME250	Applied Thermodynamics	(3-1-0)4
ME251	Analysis & Design of Machine Components	(3-1-0)4
ME252	Computer Aided Engineering	(3-0-0)3
ME253	Manufacturing Technology	(3-0-0)3
ME254	Metrology	(3-0-0)3
ME255	Machine Drawing	(1-0-3)3
ME300	Energy Engineering	(3-0-0)3
ME301	Design of Mechanical Drives	(3-1-0)4
ME302	Mechanical Measurements & Instrumentation	(3-0-0)3
ME303	Metrology & CAD Lab	(0-0-2)1
ME304	Mechanical Lab-I	(0-0-2)1
ME350	Heat Transfer	(3-1-0)4
ME351	Machine Dynamics and Vibrations	(3-1-0)4
ME352	Machine Shop-I	(0-0-3)2
ME401	Mechanical Lab-II	(0-0-2)1
ME402	Machine Shop-II	(0-0-3)2

Programme Specific Electives (PSE)

ME210	Mechanical Behavior of Engg. Materials	(3-0-0)3
ME211	Fuels And Combustion	(3-0-0)3
ME212	Synthesis of Mechanisms	(3-0-0)3
ME213	Fundamentals of Turbo machines	(3-0-0)3
ME214	Quality Control	(3-0-0)3
ME215	Mini Project	(0-0-3)2
ME310	Measurements In Thermal Systems	(3-0-0)3
ME311	Hydraulic and Pneumatic Control	(3-0-0)3
ME312	Introduction to Aircraft Structures	(3-0-0)3
ME313	Internal Combustion Engines	(3-0-0)3
ME314	Mechatronics System Design	(3-0-0)3
ME315	Rotor Dynamics	(3-0-0)3
ME316	Theory of Elasticity	(3-0-0)3
ME317	Refrigeration Technology	(3-0-0)3
ME318	Manufacturing Technology of Polymers	(3-0-0)3
ME319	Mechanics of Compressible Fluids	(3-0-0)3
ME320	Automation Systems	(3-0-0)3
ME321	Welding Technology	(3-0-0)3
ME322	Automatic Control Engineering	(3-0-0)3
ME323	Production and Operations Management	(3-0-0)3
ME324	Product Development & Prototyping	(3-0-0)3
ME325	Manufacturing and Design of MEMS	(3-0-0)3
ME326	Flexible Manufacturing Systems	(3-0-0)3
ME327	Metal Cutting and Press Working	(3-0-0)3
ME328	Metal Forming	(3-0-0)3
ME329	Basics of Computational Fluid Dynamics	(3-0-0)3
ME330	Introduction to Robotics	(3-0-0)3
ME331	Mini Projects	(0-0-3)2
ME332	Composite Materials	
ME410	Non Conventional Energy sources	(3-0-0)3
ME411	Pollution Control & Environmental Management	(3-0-0)3
ME412	Operations Research	(3-0-0)3
ME413	Microprocessors and PLC	(3-0-0)3
ME414	Advanced I.C. Engines	(3-0-0)3
ME415	Theories of Engineering Fracture	(3-0-0)3
ME416	Cryogenics	(3-0-0)3
ME417	Applied Finite Method	(3-0-0)3
ME418	Auto Mobile Engineering	(3-0-0)3
ME419	Propulsion	(3-0-0)3
ME420	Mechanical Vibration & Acoustics	(3-0-0)3
ME421	Theory of Plasticity	(3-0-0)3
ME422	Human Factors in Engineering Design	(3-0-0)3
ME423	Nuclear Energy	(3-0-0)3
ME424	Industrial Tribology	(3-0-0)3
ME425	Engineering Acoustics	(3-0-0)3
ME426	Applied Computational Methods in Mechanical Sciences	(3-0-0)3
ME427	Collaborative Manufacturing	(3-0-0)3
ME428	Refrigeration and Air-conditioning	(3-0-0)3

Open Electives (OE)

ME341	Mechatronics	(3-0-0)3
ME342	Environmental Pollution Control	(3-0-0)3
ME343	Fluid Power Control	(3-0-0)3
ME344	Condition Monitoring and Predictive Maintenance	(3-0-0)3
ME441	Nuclear Science & Engineering	(3-0-0)3
ME442	Micro System Technology	(3-0-0)3
ME443	Product Design and Manufacturing	(3-0-0)3
ME444	Solar Energy	(3-0-0)3
ME445	Energy Management	(3-0-0)3
ME446	Theory of Gas Turbine and Jet Propulsion	(2-1-0)3
ME447	Multi Body dynamics and applications	(2-1-0)3
ME429	Analytical Mechanics	(3-0-0)3
ME430	Theory of Fatigue Analysis	(3-0-0)3
ME431	Contemporary Product Design	(3-0-0)3
ME432	Design of Solar Energy Systems	(3-0-0)3
ME433	Energy Audit and Management	(3-0-0)3
ME434	Experimental Stress Analysis	(3-0-0)3
ME435	Modeling & Simulation of Engineering Systems	(3-0-0)3
ME436	Data Base Management Systems	(3-0-0)3
ME437	Non linear and Random Vibrations	(3-0-0)3
ME438	Polymer Nano Composites	(3-0-0)3
ME439	Introduction to Laser Processing of Materials	(3-0-0)3

Project (MP)

ME449	Major Project –I	(0-1-3)2
ME499	Major Project –II	(0-1-9)6

Mandatory Learning Courses (MLC)

CV110	Environmental studies	(1-0-0) 1
HU111	Professional Ethics and Human values	(1-0-0) 1
ME440	Practical Training	(0-0-3) 2
ME490	Seminar	(0-0-2) 1

Suggested Plan of Study

Sem →	III	IV	V	VI	VII	VIII
1	ME201	ME250	ME300	ME350	ME440	ME490
2	ME202	ME251	ME301	ME351	ME449	ME499
3	ME203	ME252	ME302	HU300	Elective	Elective
4	ME204	ME253	HU302	Elective	Elective	Elective
5	ME205	ME255	Elective	Elective	Elective	Elective
6	ME206	Elective	Elective	Elective	Elective	Elective
7	AM201 / ME254	ME254 / AM201	Elective	Elective	Elective	Elective
8			ME303 / ME352	ME352 / ME303	ME401 / ME402	ME402 / ME401
9	AM217 / ME207	ME207 / AM217	AM317 / ME304	ME304 / AM317	--	--

Degree Requirements:

Category of courses	Minimum credits to be earned
Foundation courses : Basic Science core Engineering Science core Humanities and Social science core	50
Programme core:	69
Programme Electives: Programme Specific electives: 28 credits (min) Open Electives: 0-12 credits	42
Project (MP):	08
Mandatory Learning Courses (MLC):	05
Total:	174

Department of Metallurgical and Material Engineering
Bachelor of Technology in Metallurgical and Materials Engineering

Basic Science Core (BSC)

MA100	Engineering Mathematics – I	(3-0-0) 3
PH100	Physics	(3-1-0) 4
PH101	Physics Lab	(0-0-2) 1
MA101	Engineering Mathematics – II	(3-0-0) 3
CY100	Chemistry	(3-0-0) 3
CY101	Chemistry Lab	(0-0-3) 2

Engineering Science Core (ESC)

AM100	Engineering Mechanics	(3-0-0) 3
EE100	Elements of Electrical Engg.	(3-0-0) 3
ME100	Elements of Mechanical Engg.	(3-0-0) 3
CO100	Computer Programming	(3-0-0) 3
CO101	Computer Programming Lab	(0-0-3) 2
EC101	Elements of E &C Engg.	(3-0-0) 3
ME101	Engineering Graphics	(0-3-0) 3
AM200	Mechanics of Materials	(3-0-0) 3
CY206	Instrumental Analysis Lab	(0-0-4) 2
ME200	Workshop	(0-0-2) 1
ME328	Machine Design	(3-1-0) 4

Humanities and Social Science Core (HSC)

HU100	Professional Communication	(3-0-0) 3
HU300	Engineering Economics	(3-0-0) 3
HU302	Principles of Management	(3-0-0) 3

Programme Core (PC)

MT210	Mechanical Testing	(2-0-0) 2
MT211	Metallurgical Thermodynamics	(3-1-0) 4
MT212	Physical Metallurgy	(3-1-0) 4
MT213	Polymer Science & Technology	(3-0-0) 3
MT214	Mineral Dressing	(3-0-0) 3
MT260	Process Engineering	(3-1-0) 4
MT261	Phase Diagrams	(3-1-0) 4
MT262	Principles of Extractive Metallurgy	(3-1-0) 4
MT263	X-rays and Electron Metallography	(3-1-0) 4
CH263	Mineral Dressing Lab	(0-0-3) 2
MT289	Testing of Materials Lab	(0-0-2) 1
MT320	Production of Iron and Ferro Alloys	(3-0-0) 3
MT321	Heat Treatment	(3-1-0) 4
MT322	Physical Metallurgy Lab	(0-0-3) 2
MT323	Extractive metallurgy Lab	(0-0-3) 2
MT360	Production of Steel	(3-0-0) 3
MT361	Ceramics Engineering	(3-0-0) 3
MT363	Metal Forming	(3-0-0) 3
MT370	Professional Practice	(1-0-0) 1
MT377	Metallographic Lab	(0-0-3) 2
MT378	Ceramics and Polymers Lab	(0-0-2) 1
MT379	Heat Treatment Lab	(0-0-3) 2
MT420	Foundry Technology	(3-0-0) 3
MT421	Corrosion Engineering	(3-0-0) 3
MT423	Metal finishing lab	(0-0-3) 2
MT424	Foundry Technology Lab	(0-0-3) 2
MT478	Metal Processing Lab	(0-0-2) 1

Programme Specific Electives (PSE)

MT264	Electronic Properties of Materials	(3-0-0) 3
MT265	Instrumental Methods of Analysis	(3-0-0) 3
MT266	Measurements and Control	(3-0-0) 3
MT324	Fatigue, Fracture and Creep	(3-0-0) 3
MT325	Fuels, Furnaces and Refractories	(3-0-0) 3
MT362	Powder Met. and Joining of Metals	(3-0-0) 3
MT364	Aerospace Materials	(3-0-0) 3
MT411	Phase Transformations	(3-0-0) 3
MT412	Extraction of Nonferrous Metals	(3-0-0) 3
MT413	Secondary Refining of Steels	(3-0-0) 3
MT414	Non Destructive Testing	(3-0-0) 3
MT416	Advanced Engineering Materials	(3-0-0) 3
MT471	Composite Materials	(3-0-0) 3
MT472	Advanced Welding Technology	(3-0-0) 3
MT473	Surface Engineering	(3-0-0) 3
MT474	Modeling and Simulation in Material Processes	(3-0-0) 3
MT475	Science &Technology of Nanomaterials	(3-0-0) 3
MT476	Advanced Microscopic Techniques	(3-0-0) 3

Open Electives (OE)

MT415	Process Plant Materials	(3-0-0) 3
MT418	Nuclear Materials	(3-0-0) 3
MT419	Fracture of Engineering Materials	(3-0-0) 3
MT477	Smart Materials and Sensors	(3-0-0) 3

Project (MP)

MT449	Major Project – I	(0-0-6) 3
MT499	Major Project – II	(0-0-9) 5

Mandatory Learning Courses (MLC)

CV110	Environmental Studies	(1-0-0) 1
HU111	Professional Ethics and Human Values	(1-0-0) 1
MT422	Practical Training	(0-0-3) 2
MT480	Seminar	(0-0-2) 1

Suggested Plan of Study:

Semester →	III	IV	V	VI	VII	VIII
1	MT 210	MT 260	MT 320	MT 360	MT 420	MT 478
2	MT 211	MT 261	MT 321	MT 361	MT421	MT 479
3	MT 212	MT 262	ME328	MT363	MT 422	MT 480
4	MT 213	MT 289	MT 322	MT 370	MT 423	Elective
5	MT 214	CH 263	MT 323	MT 377	MT 424	Elective
6	AM200	MT263	HU 302	MT 378	MT 429	Elective
7	CY 206	Elective	Elective	MT 379	Elective	
8	Elective	Elective	Elective	HU 300	Elective	
9		ME 200	Elective	Elective	Elective	
10				Elective	MLC	

Degree Requirements:

Category of Courses	Minimum credits to be Earned
Foundation Courses (FC) [Including Basic Science Core (BSC)- 16, Engineering Science Core (ESC)-30 and Humanities and Social Science Core (HSC)- 9]	55
Programme Core (PC)	72
Electives (PSE and OE)	40
Project (MP)	08
Mandatory Learning Courses (MLC)	05
Total	**180**

COURSE CONTENTS - UG

Departments

Department of Applied Mechanics and Hydraulics

AM110 ENGINEERING MECHANICS (3-0-0) 3

Fundamentals of force system, Concept of Rigid body and deformable bodies, Free body diagrams. Support Reactions-Determinate and Indeterminate structures. Analysis of Trusses, Frames and Machines. Centroid and Moment of Inertia of plane areas. Shear Force and Bending Moment Diagrams. Simple stress and strain, Hooke's Law, Mechanical properties of materials, Elastic Constants.

Merian, J.L, Kraige, L.G. Engineering Mechanics – Statics, 5th Edition, Wiley Publishers, New-Delhi, 2007.

Beer & Johnston, Mechanics for Engineers, 4th Edition, McGraw – Hill, New Delhi, 1987.

Timoshenko, S.P., Young, D.H., Rao, J.V. Engineering Machines,4th Edition, McGraw-Hill, Singapore, 1956.

Singer, F.L. Strength of Materials, Third Edition, Harper and Row Publishers, New York, 1980.

Hearn, E.J., Mechanics of Materials, Pergaman Press, England, 1972.

Beer and Johnston E. R. Mechanics of Materials, 3rd Edition, Tata McGraw Hill, New Delhi, 2007.

AM200 MECHANICS OF MATERIALS (3-0-0) 3 PREREQ:*A Pass in* AM110

Simple flexure theory, Bending stress and shearing stress distribution across sections. Deflection of beams, Macaulay's method for deflection of statically determinate beams. Compound stresses - analytical method, graphical method - Mohr's circle of stresses., Torsion, Transmission of power through hollow and solid shafts. Beams of uniform strength, Springs, Combined bending and torsion, Strain energy, Theories of failure, Columns & struts, Thick and thin pressure vessels.

Singer, F.L. Strength of Materials, 3rd Edition, Harper and Row Publishers, New York, 1980.

Hearn, E.J., Mechanics of Materials, Pergaman Press, England, 1972.

Beer and Johnston E. R. Mechanics of Materials, 3rd Edition, Tata McGraw Hill, New-Delhi, 2007.

AM 201 MECHANICS OF SOLIDS (2-1-0) 3 PREREQ: *A Pass in* AM110

Simple flexure theory, Bending stress and shearing stress distribution across sections Macaulay's method for deflection of statically determinate beams. Compound stresses - Analytical Method, Graphical Method - Mohr's Circle. Torsion, Transmission of Power through hollow and solid shafts. Beams of Uniform strength, Springs, combined bending and Torsion, Strain energy. Thick and Thin pressure vessels

Singer, F.L. Strength of Materials, 3rd Edition, Harper and Row Publishers, New York, 1980.

Hearn, E.J., Mechanics of Materials, Pergaman Press, England, 1972.

Beer and Johnston E. R. Mechanics of Materials, 3rd Edition, Tata McGraw Hill, New-Delhi, 2007.

AM 216 STRENGTH OF MATERIALS LAB (0-0-3) 2

Tension test on mild steel and cast iron, Compression test on mild steel and cast iron, Torsion test on mild steel rod, Rockwell and Brinell hardness tests, Impact test (Charpy and Izod) on mild steel, Bending test on mild steel rod and wood, Shear test on mild steel plate and rod, tests on leaf and helical spring. Demonstration on fatigue test.

Hearn, E.J., Mechanics of Materials, Pergaman Press, England, 1972.

Beer and Johnston E. R. Mechanics of Materials, 3rd Edition, Tata McGraw Hill, New-Delhi, 2007.

AM217 MECHANICS OF SOLIDS LAB (0-0-2) 1

Tension tests on mild steel and cast iron, Compression tests on mild steel and cast iron, Shear tests, Bending test on mild steel, Torsion test, Hardness test and Impact test. Demonstration on fatigue test and springs

Hearn, E.J., Mechanics of Materials, Pergaman Press, England, 1972.

Beer and Johnston E. R. Mechanics of Materials, 3rd Edition, Tata McGraw Hill, New-Delhi, 2007.

AM250 MECHANICS OF FLUIDS (3-0-0) 3

Properties and classification of fluids. Basic equation of fluid statics. Manometers. Buoyant force. Kinematics of fluid flow. Continuity equation. Bernoulli's equation. Momentum equation. Flow measurements: Brief introduction. Dimensional analysis. Model law. Basics of pipe flow. Hagen-Poiseuille equation. Darcy-Weisbach equation. Moody's diagram. Uniform flow in open channels.

Modi, P.N and Seth, S.M., Hydraulics and Fluid Mechanics, Standard Book House, Delhi, 2010.
Streete. V.L and Wylie. E.B., Fluid Mechanics, McGraw Hill Book Company, New York,1997.
Ven Te Chow, Open Channel Hydraulics, McGraw Hill, New York 1959.

AM300 WATER RESOURCE ENGINEERING (3-0-0) 3 PREREQ: *A Pass in* AM250

Hydrology: Hydrologic cycle, Water budget, Catchment. Precipitation: types, measurement, intensity, duration, temporal and spatial analysis. Infiltration, soil moisture, evaporation, transpiration, Groundwater. Runoff: components, factors, hydrographs, unit hydrograph, flood estimation. Irrigation: objectives, methods, irrigation water requirements. Components of irrigation system and design principles. Water Power Engineering: Basic principles, types of schemes

Subramanya K, Engineering Hydrology, Tata McGraw Hill, 3rd Edition, 2008.
Garg S. K, Irrigation Engineering and Hydraulic Structures, Khanna Publishers, 2008.
Ven Te Chow, LW Mays and DR Maidment., Applied Hydrology, McGraw Hill, 1988.

AM316 HYDRAULICS LAB (0-0-3) 2 PREREQ: *A Pass in* AM250

Calibration of V notch, Rectangular Notch; Venturimeter, Orifice meter, Water meter. Friction factor of pipes. Impact of jet on vanes. Tests on centrifugal pump, reciprocating pump, Pelton wheel turbine, Francis turbine. Hydraulics jump, Syphons, Demonstration experiments (pressure gauge, Pitot tube, Kaplan turbine)

Modi, P.N and Seth, S.M., Hydraulics and Fluid Mechanics, Standard Book House, Delhi, 2010

AM317 FLUID MECHANICS AND MACHINERY LAB (0-0-2) 1 PREREQ: *A Pass in* ME202

Calibration of V notch, Venturimeter, Orifice meter, Water meter. Friction factor of pipes. Impact of jet on vanes. Tests on centrifugal pump, reciprocating pump, Pelton wheel turbine. Demonstration experiments (pressure gauge, Pitot tube, Kaplan turbine)

Modi, P.N and Seth, S.M., Hydraulics and Fluid Mechanics, Standard Book House,

AM371 OPEN CHANNEL FLOW AND SEDIMENT TRANSPORT

(3-0-0) 3 PREREQ: *A Pass in* AM250

Steady GVF, SVF, RVF. Unsteady flow: basic equations, velocity of flood wave discharge, flood routing. Bulk properties of sediments, various related theories such as competent velocity concepts, lift concept, critical tractive force concept, Shield's analysis, regimes of flow, bed forms, resistance to flow, bed and suspended load transport, reservoir sedimentation, agredation and degradation of rivers, local scour, sediment samplers.

Subramanya. K, Open channel flow, Tata McGraw Hill,3rd Edition, 2010.
Graf,W. H. Hydraulics of sediment transport, McGraw Hill, 1984.

Garde and Rangaraju, Sediment transport, Wiley Eastern, 2nd Edition,1985
Chow, V. T. open channel flow

AM372 CIVIL ENGINEERING SYSTEMS (3-0-0) 3

Introduction to systems approach, simple and complex system, unique features of complex system. Unconstrained optimization, concave & convex functions, constrained optimization - KT conditions, Lagrangian multiplier method. Introduction to LP, Simplex method, Two phase method, Duality in LP, Introduction to DP, Network model, Allocation model. Some typical case studies.

Rao. S.S., Engineering Optimization, Wiley-IEEE, 3rd Edition, 1996.

Taha, H..A,Operation Research, Prentice Hall, 6th Edition, 1997.
Panik M. .J., Classical optimization foundation, North Holland Pub. Co., 1976.

AM380 MINI PROJECT – I (0-0-3) 2

Experimental work either in the field or in the laboratory or design tasks of relatively smaller magnitude compared to Major Project work and in line with the guidelines formulated by the DUGC (AM).

AM381 MINI PROJECT – II (0-0-3) 2

Experimental work either in the field or in the laboratory or design tasks of relatively smaller magnitude compared to Major Project work and in line with the guidelines formulated by the DUGC (AM).

AM 400 GEOGRAPHIC INFORMATION SYSTEM (3-0-0) 3

Components of GIS, functions , Coordinate Systems, Raster and vector-based GIS and data structures, Spatial data sources Geo-relational Vector data model, Object based vector data model, raster data model, data input, geometric Transformation, Spatial data editing, Attribute data input and management, vector data analysis, Raster data analysis., GIS Modeling and Decision support system, Applications of GIS in several domains

Kang-tsung Chang, Introduction to Geographic Information Systems, 4 th edition Tata McGraw Hill
Burrough & McDonnell, Principles of Geographical Information Systems, Oxford University Press
Yang, Snyder & Tobler, Map projection Transformation principles and applications, Taylor and Francis

AM 401 SATELLITE DIGITAL IMAGE ANALYSIS (3-0-0) 3

Introduction to Remote sensing and Digital image Processing, Remote sensing data collection Alternatives, Hardware and software issues, Image Quality assessment , Electromagnetic Energy Radiation Principles and radiometric correction, Geometric correction, Image Enhancement , Pattern Recognition, Information extraction from MSS and Hyperspectral data, Change detection studies.

Jensen J.R Remote Sensing of the Environment An Earth Resource Perspective Second Edition , Dorling Kindersley India Pvt Ltd.
Jensen J.R Introduction to Digital Image Processing: A remote sensing Perspective. Prentice-Hall,2005.
Lillesand, T.M., R.W. Kiefer, and J.W. Chipman. Remote Sensing and Image Interpretation. 5th Edition. John Wiley and Sons. 2004.

AM 402 PRINCIPLES OF GEOINFORMATICS (3-0-0) 3

The electromagnetic spectrum and atmospheric considerations, Spectral Characteristics ,Sensors and platforms : Visible and infrared sensors, Radar technology, Data Products , Visual Interpretation , GIS, GPS , Applications.

Lillesand, T.M., R.W. Kiefer, and J.W. Chipman. 2004. Remote Sensing and Image Interpretation. 5th Edition. John Wiley and Sons.
Sabins, F.J. Jr. 1996. Remote Sensing: Principles and Interpretation. Third Edition. W.H. Freeman and Company, NewDelhi
Kang-tsung Chang Introduction to Geographic Information Systems 4th edition, Tata McGraw Hill k.
Ahmed El- Rabbany " Introduction to GPS" Artech House

AM 403 GLOBAL POSITIONING SYSTEMS (3-0-0) 3

Introduction to GPS, GPS details, GPS Errors and Biases , Datum, Coordinate Systems and Map Projections , GPS Positioning Modes, Ambiguity-Resolution Techniques, GPS Data and Correction Services,GPS standard Formats, GPS integration, GPS applications, Other Satellite Navigation Systems

Ahmed El- Rabbany " Introduction to GPS" Artech House Rao,
K.N. R Fundamentals of Satellite Communications PHI, 2004

AM421 DESIGN & DRAWING OF HYDRAULIC STRUCTURES

(1-0-3) 3 PREREQ: *A Pass in* AM 300

Introduction to Lacey's regime theory, Khosla's theory, Bligh's creep theory, Hydraulic design and drawing of following structures: i. Earthen dam; ii. Gravity dam (OS); iii. Gravity dam (NOS); iv. Surplus weir; v. Canal drop; vi. Canal regulator; vii. Tank sluice with tower head; viii. Direct sluice; ix. Aquaduct.

Punmia,BC and Lal,PBB. Irrigation& Water Power Engineering, Standard Book House, 2nd Edition,1990.

Michel, WH. Manual of Irrigation Engineering, Hubbard Press,1997.

C.S. Murthy, Water Resources Engineering:Principles and Practices, New Age International,1997.

AM422 FUNDAMENTALS OF COASTAL ENGINEERING (3-0-0) 3 PREREQ : *A Pass in* AM250

Basic Wave Hydrodynamics, Linear Wave Theory, Wave Phenomena,Generation of Wind Waves, Wave Spectrum, Wave Forecasting, Basics of Wave Structure Interaction, Coastal Processes - Littoral Drift, Coastal Erosion and Protection (Hard and Soft Options), Design Principles of Breakwaters.

Shore Protection Manual, U.S.Army Corps of Engineers, Coastal Engineering Research Center,1984. US Army Corps of Engineers, 'Shore protection manual(SPM)", Vol. 1 &2, Coastal Engg Res. Centre, US Govt. Printing Office , Washington D.C. USA, 1984.

US Army Corps of Engineers, 'Coastal Engg. Manual (CEM)", Parts 1 to 6, Coastal Engg Res. Centre, Washington D.C. USA., 2006.

Ippen A.T., Estuary & Coastline Hydrodynamics, McGraw Hill, New York, USA, 1996.

AM423 BASICS OF OFFSHORE ENGINEERING (3-0-0) 3 PREREQ *A Pass in* AM 250

Ocean Waves, Currents, Winds, Ice and Mud loading, Basics of Offshore Structures - Jacket, Tower, Gravity platforms, Hybrid Structures and factors governing their selection, Linear wave theory, Morison equation. Linear dynamic analysis, Pile foundations, Bearings capacity of footings, Corrosion and under water Welding.

US Army Corps of Engineers, 'Shore protection manual(SPM)", Vol. 1& 2, Coastal Engg Res. Centre, US Govt Printing Office , Washington D.C. USA., 1984.

US Army Corps of Engineers, 'Coastal Engg. Manual (CEM)", Parts 1 to 6, Coastal Engg Res. Centre, Washington D.C.,USA, 2006.

Weigel R.L.,Recommended practice for Planning, Designing, & Construction of Fixed Offshore Structures - Oceonographical Engg., Prentice Hall, 1969.

Pilarckzyk K. W. and Zeidler R. B., "Offshore breakwaters and Shoreline Evolution Control", A. A. Balkema Publishers, Rotterdam, The Netherlands,1996.

AM424 COASTAL EROSION & ITS MITIGATION (3-0-0) 3 PREREQ : *A Pass in* AM250

Origin of Coasts, Sediment Transport and Budgeting, Coastal Erosion and Mitigation: A Global Scenario and Indian Perspective, Coastal Processes, Planning and Design of Coastal Protection Works, Soft and Hard Options, Innovative Technologies, Remote Sensing, Geographical Information System and Artificial Neural Network in Coastal Engineering, Performance of Coastal Protection Works in India,

Coastal Zone Regulation, Integrated Coastal Zone Management, Coastal Pollution and Environmental Impact Assessment.

Bruun, P., Port Engineering, Vol. I

Shore Protection Manual, U.S.Army Corps of Engineers, Coastal Engineering Research Center, U.S.Govt. Printing office, Washington D.C., Vol. 1 & 2. 1984.

Ippen A.T., Estuary and Coast line Hydrodynamics McGraw Hill, 1966

AM 435 PERFORMANCE APPRAISAL OF LARGE PROJECTS (3-0-0) 3

Introduction to performance appraisal, unique features of large projects, technical parameters, economical parameters, social parameters, environmental parameters, Evolving normalized index for performance

appraisal, comparative analysis of different methods. Decision making under risk and uncertainty, Theory of errors, sensitivity analysis - Brief introduction, Specific case studies

Taha, HA,Operation Research, Prentice Hall, 6th Edition, 1997. Luce, RD and Raiffa,H. Games and Decisions, Dover, New York, 1989.

Lorry W. Canter, Handbook of Environmenal Impact Assessment, Blackwell Science Ltd, Oxford, UK,1999.

Gupta, BI and Gupta A. Construction Management Machinery and Accounts. Standard Publishers,2005.

AM 436 DISASTER MANAGEMENT (3-0-0) 3

Types of Disasters, its Dimensions, Impact of Disasters, Forecasting, Role of Remote Sensing and Geographical Information System in Disaster Management, Vulnerability, Disaster Reduction Strategies, Multi Hazard Mapping, Financial Management, Losses from Global Disasters and Expenses in Reconstruction and Retrofitting of Structures, Role of NGO, Government Bodies and Public, Social and Economic Development of Disaster Prone areas.

Emergency Planning *Ghosh, G.K. Disaster Management, APH Publishing Co., New Delhi, 2006.*

Ghosh, S.G. Natural disaster management: New technologies and opportunities, ICFAI University Press, New Delhi,2008.

Institute of Engineers, World Congress on Natural Disaster Mitigation, Vol I & II, 2004.

AM 437 DECISION MAKING UNDER RISK AND UNCERTAINTY (3-0-0) 3

Decision making process, elements of leadership, planning and strategic management, Management of public organization. Decision making using Risk Theories, Different models of decision making under uncertainty. Sensitivity analysis and uncertainty analysis in distributed parameter systems.

Taha, HA,Operation Research, Prentice Hall, 6th Edition, 1997. Joseph L. Masij, Essential of Management, McGraw Hill, 1996.

AM 438 RURAL INFRASTRUCTURE DEVELOPMENT (3-0-0) 3

Integrated rural development, rural growth and economy, need for rural infrastructure, cooperative movement. Rural water supply schemes- Surface water and groundwater systems, components and design principles, economic analysis. Rural sanitation- requirements, methods, design features. Rural roads and communication facilities.

Twort, AC, DD Ratanayaka and MJ Brandt. Water Supply, AIWA Pub., 5th edition, New York,2000.

GS Birdi and JS Birdie , Water Supply and Sanitary Engineering, Dhanpat Rai & Sons, New Delhi, 1998.

AM 439 INVERSE MODELING (3-0-0) 3

Lumped and distributed systems, introduction to inverse modeling, conventional parameter estimation procedures, OLS, WLS and Gauss Newton Algorithm for parameter estimation, Parameter perturbation, Sensitivity analysis, Role of sensitivity analysis in parameter identifiability, uniqueness and stability. Linear error statistics, uncertainty analysis in inverse modeling, Role of redundancy in data, handling of noisy and bad data in inverse modelling, Role of spatial and temporal data in parameter uncertainty, Grouping of parameters, effect of zonation in distributed models.

Taha, HA,Operation Research, Prentice Hall, 6th Edition, 1997.

J.N.Kapur , Mathematical modeling, New Age International, 2003.

M.R. Ball , Mathematics in social & life sciences. John Wiley, 2nd edition, 1985.

Dym CL , Principle of mathematical modeling, Elsevier,2nd edition, 2004.

AM 445 FUNDAMENTALS OF FINITE ELEMENT METHOD (3-0-0) 3

Direct approach. Basic structural elements. Finite difference method, Galerkin weighted residual approach, Rayleigh Ritz method, Element properties. Linear and quadratic elements, shape functions. Isoparametric elements. Numerical integration using Gauss-Legender quadratures, 1-D problems. Shape function for 4,

8 and 9 nodal quadrilateral elements, Stiffness matrix and consistent load vector, Evaluation of element matrices using numerical integration.

Robert D Cook, David S Malkus, Michael E Plesha, 'Concepts and Applications of Finite Element Analysis', 4th edition, John Wiley and Sons, Inc., 2003.
Reddy J.N., An Introduction to Finite Element Method , McGraw Hill – 2000.
Rao. S.S., Finite Element Methods in Engineering, Butterworth and Heinemann, 2001.
L.T. Segerlind, Applied Finite Element Analysis, John-Wiley, 2nd edition,1984

.

AM 455 ENGINEERING OPTIMIZATION (3-0-0) 3

Optimization, Formulation of linear Optimization problems, Linear Programming model,Graphical method, Simplex method, Finding a feasible basis - Big M and two phase Simplex method, Duality in Linear Programme. Primal-dual relationship. Sensitivity analysis. Network analysis: Transportation problem. Dynamic Programming (DP); Non-linear Programming-unconstrained and constrained optimization, Lagrange multipliers and Kuhn - Tucker conditions.

F.S.Hiller and G.J.Liberman, Introduction to Operations Research.
Ravindran ,D. T.Philips and J.J.Solberg , Operations Research - Principles and Practice.
Hadly.G, Linear Programming(LP)
S.S.Rao, Engineering Optimisation

AM 473 WATER RESOURCES EXCESS MANAGEMENT

(3-0-0) 3 PREREQ : *A Pass in* AM 300

Excess rainfall, Direct runoff, Peak flow estimation, Frequency and Return Period, Risk, Design storm, Design Storm Hydrograph. Flow routing. Drainage of urban areas, System components and Design principles, Storm water management.

Ven Te Chow, LW Mays and DR Maidment., Applied Hydrology, McGraw Hill, 1988.
American Society of Civil Engineers Task Committee on Hydrology Handbook, Hydrology Handbook, 2nd edition, ASCE Manuals & Reports on Engg. Practice No.28, 1996
Mays. L.W. Water Resources Handbook,McGraw Hill, 2007.

AM 474 COMPUTATIONAL METHODS IN HYDROLOGY

(3-0-0) 3 PREREQ : *A Pass in* AM 300

Introduction, Hydrometeorological measurements, Hydrological models, catchment simulation. Continuity, momentum and energy equations, differential equations in hydrology. Finite difference technique, Finite element method, Galerkin method, steady and transient problems. Model application, flow routing, wave motion, unsaturated /saturated ground water flow.

Maidment, D. Hand Book of Hydrology, McGraw Hill, 1st edition, 1993.
Huyakorn and Pinder, Computational methods in subsurface flow, Academic Press, New York, 1983.
Zienkiewiz O.C. and Morgan, K., Finite elements and approximation, John Wiley,2006.

AM 475 GROUND WATER ENGINEERING (3-0-0) 3 PREREQ : *A Pass in* AM 300

Fundamentals of ground water flow, Mechanics of well flow, Image well theory, Well design, Well characteristics, Production tests and maintenance. Pollution of aquifers: salt water intrusion, Aquifer remediation and management, Groundwater recharge, Rainwater harvesting, Ground water rights.

Todd D.K, Ground water hydrology, 3rd edition, Wiley,2008.
Walton, W.C., Ground water resource evaluation. McGraw Hill, 1970. Raghunath, H.M., Ground Water, New Age International, 3rd edition, 1998. Karanth, K. Groundwater Assessment and Management, Tata McGraw Hill, 2007.

AM478 THEORY OF ISOTROPIC ELASTICITY PREREQ.: A pass in either AM200 or AM201 **(3-0-0) 3**

Definition of Stress and Strain: Stress - Strain relationships - Equations of Equilibrium, Compatibility equations, Boundary Conditions, Saint Venant's principle - Principal Stresses, Stress Ellipsoid - Stress invariants. Airy's stress function, Bi-harmonic equations, Polynomial solutions, Simple two dimensional problems in Cartesian coordinates like bending of cantilever and simply supported beams. Equations of equilibrium, Strain - displacement relations, Stress – strain relations, Airy's stress function, Axi – symmetric problems, Introduction to Dunder's table, Curved beam analysis, Kirsch, Michell's and Boussinesque problems – Rotating discs. Navier's theory, St. Venant's theory, Prandtl's theory on torsion, semi- inverse method and applications to shafts of circular, elliptical, equilateral triangular and rectangular sections.

Wang, C. T., Applied Elasticity, McGraw – Hill Co., New York, 1993.

Sokolnikoff, I. S., Mathematical Theory of Elasticity, McGraw – Hill, New York, 1978.

Volterra & J.H. Caines, Advanced Strength of Materials, Prentice Hall, New Jersey, 1991

Barber, J. R., Elasiticity, Kluwer Academic Publishers, 2004

Timoshenko, S., and Goodier, T.N., Theory of Elasticity, McGraw – Hill Ltd., Tokyo, 1990.

Ansel C Ugural and Saul K Fenster, 'Advanced Strength and Applied Elasticity', 4th Edition, Prentice Hall, New Jersey, 2003.

Bhaskar, K., and Varadan, T. K., Theory of Isotropic/Orthotropic Elasticity, CRC Press USA, 2009.

Department of Civil Engineering

CV110 ENVIRONMENTAL STUDIES (1-0-0) 1

Definition, scope and importance of Environmental Studies, Need for public awareness. Natural Resources Renewable and Non-renewable Resources. Natural resources and associated problems. Concept of an ecosystem: Structure and function of an ecosystem, Producers, consumers and decomposers, Energy flow in the ecosystem, Ecological succession, Food chains and ecological pyramids, Biodiversity and Its Conservation, Environmental Pollution: Definition, Causes, effects and control measures. Pollution case studies. Disaster management, Social Issues and the Environment, Environmental ethics, Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Wasteland reclamation, Consumerism and waste products, Acts related to Environment Protection, Isues involved in enforcement of environmental legislation, Human Population and the Environment, Field work equal to 5 lecture hours.

R. Rajagopalan, Environmental Studies, Oxford IBH Pub,2011.

Benny Joseph, Environmental Studies, McGraw Hill Pub,2008.

Erach Bharucha, Text Book for Environmental Studies, Pub., UGC,2004.

Masters, Gilbert M. Introduction to Environmental Engineering and Sciences, Prentice Hall India,2008.

CV200 CIVIL ENGINEERING MATERIALS AND CONSTRUCTION (3-0-0) 3

Traditional materials : stone, brick, tiles-roofing and flooring, steel, timber, lime, cement, their manufacture, properties and codal requirements. Mortar, cement concrete, properties, specifications and tests for quality control. Reinforced concrete, fibre reinforced concrete and ferrocement applications. Paints, enamels, varnishes, tar, bitumen, asphalt, properties and use. Modern materials: plastics, rubber, polymer, fibre reinforced plastics, manufacture, properties and use. Introduction to composites and smart materials.

Building Construction: Foundations; Stone Masonry - Random rubble and Ashlar,; Brick Masonry -Rules for bonding, stretcher and header bonds and English Bond for 1 and 1 V brick thickness,; Doors and Windows; RCC Stairs and design of a dog-legged stair; Pitched Roofs and Simple Trusses; RC Constructions - Lintels and sunshades, beams and one-way and two-way slabs.

S.K. Duggal, Building Materials, Oxford & IBH publishing Co. Ltd., New Delhi 2000

M.S. Shetty, Cement Technology, Theory and Practice, S.C. Chand & Co. Ltd., 2002

B.C.Punmia, Building Construction

CV201 ELEMENTS OF SURVEYING (3-0-0) 3

Introduction to Surveying, Chain Surveying, Compass Surveying, Errors, Accuracy and precision. Introduction to plane table surveying. Levelling, contouring, Theodolite traverse. Introduction to tacheometric surveying and Trigonometric leveling. Horizontal curves. Introduction to vertical curves. Electronic distance measurements - Introduction. Minor Instruments, Digital Theodolite and total Station.

P.C. Punmia,Surveying Vol. I and II -STD

K. R. Arora,Surveying Vol-I &II- STD Book, New Delhi.

S.K. Roy,Fundamentals of surveying -Prentice - Hall of India, New Delhi.

CV202 ENGINEERING GEOLOGY (3-0-0) 3

General Geology, Physical Geology, Mineralogy, Petrology. Study of Igneous, Sedimentary, Metamorphic rocks, Physico - mechanical properties of rocks.

Structural geology : Study of folds, faults, Joints, unconformities: resource engg., remote sensing applications, Hydrogeology : Aquifers, geophysical exploration, selection of dam sites, tunnels, land slide control measures, environmental geology.

Parbin Singh, Engineering and General Geology, Katson Pub., Delhi, Sixth edition 2001.

Blyth. F.G.H & De Freitas M. H.,Engineering Geology, ELBS, 7th edition, 1984

D.V.Reddy, Engineering Geology for Civil Engineers, Oxford IBH Publishers,1995,1997.

CV203 MINING GEOLOGY (3-0-0) 3

Physical Geology; Interior of the earth, Geological processes, Geological hazards. Mineralogy; physical properties, Quartz, Silicates, carbonate minerals, petrology; study of Igneous, Sedimentary, Metamorphic rocks. Stratigraphy; principles, geological time scale, Dharwars, Gondwana, tertiary systems. Paleontology; fossils and their uses, fossil fuels; coal and petroleum geology.

Parbin Singh, Engineering and General Geology, Katson Pub. Delhi, 6th edition 2001

Mukerjee P.K. A text book of Geology, World Press Pvt. Ltd. 11th edition, 1990

CV210 ELEMENTS OF CIVIL ENGINEERING (1-0-0) 1

CV216 CIVIL ENGINEERING MATERIALS LAB (0-0-3) 2

Sampling and testing of materials as per BIS specifications and codal requirements. Cement, fine and coarse aggregates, bricks, roofing and flooring tiles.

V.V. Sastry & M.L.Gambhir, Laboratory Manual of Concrete Testing (Part - I), Dhanpat Rai & Sons, New Delhi 1992.

Relevant BIS codes for testing of materials.

CV217 SURVEYING PRACTICE (0-0-3) 2

Chain, Compass, Plane table leveling theodolite and tacheometric surveying, curve Setting, Demonstration of Total Station.

P.C. Punmia,Surveying Vol. I and II -STD

K. R. Arora,Surveying Vol-I &II- STD Book, New Delhi.

CV218 MINING GEOLOGY LAB. (0-0-3) 2

Mineralogy; Megascopic study of minerals, Microscopic study of minerals, Petrology; Megascopic study of rocks, Microscopic study of rocks.

Paleontology; Identification and description of fossils

Crystallography ; Study of crystals through crystal models

Simmons & Schuden guide, Rocks and Minerals

Cornelius S. Hurlbut. Jr. Dana's manual of Mineralogy, John Wiley and Sons, 1985

CV250 STRUCTURAL ANALYSIS – I (3-0-0) 3

Conditions of equilibrium, degrees of freedom, determinate and indeterminate structures, Linear and non-linear structural systems. Deflection of beams : Moment area method and conjugate beam method, the first theorem of Castigliano, Betti's law, Clark Maxwell's Theorem of reciprocal deflection, strain energy method and unit load method. Redundant Structures : The second theorem of Castigliano, Consistent deformation method, slope deflection method. Rolling loads and influence lines : Statically determinate beams and bridge trusses, series of loads and uniformly distributed loads, criteria for maximum and absolute maximum moments and shears. Three hinged arches, influence lines, Cables and suspension bridges, suspension bridge with three hinged stiffening girders and influence line diagrams.

Norris and Wilber, Elementary structural analysis.

C.K. Wang, Statically indeterminate structures

CV251 DESIGN OF RCC STRUCTURES (3-0-0) 3

Strength properties and behaviour of concrete and reinforcing steel. Basic principles of working stress design. Limit state design concepts. Designing of members subjected to flexure, shear, torsion, axial forces and combinations, uniaxial and biaxial bending of columns. Design of simply supported and continuous beams and slabs; two way slabs, isolated and combined footings. Computation of deflection and crack width.

Ashok K Jain, Reinforced Limit State Design, Nem Chand & Bros. Roorkee, 1998.

Unnikrishna Pillai and Devadas Menon, Reinforced Concrete Design, Tata- McGrawhill, 1997.

CV252 SOIL MECHANICS (3-0-0) 3

Soil formation, Three phase system, Index properties of soils, Soil classification, Hydraulics of soils, Stress distribution in soils, Soil compaction, One dimensional consolidation, Effective stress and pore water pressure, Shear strength of soils.

T.W.Lambe and R.V.Whitman, Soil Mechanics, John Wiley and Sons, Inc, Newyork.

V.N.S.Murthy, Soil Mechanics and Foundation Engineering, Dhanpat Roy and Sons, New-Delhi.

Relevant IS Codes(Latest editions).

CV253 ARCHITECTURE AND TOWN PLANNING (3-0-0) 3

Town Planning and Architecture: An overview of ancient human settlements; Indus Valley, Manasura's classification of villages, Dantaka Village, Slums, Housing Bye-laws, Neighbourhood units, objectives and principles of town planning, Master-Plan, Zoning, Aesthetics and Principles of Architectural Composition.

S.C.Rangawala, Principles of Town Planning Sir.

Banister Fletcher, Comparative Architecture

Talbot Hamlin, Forms and Functions of Twentieth century Architecture; Vol II

CV254 ADVANCED MINING GEOLOGY LAB (0-0-3) 2

Structural Geology : Interpretation of Geological and Structural geological maps. Solving Dip and Strike, borehole problems. Megascopic and Microscopic Study of ore minerals, ore reserve estimation. Geophysical exploration.

Gurappa. K.M,. Structural geology manual.

CV266 GEOLOGY LAB (0-0-3) 2

Mineralogy : Identification and description of important rock-forming and ore minerals.

Petrology : Identification and description of Igneous, Sedimentary, Metamorphic rocks.

Structural Geology : Interpretation of geological and Structural geological maps, Solving Dip and strike problems.

K.M. Gurappa, Structural geology Manual

B.S. Sathya Narayanaswamy Engineering Geology Laboratory Manual, Eurasia pub.

CV267 SOIL MECHANICS LAB (0-0-3) 2

Identification of soils, Index properties of soils, Soil permeability, Light compaction test, Coefficient of consolidation, Direct shear test, Unconfined comp. Test, Triaxial comp. Test and Vane shear test, CBR test.

T.W.Lambe, Soil Testing for Engineers, John Wiley and Sons, Inc, New York.

SP36 Part 1 and Part 2 (Latest editions).

CV268 ADVANCED MINING GEOLOGY (3-0-0) 3

Structural Geology ; Dip and Strike, study of folds, faults, Joints, unconformities, Economic Geology; Magmatic, Hydrothermal, Sedimentary, Metamorphic deposits, oxidation and supergene enrichment, study of Gold, Iron, copper, lead, Zinc Chromite, manganese, bauxite, mica, asbestos, magnetite, borytes deposits.

Exploration Geology ; Principles, Stage of mineral exploration, Geological, Geophysical, geochemical and remote sensing methods of exploration. Applied Geology; Sampling, guides for locating ore deposits, geological mapping, Hydrogeology.

Arogya Swamy, Courses in Mining Geology, Oxford & IBH, 1988

Bateman A.M., Economic mineral deposits, John Wiley & Sons

Billings, Structural Geology

CV300 STRUCTURAL ANALYSIS – II (3-0-0) 3

Analysis of statically indeterminate Structures, Moment distribution Method, Kani's Method, Matrix method: introduction to flexibility and stiffness methods, two hinged arches, influence lines for indeterminate beams and arches, analysis of multistorey frames by approximate methods, substitute frame, portal and cantilever methods, plastic analysis of simple beams and portal frames.

S.P. Timoshenko, Theory of structures

M.B. Kanchi, Matrix method of structural analysis

CV301 HIGHWAY AND TRAFFIC ENGINEERING (3-0-0) 3

Introduction: Initial recommendations for highway planning in India, saturation system, Third 20 year road development plan and fundamentals of transportation systems, planning on trip generation, distribution, assignment and modal split

Traffic Engineering: Vehicular and road user characteristics, traffic studies, junctions and signals, traffic control devices

Highway alignment and geometric design: Highway alignment, cross-sectional elements, horizontal alignment and vertical alignment *Highway design and construction:* design of flexible and rigid pavements, WBM and bituminous concrete roads and highway maintenance

S.K. Khanna and C.E.G. Justo, Highway Engineering, Nemchand Bros., Roorkee

L.R. Kadiyali, Traffic and Transport Planning, Khanna Publishers, New Delhi

CV316 BUILDING DESIGN AND DRAWING (1-0-3) 3

Foundations; Doors and Windows; Stairs - proportioning and designing of different types of staircases for residential and commercial buildings; Different types of roofs and trusses. Functional design of buildings: To draw the line diagram, plan elevation and section and line sketches of different types of buildings (school, hospital, hostel, residential, office etc.).

Introduction to AutoCAD.

Shah and Kale, Principles of Building Drawing

Sharma and Kaul, Text of building construction

B.C. Punmia, Building construction

CV321 APPLIED SOIL ENGINEERING (3-0-0) 3 PREREQ: CV 252

Soil exploration, Earth pressure and its determination, Bearing capacity - Theoretical methods and Insitu tests, Stability of slopes by various approaches, Load carrying capacity of single and group of piles. Ground improvement methods. Introduction to soil dynamics.

B.M. Das, Principles of Geotechnical Engineering, The PWS Series in Civil Engg.

V.N.S. Murthy, Soil Mechanics and Foundation Engineering, Dhanpat Rai & Sons, New Delhi.

CV322 CONCRETE TECHNOLOGY (3-0-0) 3

Concrete making materials - Manufacture of Cements, types of cements and aggregates, properties and testing, Water, admixtures. Fresh concrete, workability, Compaction, Curing. Strength of Concrete, elasticity, shrinkage and creep. Durability of Concrete. Testing of hardened concrete, destructive and non destructive testing methods, Concrete mix design, Quality Control and acceptance Criteria. Special Concretes, Concrete chemicals.

A.M. Neville, Properties of Concrete, The English Language Book Society and Pitman Publishing Co. London, U.K.

M.S. Shetty, Concrete Technology - Theory and Practice, S. Chand & Co. Ltd., New Delhi.

CV350 ENVIRONMENTAL ENGINEERING (3-0-0) 3

Essentials of water and wastewater engineering systems, quantities, sources, water distribution systems, planning and analysis. Wastewater collection. House drainage. Water and wastewater characteristics. Drinking water standards. Unit operations and processes of water and wastewater treatment. Design of treatment units.

Fair & Geyer, Water Supply and Waste water disposal, John Wiley Publications
B.C. Punmia & Ashok Jain, Water supply Engineering & Wastewater Engineering, Arihant Publications

CV351 DESIGN OF STEEL STRUCTURES (2-1-0) 3

General principles of elastic method of design of steel structures. Bolted and welded connections, Tension and compression members, laterally supported and unsupported beams, unsymmetrical bending, built up beams, plate girders, members subjected to axial force and uniaxial and biaxial moments. Introduction to the limit state design philosophy of steel structures.

A.S. Arya and J.L. Ajmani, Design of steel structures, Nem Chand Bros, Roorkee.
Ramachandra, Vol I & II, Design of steel structures, Standard Book House, New Delhi.
S.K. Duggal, Design of Steel Structures, Tata McGraw Hill, Publishing Co. Ltd., New Delhi.
Related IS Codes

CV366 ENVIRONMENTAL ENGINEERING LAB (0-0-3) 2

pH, colour, turbidity; Solids - suspended, dissolved, settleable and volatile; Dissolved oxygen, BOD, COD; Determination of fluorides and iron; hardness, chlorides; Nitrite-Nitrogen and Ammonical-nitrogen; Available chlorine in bleaching powder, residual chlorine in water and chlorine demand; Bacteriological quality of water-presumptive test, confirmation test and determination of MPN; Jar test

Kotaiah B. and Kumaraswamy N, "Environmental Engineering Laboratory Manual", Charitor Publishing House, India.
APHA, "Standard Methods for testing of water and wastewater, 21st edition, American Public Health Association, Washington, D. C.
BIS-10500: Indian Standards Code for Drinking Water
BIS-3025: Indian Standards Code for Testing of Water

CV367 HIGHWAY MATERIALS AND CONCRETE TESTING LAB (0-0-3) 2

Tests on highway materials, aggregates and bituminous materials. Tests on fresh concrete - workability tests, tests on hardened concrete, strength tests - destructive and non destructive testing, tests on R.C. beams and columns.

S.K. Khanna and C.E.G. Justo, Highway materials Testing - Nem Chand Bros, Rookee
V.V. Sastry andM.L. Gambir, Laboratory manual on concrete testing (Part II).

CV371 RAILWAYS, TUNNELS, HARBOURS AND AIRPORTS (3-0-0) 3

Railways: Rail gauges; coning; adzing; railway track components, functions, requirements, and width of formation; creep; tractive resistance; geometric design; points and crossings; stations and yards; signaling and interlocking.

Docks & Harbors: Types of harbors, tides, wind and waves, breakwaters, docks, quays, Transit sheds, warehouses, navigational aids

Tunnels: Introduction to tunneling, tunneling through soils, soft and hard rocks, tunnel ventilation

Airports: Introduction to airport planning and development, Airport design standards, airport planning

S.P. Arora & S.C. Saxena, A text Book of Railway Engineering
Srinivasan, Docks, Harbors and Tunnels.
S.K. Khanna, M.G. Arora and S.S. Jain, Airport Planning and Design

CV372 DESIGN OF P.S.C. STRUCTURES (3-0-0) 3 PREREQ: CV 251, CV 300

Materials- Pre and post tensioning methods-Losses of prestress-Stresses in concrete due to prestress and loads-Prediction of long term and short term deflections-Limit state of collapse in flexure and shear-Limit state of serviceability-Transmission length-Anchorage zone stresses-Design of endblock-Design of pre and

post tensioned beams-Analysis of continuous beams-Concordant cable profiles-Analysis of composite beams-Determination of stress distribution in a composite sections.

N. Krishna Raju, Prestressed concrete, Tata-McGraw Hill, NewDelhi.

T. Y. Lin and N. H. Burns, Design of prestressed concrete structures, John Wiley and Sons, NewYork.

CV373 PROBABILITY METHODS IN CIVIL ENGINEERING (3-0-0) 3

Role of probability in civil engineering problems; Definition of basic random events; Application of set theory in definition of composite event operations; Probability of events and definition of probability axioms; Random variables; Probability definitions; Moments and expectations; Functions of random variables; Common probability models; Statistics and sampling; Regression and correlation analyses; Estimation of distribution parameters from statistics; Hypothesis testing and significance; Bayesian updating of distributions; Uncertainty quantification; Probabilistic analysis; Methods of structural reliability; Applications to design of civil engineering systems.

A.H-S. Ang & W.H. Tang, Probability Concepts in Engineering: Emphasis on Applications to Civil and Environmental Engineering, Wiley, 2006

A. Haldar & S. Mahadevan, Probability, Reliability, and Statistical Methods in Engineering Design, Wiley, 1999

CV 380 MINI PROJECT (0-0-3)2

Experimental work either in the field or in the laboratory or design task of relatively smaller magnitude compared to Major project and in line with the guidelines formulated by the DUGC.

CV381 Mini Project II (0-0-3)2

CV385 GEOINFORMATICS (3-0-0) 3

Introduction to geinformatics : Principles of Remote sensing Satellites and Sensors, Aerial photography, elements of photo-grammetry, Satellite data products, Visual interpretation, Digital interpretations. Introduction to GIS principles, Generation of thematic maps, Georeferencing, Digitization, overlay analyses, Map projections : Global positioning system: Application of RS and GIS in mining; Geological mapping, geomorphological mapping, oil and mineral exploration,Ground water and surface water potential mapping, Natural hazard and disaster (Earthquakes,volcanic eruptions, Land slides, Avalanches, flood, drought etc.) Zone mapping, Forecasting, estimaton of losses and management, monitoring ocean productivity and coastal zone management, computer applications in mining.

Lillesand, Thomas and Kiefer, Remote Sensing and image interpretation, John Wiley and Sons.

Burrough and Mc Dennell, principles of Geographical information systems, Oxford University Press.

CV386 ROCK MECHANICS (3-0-0) 3

Introduction to rock mechanics, Engineering classification of rocks, Engineering properties of intact rocks, Determination of insitu properties - shear strength, deformation, insitu stress, strength of jointed rocks, application to rock slopes, rock blasting, ground improvement techniques in rocks and bearing capacity.

Jaegar and Cook, Foundation of rock masses.

Goodman, Introduction to rock mechanics, Wiley international

CV387 APPLIED GEOLOGY (3-0-0) 3 PREREQ: CV202

Introduction, interior of the earth, Geological process, Geological hazards, Natural resources; Minerals, rocks, water, soil; Engineering properties of rocks, Structural geology, stratigraphy, Hydrogeology; artificial recharge structures, rain water harvesting, ground water exploration, geophysical exploration, Remote sensing and GIS applications. Economic Geology, process of formation of mineral deposits, ore genesis, ore dressing, Indian mineral deposits, Environmental geology, Application of geology in Civil Engg. projects like Dams, tunnels, bridges etc.,

Blyth, F.G.H & De Freitas M.H., Engineering Geology, ELBS, 7th Edition, 1984.
Robert F. Legget, Geology and Engineering, Mcgraw Hill

CV388 ADVANCED SURVEYING (3-0-2) 4 PREREQ CV201

Introduction to tacheometric surveying, tacheometric levelling and errors in tacheometric levelling; Fundamentals of geodetic surveying; theory of errors and triangulation adjustments; Electronic distance measurement; Hydrographic surveying including three-point problems; photogrammetric surveying including aerial photogrammetry; fundamentals on the use of digital theodolites and total stations.

B.C. Punmia, Surveying Vol. 2 and 3
T.P. Kanetkar & Kulkarni, Surveying and leveling Vol. 2
S.K. Roy, Fundamentals of surveying
David Clark, Plane and geodetic surveying Vol.2

CV389 ADVANCED STRUCTURAL ANALYSIS (3-0-0) 3

Matrix method of structural analysis : flexibility and stiffness formulation - Direct stiffness method. Analysis of Beams of non-uniform cross section. Unsymmetrical bending of beams. Analysis of beams curved in plan. Introduction to analysis of shell roofs.

Genaro, Advanced Structural Analysis.
G.S. Ramaswamy, Design and Construction of shell roofs.

CV390 SEMINAR (0-0-2) 1

This course is a 1 credit course to be completed during 6th semester. The student will make presentations on topics of academic interest.

CV400 ESTIMATION, COSTING AND SPECIFICATIONS (3-0-0) 3

Methods of estimating, measurements, taking out quantities, typical estimates for buildings, and Civil Engineering works, Specifications for all types of building items. Analysis of rates, data for various building items, Earthwork calculations. Introduction to Departmental procedures, tender, contracts, arbitration, valuation of buildings.

B.N. Dutta, Estimating and Costing in Civil Engineering Theory and Practice.
M. Chakroborti, Estimating, Costing & Specifications in Civil Engineering.
S.C. Rangawala - Valuation of Real Properties, Charotar Publishing House.

CV401 BRIDGE ENGINEERING (3-0-0) 3 PREREQ: CV251

Bridge site investigation and planning, bridge hydrology, Standards of loading for highway and railway bridges, Culverts, bridge superstructures, Design of R.C.C. beam and slab bridges, load distribution methods, Bearings, Design of bridge substructures and foundations, Design principles of prestressed concrete, steel and composite bridges, Introduction to cable stayed and suspension bridges, flyovers, temporary and movable bridges, construction and maintenance of bridges and flyovers.

D.J. Victor, Essentials of Bridge Engineering, Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.
N. Krishna Raju, Design of Bridges, Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.

CV417 STRUCTURAL DESIGN AND DRAWING (1-0-3) 3 PREREQ: CV251, CV351

R.C. design- R.C. staircases, retaining walls - Cantilever and Counterfort type, Water tank- rectangular and circular tanks, underground and resting on ground. Framed structures.

Steel design - Connections : Column splices, column bases, beam - columns, Steel purlins and roof trusses, connection between roof truss and supporting column, bracing systems.

N. Krishna Raju, Structural Design and Drawing - R.C. and Steel, University Press, Hyderabad.
D. Krishna Murthy, Structural Design and Drawing, Vol II & III, C.B.S. Publishing Co., New Delhi.

CV421 TRANSPORTATION PROJECT PLANNING & EVALUATION (3-0-0) 3

Transport Projects Planning by various models, use of design traits, evaluation of transport project performance measures using econometric parameters. Assessing the project's environmental impact and programming transportation investments for optimal allocation of resources.

Kumares C. Sinha, Samuel Labi, Transportation Decision Making: Principles of Project Evaluation and Programming, John Wiley & Sons, 2007.

Transport Projects, Programmes, and Polices-Evaluation, Needs, and Capabilities, Edited by Alan Pearman, Peter Mackie, and John Nellthrop, Athenacum Press Ltd., Gateshead, 2003

CV422 ADVANCED DESIGN OF STRUCTURES – I (3-0-0) 3 PREREQ: CV251

Design of R.C. flat slabs, continuous beams and portal frames, redistribution of moments. Yield line analysis of slabs, Deep beams, Curved beams, Elevated water tanks and supporting structures, Chimneys, Silos and Bunkers.

N. Krishna Raju, Advanced Reinforced Concrete Design, C.B.S. Publishers and Distributors, Delhi.

P.C. Varghese, Advanced Reinforced Concrete Design, Prentice - Hall of India, Pvt. Ltd., New Delhi.

CV423 DESIGN OF FOUNDATIONS, EARTH AND EARTH RETAINING STRUCTURES (3-0-0) 3 PREREQ: CV252, CV321

Loads for foundation design, Depth of foundation, proportioning of footings, Geotechnical and structural design of isolated, combined and raft foundations. Analysis of pile groups. Design of piles and pile cap. Design of cantilever, counterfort and soil reinforced retaining walls.

Swami Saran, Design of Substructures, Oxford and IBH Publishers.

J.E. Bowles, Analysis & Design of Foundations, Mc Graw Hill.

Relevant IS Codes.

CV424 ADVANCED ENVIRONMENTAL ENGINEERING (3-0-0) 3 PREREQ: CV350

Water pollution control: Effluent standards. Disposal of wastewater. Stream sanitation. Water quality indices; Solid waste management: Characteristics, treatment disposal; Air Pollution Control: Sources and Characteristics, effects, Control; Noise Pollution Control, measurement & analysis; Hazardous solid waste: Classified wastes, Disposal of hospital wastes; EIA: Introduction, case studies

Metcalf & Eddy, Waste Water Engineering Treatment, Disposal & Reuse, Tata Mcgraw Hill Publishers

Sincero & Sincero, Environmental Engineering, Prentice Hall Inc.

CV425 COMPUTER AIDED DESIGN & APPLICATIONS IN CIVIL ENGINEERING (2-0-3) 4

Object oriented programming, Application programs to solve problems in structural analysis, surveying, soil mechanics, transportation engineering and numerical analysis. Design of structural elements and programming concepts. Programs for the design of beams, slabs and columns by Limit state theory.

E. Balaguruswamy, Object oriented programming in C++,Mc Graw Hill Publishers

V.L.Shah, Computer aided design in reinforced concrete, Structures publishers.

CV426 SOLID WASTE MANAGEMENT (3-0-0) 3

Characterization of Municipal wastes; Waste Collection, Disposal and Management-Laws and guidelines; Utilization of municipal wastes for bio-gasification and manure; landfill; Recent technological advances in composting and thermal gasification; utilization and management of nonhazardous and hazardous waste; Case studies.

George Tchobanoglous, Frank Kreith, Handbook of Solid Waste Management, McGraw-Hill, 2002.

CPHEEO Manual on Solid Waste Management, 2000.

Asian Productivity Organization Report on Solid-Waste Management: Issues and Challenges in Asia, Environmental Management Centre, 2005

Thomas H. Christensen, Solid Waste Technology & Management: Volume 1 & 2, A John Wiley& Sons, 2010

Michael D. LaGrega, Phillip L. Buckingham, Jeffrey C. Evans. Hazardous Waste Management, Waveland Press Inc., 2010

CV438 STRUCTURAL DYNAMICS AND WIND ENGG. (3-0-0) 3

Vibration of SDOF systems - Free and Forced vibrations, effect of damping, response spectrum, MDOF systems - Natural frequencies and modes, Eigen value problem, mode superposition method, Wind effects - Mean Wind speed, turbulence, spectrum of turbulence, Aerodynamic instabilities, Aerodynamic damping, Along - wind and Across - wind responses.

Cloush and Penzien, Dynamics of Structures, McGraw Hill, New York.
J.W. Simth, Vibration of Structures, Chapman and Hall Ltd., New York.
Scanlan and Sachi, Wind Engineering

CV440 PRACTICAL TRAINING / EDUCATIONAL TOUR 2

This course is a 2 credit course. A student may complete the training or educational tour before the beginning of 7th semester (or as stipulated by DUGC) and register for it in 7th Semester. The duration and the details shall be decided by the faculty advisor, with approval from DUGC.

CV471 ADVANCED DESIGN OF STRUCTURES – II (3-0-0) 3 PREREQ: CV251

R.C. domes and shell roofs, membrane and beam method of analysis, Multistoried building systems; Grid floors, Composite steel and in-situ concrete beams & slabs. Communication and transmission line steel towers.

P. Dayaratnam, Design of Reinforced concrete structures, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
P. Dayaratnam, Design of Steel Structures, A.H. Wheeler & Co. Ltd. Allahabad.
N. Krishna Raju, Advanced Reinforced concrete Design, C.B.S. Publishers and Distributors, New Delhi.

CV472 GROUND IMPROVEMENT TECHNIQUES (3-0-0) 3 PREREQ; CV252, CV321

Need and Objectives, Mechanical Modification-Compaction control, Vibro flotation, Hydraulic modification - Dewatering methods, Electro-Osmosis, Vertical drains, Physical and chemical modification - grouting, shortcreting, ground freezing. Modification by inclusions and Confinement. Stone columns, lime columns, Sand drains and Compaction piles.

M.R. Hausmann (1990) Engineering Principles of Ground Modifications, McGraw Hill Publishing Co.
Purushotham Raj, Ground Improvement Techniques, Laxmi Publications, New Delhi.

CV473 FEM APPLICATIONS IN CIVIL ENGG. (3-0-0) 3

Types of elements - Boundary value and initial value problems - Approximate methods - Principles and steps in Finite Element Analysis - Generalized and natural co-ordinates - Direct stiffness approach- Analysis of 2D Trusses, beams, and Plane frames. Introduction to continuum problems - Triangular elements for plane stress problems - Numerical Integration.

T.R. Chandrupatla & Ashok D. Belegundu , Introduction to Finite Elements in Engg. - Prentice Hall.
O. C. Zienkiewicz and K Morgan, Finite Elements & Approximation, John Wiley & Sons.

CV474 ELEMENTS OF EARTHQUAKE ENGINEERING (3-0-0) 3

Engineering seismology - Plate tectonics, Earthquake mechanism, Seismic zoning map of India, seismic waves, earthquake magnitude and intensity, seismic vulnerability, hazard and risk,

Introduction to the theory of vibrations - simple SDOF systems, response spectra, Performance of structures, Lessons from past earthquakes, causes of failure and damage

Aseismic design of structures - Philosophy & Principles of earthquake resistant design, building forms and architectural design concepts, Introduction to seismic codes, Calculation of equivalent static earthquake forces.

Restoration and retrofitting of existing structures.

A.K.Chopra, Dynamics of Structures, Prentice Hall, 2002 IITKanpur, Earthquake Tips, www.nicee.org

CV475 OIL AND NATURAL GAS EXPLORATION (3-0-0) 3

Geology of oil and Natural gas fields: Introduction to petroleum, Economic Importance, Geological factors, Reservoir Sedimentology and Sequence Stratigraphy of oil and natural, Structural Geology and Basin Development, oil and natural gas deposit distribution in India, Gas hydrated deposits in India and in the world.Exploration of oil and natural gas deposits: Remote Sensing, GIS, GPS, geological, geophysical and geochemical methods of exploration of oil and natural gas deposits.

Reservoir Engineering; Drilling and Production Engineering (drilling Methods of oil and natural gas wells, drilling technologies for deep water areas); Refining Engineering.

Safety and Environmental Engineering: Safety norms and regulations; environmental norms and regulations; safety auditing; environmental auditing; carbon credits; preparation of EIA reports; principles of developing green belt around petroleum installations to minimize carbon foot prints.

A. I. Levorsen, 1967, Geology of petroleum,

Reddy D V, 2010, Engineering Geology, Vikas Publishers.

Azar J J, Samuel G R, 2007, Drilling Engineering. Pennwell Corporatin.

Edwin S. Robinson and Cahit Coruh, 1988, Basic Exploration Geophysics, John Wiley and Sons.

CV476 DISASTER MANAGEMENT & MITIGATION (3-0-0) 3

Concepts of disaster; Types of disasters - natural and manmade: Cyclone, flood, land slide, land subsidence, fire and earthquake, tsunami, coastal erosion, river erosion, chemical spills, nuclear disasters, mine disasters etc.; Psychological and Social Dimensions in Disasters, Trauma and Stress. Techniques of monitoring and design against disasters; forecasting and early warning; communications & IT Tools; disaster risk reduction through prevention, preparedness, mitigation, response, recovery, rehabilitation and reconstruction.Management issues related to disaster, national Policy on disaster management, legislative responsibilities; mitigation through capacity building, disaster mapping, assessment, pre-disaster risk & vulnerability reduction, post disaster recovery & rehabilitation; Participation by voluntary Agencies & Community at various stages of disaster management; disaster related infrastructure development.

http://ndma.gov.in/ (Home page of National Disaster Management Authority).

http://www.ndmindia.nic.in/ (National Disaster Management in India, Ministry of Home Affairs).

Pradeep Sahni, 2004, Disaster Risk Reduction in South Asia, *Prentice Hall.*

Singh B.K., 2008, Handbook of Disaster Management*: techniques & Guidelines, Rajat Publication.*

Ghosh G.K., 2006, Disaster Management *,APH Publishing Corporation.*

CV477 SEISMORESISTANT CONCRETE STRUCTURES (3-0-0) 3

Introduction to dynamic response of structures- Dynamic equilibrium, SDOF and MDOF. Earthquake ground motion and response spectra- Characteristics of ground motion, earthquake response spectra. Seismoresistant architecture, IS 1893(Part1):2002 codal provisions, Simplified modal response spectrum analysis- Example problems. Earthquake resistant design of RC elements, Shear walls - Response of concrete and steel to monotonic cyclic loading, Codal provisions of IS 13920:1993. Design example of a multi-storey building. Seismic retrofitting strategies – considerations, classification, case studies. (IS 13935:1993) Base isolation- Isolation system components, Isolator design procedures.(Mini project on analysis and design of a multi storey building)

The Seismic Design Handbook., Farzad Naeim, International code council, Kluwar Academic publishers (USA), 2001

George. G. Penelis and Andreas J. Kappos, Earthquake resistant concrete structures, E & FN Spon Chapman, Hall London, 1997

Farzad Naeim and James M Kelley, Design of seismic isolated structures, John Wiley and sons Inc. 1999

IS codes: IS 1893(Part1):2002, IS 13920:1993, IS 13935:1993

A.K. Chopra, Dynamics of structures - Theory and applications to earthquake engineering, Pearson Education, 2001
Pankaj Agarwal, Manish Shrikhande Earthquake Resistant Design of Structures, Prentice- Hall India, 2006

CV485 AIR POLLUTION AND NOISE POLLUTION (3-0-0) 3

Natural and man made air pollution, sources, effects, control. Noise pollution - sources, measurement, mitigation.

Wark Kenneth and Warner C.F., Air Pollution its Origin and Control, Harper and Row, Publ.
Sincero A.P. and Sincero G.A. Environmental Engineering. Prentice Hall.

CV486 ENVIRONMENTAL IMPACT ASSESSMENT (3-0-0) 3

Introduction of EIA - Environmental impact Statement (EIS) and Environmental Impact Analysis (EIA) - Meaning and objective of EIA; Environmental Impact Prediction - Planning and Management of Impact Studies - ISO 14000 Series - Environmental monitoring and mitigation measures.

Canter, R.L., Environmental Impact Assessment, McGraw Hill Inc.,
John G. Rau and David C. Wooten (Ed)., Environmental Impact Analysis Handbook, McGraw Hill Book,1980.
Peter Wathern (Ed)., Environmental Impact Assessment, Theory and Practice, Unwin Hyman Ltd., London, 1988.
Munn, R.E., (Ed)., Environmental Impact Assessment, Principles and Procedures, Published on behalf of Scope, Unwin Brothers Ltd., Surrey, London, 1979.

CV487 CONSTRUCTION AND PROJECT MANAGEMENT (3-0-0) 3

Introduction: project forms, management objectives and functions; organizational chart of a construction company; manager's duties and responsibilities; public relations; Leadership and team - work; ethics, morale, delegation and accountability. Man and Machine: Man-power planning, training, recruitment, motivation, welfare measures and safety laws; machinery for Civil Engg., earth movers and hauling costs, factors affecting purchase, rent, and lease of equipment, and cost-benefit estimation. Planning, scheduling and Project Management: Planning stages, construction schedules project specification, monitoring and evaluation; Bar-chart, CPM, PERT, network- formulation and time computation.
Departmental Procedures: specifications, tendering, contracting and arbitration

Lionel Stebling, Project and Quality Management
P.P. Dharwadkar, Management in Construction Industry, Oxford IBH, New Delhi
J.O.Brien, Construction Management, Mcgraw Hill
J.M.Antill & R.W. Woodhead, Critical Path Methods in Construction, Wiley
B.C. Punmia & K.K.Khandelwal, Project Planning and control with PERT and CPM
PWD Codes A and D

CV 488 GROUND WATER DEVELOPMENT AND MANAGEMENT (3-0-0) 3

Hydrological cycle, Hydrological properties of rocks, Distribution of ground water, Ground water movement- Darcy's law, Flow nets. Aquifer parameters, Parameter estimation, pump test and recovery test-Thei's, Theim's, Jacob's equations. Ground water exploration-Geophysical techniques RS, GIS, GPS, Construction of wells, Springs. Ground water recharge, Rain Water harvesting, Water conservation techniques. Ground water quality, Ground water pollution, Environmental issues. Ground water buget, Ground water management. Ground water legislation

Todd D. K, Ground water hydrology, 3rd edition, Wiely, 2008.
Walton, W. C., Ground water resource evaluation. McGraw Hill, 1970.
Raghunath, H. M, Ground water, New Age International, 3rd edition, 1998.
Karanth, K. Groundwater Assessment and Management, Tata McGraw Hill, 2007.

CV 489 RETROFITTING AND REHABILITATION OF STRUCTURES (3-0-0) 3

Introduction, Causes of Deterioration, Deterioration process, Planning, Investigation and diagnosis, Assessment of distress structures, Assessment procedure for evaluation of structures and demolition procedures, Testing techniques, Interpretation of results, Repair and renovation techniques, Repair materials, Surface coatings, Protection, Seismic retrofitting.

Allen, R.T.L. and Edwards, S.C., 'The repair of concrete structures'
Key, T., 'Assessment and renovation of concrete structures'
Emmons, P.H., 'Concrete repair and maintenance illustrated'

CV490 SEMINAR (0-0-2) 1

This course is a 1 credit course to be completed during 7^{th} / 8^{th} semester. The student will make presentations on topics of academic interest.

CV 449 MAJOR PROJECT –I 2

CV 499 MAJOR PROJECT –II 6

Department of Mining Engineering

MN 201 DEVELOPMENT OF MINERAL DEPOSITS (3-1-0)4

Methods of shaft construction Widening and deepening of shafts. Special methods of shaft sinking under difficult conditions. Methods of raising. Drivage of horizontal openings. Tunneling under difficult conditions. Supports: supporting roadways and mine faces.

Deshmukh, D. J., Elements of Mining Engineering, Vol. I, Central Techno Publications, Nagpur, 1998.
Onika D. Design of Mine Excavations. Mir Publishers, Moscow, 1973.
Pokrovskiy. Driving of Horizontal Workings. Mir Publishers, Moscow, 1992.

MN 202 MINE SURVEYING (3-1-0)4

Principles of mine surveying and its scope. Plane and geodetic surveying. Compass surveying. Leveling. Theodolites: Construction and operation. Tests and adjustments. Angle measurement. Errors in measurement. Traversing. Balancing of traverse. Calculation of coordinates and plotting. Contouring, Interpolation of contours. Calculation of areas and volumes. Dip, fault and borehole problems.

Punmia,B. C. Surveying Vol- I & II, Laxmi Publishers, New Delhi, 2008.
Kanetkar,T.P. Suveying, Vol- I & II, Tata McGraw Hill, New Delhi, 2007.
Ghatak, S. Mine Surveying and Levelling – Vol I, II & III, Coal Field Publishers, Asansol, 2005.

MN 203 MINE SURVEYING LAB (0-0-3)2

A total of 10 to 12 experiments shall be carried out pertaining to the subject.

MN 204 MINING MACHINERY (3-1-0)4

Basic principles of transport of men, materials and mineral in underground mines. Techno-economic indices of transportation systems. Pit top and pit bottom lay outs. Motive power used in mines. Types of compressors used in mines. Wire ropes: construction, classification, application, inspection, maintenance and calculations. Capping and slicing of ropes. Suspension gear for drum and Koepe winding. Rope haulages: Types, principle of operation, suitability, safety appliances, calculations. Winding: Drum winding and Koepe winding, Braking systems – mechanical and electrical. Drainage and Pumping. Sumps.

Ramlu M.A. Mine Hoisting. Oxford & IBH. New Delhi 1996.
Walker S.C. Mine Winding and Transport. Elsevier, Amsterdam 1988.
Deshmukh D.J. Elements of Mining Technology Vol. III; Vidyasewa Prakashan, Nagpur, 1994

MN 210 DRILLING & BLASTING ENGINEERING (3-1-0)4

Applications of drilling in mining industry. Classification and mechanism of rock drilling methods. Different types of drill machines. Alignment and deviation of bore holes. Factors influencing drilling in percussive and rotary methods. Developments in explosives and initiating devices. Properties of explosives. Safety aspects. Exploders & Circuit testers.

Das, S. K., Explosives and Blasting Practices in Mines, Lovely Prakashan, Dhanbad, 2001.
Pradhan, G. K. & Sandhu, M. S., Blasting Safety Manual, 2002
Deshmukh D.J. Elements of Mining Technology Vol. I; Vidyasewa Prakashan, Nagpur, 1994
Chug, C. P. Manual of drilling Technology, Oxonian Press Pvt. Ltd., Delhi, 1985.

MN 211 SEABED MINING (3-0-0)3

Resources from the seabed, exploring and exploiting minerals from seabed, comparison of seabed mining with traditional in-land mining. Mining systems- hydraulic mining, continuous line bucket (CLB) mining, modular or shuttle mining systems. Alternative systems for deep sea mining, transport and processing. Ore

transfer technology. Environmental impact of seabed mining. Economics. Indian scene- phase wise development of seabed mining, vessels for conducting survey and research, possible ore reserves.

Hartman, H.L., Introductory Mining Engineering; Wiley Interscience, New York, 1987.
Manjula, R. Shyam, Metals from the seabed: Prospects for Mining Polymetallic Nodules of India. Oxford & IBH Publishing Co., New Delhi, 1982.

MN 251 MINE ENVIRONMENTAL ENGINEERING – I (3-1-0)4

Mine gases. Mine illumination. Heat and humidity. Cooling power of mine air. Air conditioning. Airflow in mines. Natural and mechanical ventilation. Ventilation networks. Computer aided design of ventilation systems.

Mishra, G.B. – Mine Environment and Ventilation; Oxford University Press, Delhi, 1986.
Vutukuri, V.S. & Lama, R.D. – Environmental Engineering in Mines; Cambridge University Press, Cambridge, 1986.

MN 252 MINE ENVIRONMENTAL ENGINEERING- I LAB (0-0-3)2

A total of 10 to 12 experiments shall be carried out pertaining to the subject.

MN 253 APPLIED MINE SURVEYING LAB (0-0-3)2

A total of 10 to 12 experiments shall be carried out pertaining to the subject.

MN 254 INDUSTRIAL TRAINING-1 (0-0-0)1

Industrial training should be taken up at the end of III semester, preferably in surface mines. Relevant information pertaining to the development and extraction of mineral deposits by surface mining methods, details of different equipments, layouts and other techno-economic data should be collected. Information regarding safety aspects, man-power, production and productivity, management practices and environmental protection measures should also be included in the report.

MN 260 ROCK EXCAVATION ENGINEERING (3-0-0)3

Rock excavation by different methods and different machines in mining and civil projects. Application of rock mechanics in selection of equipment. Excavation in sensitive areas. Equipments. TBMs. Project management. Arbitration. Practical examples in mining projects, ports, tunneling projects, pipeline excavations, canal excavation projects, hydel projects etc. Environmental planning, environmental impact assessment.

Stack, B., Mining and Tunneling Machine, 1978.
Martin, J. W., Martin T. J., Bennett, T. P. & Martin,K. M. Surface Mining Equipment, Martin Consultants Inc., USA, 1982.

MN 261 APPLIED MINE SURVEYING (3-0-0) 3

Triangulation: Station marks, signals and towers. Satellite station and reduction to center. Tacheometry: Tangential method and movable bar method. Curve ranging: Different methods of curve ranging. Laying of curves in underground. Theory of errors, Aerial photogrammetry, Field astronomy, Correlation survey: Connection of underground and surface survey. Total station.

Punmia,B. C. Surveying Vol- I & II, Laxmi Publishers, New Delhi, 2008.
Kanetkar, T.P. Suveying, Vol- I & II, Tata McGraw Hill, New Delhi, 2007.
Ghatak, S. Mine Surveying and Levelling – Vol I, II & III, Coal Field Publishers, Asansol, 2005.

MN262 ELECTRIC MACHINERY IN MINES (3-0-0)3

Magnetic circuits, three-phase circuit analysis, power transformers, transformer losses, tests on transformers, auto-transformers, electromechanical energy conversion principles, direct current motors and generators, poly-phase induction motors, synchronous motors and generators, electronic control of speed and torque of DC and AC motors.

Fitzgerald, A. E., Charles Kingsley Jr.& Umans, S. D., Electric Machinery, 6th Edition, McGraw Hill, 2002.

Gross, C. A., Electric Machines, 1st Edition, CRC Press, 2006.

MN 301 SURFACE MINING (3-1-0)4

Status and scope of surface mining. Elements of surface mining. Drilling and blasting operations. Details of principal production equipment. Layout of workings and waste dumps. In-pit crushing and conveying. Environmental management and reclamation in mines. Operational details of major surface mines with special reference to coal, lignite, iron, limestone etc. Selective mining. Hydraulic Mining. Techno-economic evaluation of surface mining projects.

S.K. Das, Surface Mining Technology, Lovely Prakashan, Dhanbad, 1984.

Misra, G.B., Surface Mining, Dhanbad Publishers, Dhanbad, 1994.

Deshmukh, D. J. Elements of Mining Technology, Vol. I, II & III, Central Techno Publishers, Dhanbad, 1988.

MN 302 MINE ENVIRONMENTAL ENGINEERING – II (4-0-0)4

Spontaneous combustion. Surface and underground fires. Fire extinguishers. Isolation/Explosion proof stopping. Reopening of sealed off areas. Mine explosions. Inundation. Approaching water logged areas and old workings. Water dams and design. Rescue organization. Examples of major disasters.

Ramlu, M.A. Mine Fires, Explosions, Rescue, Recovery & Inundations; Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi, 1991.

Rakesh & Lele, M.G. Inundation in Mines; Mrs. Asha Lata, Varanasi, 1970.

MN 303 UNDERGROUND COAL MINING (3-1-0)4

Status and scope of underground coal mining. Classification of coal reserves. Opening up of deposit. Horizon mining. Basic coal mining methods. Bord and pillar mining/ Room & pillar mining - development & depillaring. Longwall mining. Thick-seam extraction. Special methods. Hydraulic Mining. Underground gassification of coal.

Singh, R.D. Principles and Practices of Modern Coal Mining, 1997.

Singh, T.N. Underground Mining of Coal, Oxford & IBH, 1992.

MN 304 INDUSTRIAL TRAINING - II (0-0-0)1

Industrial Training – II should be taken up at the end of IV semester, preferably in underground coal mines. Relevant information pertaining to the development and extraction of coal by underground mining methods, details of different equipments working in the mines and their operational information, layouts and other techno-economic data, information regarding safety aspects, man-power, production and productivity, management practices and environmental protection measures should be included.

MN 310 NOISE POLLUTION AND CONTROL ENGINEERING (3-0-0)3

Sound behaviour: Causes of sound production. Low and high frequencies sound. Sound attenuation in air. Sound from vibrating plates: size and thickness. Sound production in air and flowing liquids. Reactive and dissipative mufflers. Sound from vibrating machines. Statutory provisions pertaining to noise. Noise measurement practice for individual noise sources. Noise measurement in community and industry. Noise prediction and modeling. Noise impact prediction and assessment. Noise abatement measures- sound absorption, acoustic barrier, vibration isolation, vibration damping, muffling and green belt- principles and

design considerations. Noise pollution and management in industries. Human vibration- Health effects and control measures.

Harris, C.M : Handbook of Noise Control, McGraw- Hill Book Company, 1979.
Albert Thumann & Richard K. Miller : Secrets of Noise Control, The Fairmont Press, Georgia, 1976.
Harsha Vardhan, Noise Spectrum based Maintenance Guidelines for HEMM, Lambert Academic Publishing, 2012.

MN 311 MINE MECHANIZATION (3-0-0)3

Locomotive haulage, Rolling stocks, Conveyors, Belt conveyor calculations, Safety devices for conveyors, Face machinery, Calculation of productivity of loading machines, Aerial ropeways, Aerial ropeway calculations, Equipment for hydraulic and pneumatic stowing, Roof bolting machines, Concepts of intrinsically safe and flame-proof equipment. Mine cables, Power distribution in underground and surface mines. Concepts of variable and thyristor drives, Remote control, monitoring and automation of mining processes.

Ramlu M.A. Mine Hoisting. Oxford & IBH. New Delhi 1996.
Walker S.C. Mine Winding and Transport. Elsevier, Amsterdam 1988.
Deshmukh D.J. Elements of Mining Technology Vol. III; Vidyasewa Prakashan, Nagpur, 1994.

MN 312 ROCK REINFORCEMENT ENGINEERING (3-0-0)3

Roof bolting. Cable bolting. Shotcreting. Cavability of rocks – effect on supports design. Longwall supports. Lining of tunnels and shafts. Yieldable arches and ring sets. Reinforcement of pillars. Stabilization of slopes. Roof convergence. Stope closure. Back filling, Mechanical behavior and monitoring of various supports. Capital investment for supports, cost control process.

Biron, C and Ariglu, E., Design of Supports in Mines, John Wiley & Sons, 1983.
Britton, S.G., Construction Engineering in Underground Coal Mines, SME, 1983.

MN313 MINE POWER SYSTEMS (3-0-0)3

Electric power in mining, three-phase circuit analysis, components of mine power systems, power flow calculations, control of reactive power flow, grounding systems, ground bed construction, per unit representation, symmetrical components, analysis of symmetrical and unsymmetrical faults on mine power systems, transients and over-voltages, protective equipment and relaying.

Morley, L.A., Mine Power Systems, US Bureau of Mines Information Circular 9258, 1990.
Stevenson, W.D., Grainger, J. J., Power System Analysis, 1st Edition, McGraw Hill, 1994.
Nasar, S. A., Trutt, F. C., Electric Power Systems, 1st Edition, CRC Press, 1998.

MN 314 MAINTENANCE AND RELIABILITY ENGINEERING (3-0-0)3

Maintenance of mining machinery, MIS for maintenance function. Maintenance planning and scheduling. Reliability, availability and maintainability. Concepts of deterministic R and statistical failure of components. Different equipment failure distributions. Estimation of reliability indices for new equipment. Reliability and availability of non-maintained and maintained systems. Systems with preventive and corrective maintenance. Reliability evaluation. Introduction to Markov chains and processes. FMECA (Failure Mode Effect & Criticality Analysis). Fault tree analysis. Application of reliability in engineering systems.

John Davidson (Ed). The Reliability of Mechanical Systems. I Mech E. London 1994.
John P. Bentley. An Introduction to reliability & Quality Engineering. Longman Scientific & Technical, England, 1993.

MN 315 FINANCIAL ENGINEERING (3-0-0) 3

Scope and importance of Financial Engineering, Introduction to Financial Markets and investment instruments. Rate of return on Fixed Income Securities and Shares: Valuation of bonds and bond rating. Valuation models for equity shares. Investment decisions and risks. Asset Pricing Models, Basics of Fundamental and Technical Analysis. Derivative instruments – futures, options and hedging. Theories of Portfolio Management.

Salih N.Neftei and Fam. Principles of Financial Engineering. Elsevier Academic Press, London, 2006.

Yuh-Dauh Lyuu. Financial Engineering and Computation: Principles, Mathematics, Algorithms, Cambridge University Press: Cambridge. 2004.

Paul Wilmott. Paul Wilmott Introduces Quantitative Finance. 2nd Ed., John Wiley & Sons: West Sussex., 2004.

Prasanna Chandr. Investment Analysis and Portfolio Management, 2nd Ed., Tata-McGraw Hill Publishing Co., New Delhi, 2001.

Fisher D.E., and Jordon, R.J). Security Analysis and Portfolio Management. 6th Ed., Prentice Hall of India, New Delhi, 2001.

MN 351 UNDERGROUND METAL MINING (3-1-0)4

Development and opening up of underground deposits. Choice and suitability of entries. Draw points and ore passes. Different methods of stoping. Problems encountered in deep mines and measures to tackle them. Introduction to solution mining and in-situ leaching. Case studies from Indian Mines.

Hartman, H.L. Introductory Mining Engineering. John Wiley & Sons, 1987.

Hustrulid, W.A., SME Handbook on Metalliferous Mining, 1985.

MN 352 ROCK MECHANICS (3-1-0)4

Definition, Analysis of stresses and strains. Differential equations in elastic theory, Mohr's representation of stress and strain. Stress – strain relations in elastic and non-elastic media. Behaviour of rock under stress. Physical properties of rocks, Determination of rock indices, Physico-mechanical properties of rocks, Elastic constants under static and dynamic loading. Determination of in-situ strength properties of rocks, Engineering classification of rock mass, Rock fracture mechanics.

Obert, L. & Duvall, W.I.- Rock Mechanics and design of structures in rock; John Wiley & Sons, New York, 1967.

Wittke, W., Rock Mechanics, Springer-Verlag, Berlin, 1990.

MN 353 ROCK MECHANICS LAB (0-0-3)2

A total of 10 to 12 experiments shall be carried out pertaining to the subject.

MN 354 MINE SYSTEMS ENGINEERING (3-1-0)4

Introduction to systems concept, analysis and systems engineering. Models in system analysis. Basic concepts of statistical decision theory, Network techniques for mining projects. CPM and PERT techniques. Linear programming. Integer programming. Dynamic programming. Transportation and assignment models. Inventory control. Queuing theory. Simulation techniques for equipment selection and production scheduling. Significance of management information systems in controlling and managing the mining activities.

Sharma J.K. Mathematical Models in Operations Research. Tata Mcgraw-Hill, New Delhi, 1989.

Cummins . Mining Engineers Handbook, Vol. II SME, AIME, New York, 1979.

MN 355 MINE CAMP (0-0-0)1

Mine camp to be held at the end of V semester. Relevant information pertaining to the development and extraction by mining methods, details of different equipments working in the mines and their operational information, layouts and other techno-economic data, information regarding safety aspects, man-power,

production and productivity, management practices and environmental protection measures should be included in the report.

MN 360 ADVANCED UNDERGROUND COAL MINING (3-0-0)3 PREREQ *Exposure to* MN303

Planning considerations for inclines and shafts, considerations for their location and construction. Design of shaft pillar. Bord & pillar mining -design of panel, barrier pillar. Development of district by continuous miners. Depillaring. Extraction of pillars in thick and steep seams with caving and stowing. Planning of longwall panel. Caving characteristics of roof rocks. Thick seam mining- Soutirage method, Komaro method, Wangavalli method, Shield Mining.

Singh, T.N., Thick seam Mining, Oxford & IBH, 1992.

Vorbjev & Deshmukh, Advanced Coal Mining, Tata McGill, 1988.

Mathur, S.P., Advanced Coal Mining, M.S. Enterprises Bilaspur, 1999.

MN 361 ADVANCED SURFACE MINING TECHNOLOGY (3-0-0)3 PREREQ *Exposure to* MN301

Classification of surface mining equipment systems vis-à-vis unit operations. Equipment selection criteria and procedures, application and selection. Types, basic operations, maintenance and capacity utilization, applicability and selection considerations. Computations for the capacity and number of machines vis-à-vis mine production.

Amithosh Dey, Latest Development of Heavy Earth Moving Machinery, Annapurna Publishers, Dhanbad, 1995.

Martin, J. W., Martin T. J., Bennett, T. P. & Martin,K. M. Surface Mining Equipment, Martin Consultants Inc., USA, 1982.

MN 362 PRODUCTION DRILLING FOR OIL WELLS (3-0-0)3

Geography of petroleum and natural gas. Characterisation of crude and natural gas deposits. Well logging. Interpretation and use of information in petroleum and natural gas engineering. Drilling technology for mining of crude and gas. Well completion and stimulation.

Chugh, C.P., Drilling Technology Handbook, Oxford & IBH Pub. Co, 1988.

Hartman, H.L., Introductory Mining Engineering; Wiley Interscience, New York, 1987.

Manjula, R. Shyam, Metals from the seabed: Prospects for Mining Polymetallic Nodules of India. Oxford & IBH Publishing Co., New Delhi, 1982.

MN 363 TUNNELLING ENGINEERING (3-0-0)3

Design principles of underground openings. Dimensions, shape, structural behavior and sequence of excavations. Rock conditions and initial state of stresses. Computer aided tunnel design. Tunnel driving techniques. Tunnel supports, automation of supports, Shield tunneling system with road headers. Field instrumentation, Convergence measurement, change in curvature and strain of tunnel lining, stress measurement in tunnel lining. Tunnel stability analysis, Back analysis, Case Histories.

Bieniawski, Z.T., Rock Mechanics and Design in Mining and Tunnelling, Rotterdam : A.A. Balkema, 1984.

Pokorovski, Driving Horizontal Workings and Tunnel, Mir Publishers, 1980

MN 401 MINERAL PROCESSING (4-0-0)4

Scope and objective of mineral processing. Ore handling and storage. Ore sorting, Sampling techniques and devices. Liberation and communition, Laboratory and industrial sizing. Concentration methods. Magnetic and high tension separation. Forth flotation. Classifiers. Coal quality. Coal preparation for coarse and fine coal. Washability curves and washability number. Dewatering devices. Drying and tailings disposal.

Wills, B.A., Mineral Processing Technology ; Pergamon Press – 4th Edition , 1989.

Weiss, N.L. , Mineral processing Handbook – Vol. I & II, S.M.E., 1985

MN402 MINERAL PROCESSING LAB (0-0-3)2

A total of 10 to 12 experiments shall be carried out pertaining to the subject

MN 403 INDUSTRIAL TRAINING - III (0-0-0)1

A detailed report of the industrial training undergone at the end of VI semester, preferably in underground metal mines, should be submitted. The report should consist of all details about opening up of the deposit, development and stoping techniques, specifications and operational details of equipment working in the mine, ventilation scheme, power distribution, safety aspects, management practices and environment protection measures and the relevant lay outs. Current techno-economic indices should be a part of the report.

MN 410 ROCK FRAGMENTATION ENGINEERING (3-0-0)3

Drillability indices. Specific energy. Drilling costs. Determination of drill availability and utilization. Bulk explosive systems. Substitutes for explosives. Blast design. Mechanisms of rock fragmentation due to blasting. Fragmentation prediction and assessment. Theory of shaped charges. Recent advances in blasting techniques in both underground and surface mines. Special techniques of blasting. Underwater blasting. Environmental effects and their control. Controlled blasting techniques. Economic evaluation of blasting operations.

Konya, C.G. Blast design, CRC Press, London, 1989.

Persson, Rock fragmentation. International development Corporation, Sweden, 1986.

MN 411 STRATA MECHANICS (3-1-0)4

Definition and concepts of ground control in mines; State of stress in underground openings- premining and induced stresses, influence of water, time, temperature on stress behaviour. Design of structure in rock, Design of pillars, Underground supports: Conventional and powered supports. Rock reinforcement design. Subsidence- Concept, prediction and determination, measurement techniques, subsidence damage and its prevention. Rock bursts and bumps – mechanisms, prediction and estimation of damage.

Obert L. and Duvall W.I. – Rock Mechanics and The Design of Structures In Rocks; John Wiley & Sons, New York, 1967.

Peng, S.S. Coal Mine Ground Control ; John Wiley & Sons, New York, 1978.

Biron C. and Arioglue E- Design of Supports in Mines; John Wiley & Sons, New York, 1983.

MN 412 MINE HEALTH AND SAFETY ENGINEERING (3-0-0)3

Mine accidents. Planning for safety. Safety analysis. Safety prevention. Information system and safety audits. Hazard Control - engineering approach, systems approach. Hazard analysis. Safety management. Economics of safety and cost-effectiveness. Occupational hazards in mines- occupational hygiene, occupational diseases.

Ridley, J & Channing, J.; Safety at Work; Butterworth-Heinemaan, Oxford, 2001.

Rodgers, W.P.; Introduction to System Safety Engineering; John Wiley & Sons Inc., New York, 1971.

Green, A.R.; Safety in Mines Research; A.A. Balkena; Rotterdam; 1985.

MN 413 ROCK SLOPE ENGINEERING (3-0-0)3

Mechanisms of slope failures. Field investigations. Design of slopes - physical, empirical, probabilistic methods, analytical (limit equilibrium analysis) and numerical (continuum models, discontinuum and crack propagation models) modeling. Stabilization and reinforcement of slopes. Slope failure monitoring.

Hoek, E. and Bray, J.W; Rock Slope Engineering; John Wiley & Sons; New York; 1984

Brawner, C.O; Stability in surface mining, SME of USA; New York, 1982.

Giani, F; Rock Slope Stability Analysis; Balkema; Rotterdam; 1992.

MN 414 NUMERICAL MODELLING TECHNIQUES (3-0-0)3

Development and use of numerical modeling for underground mine design. Finite element (2D and 3D). Boundary element (2D and 3D). Displacement and continuity. Rigid block. Discrete block models. Basic equations for mathematical modeling of rock mass. Formulation of static and dynamic behavior of rock mass. Elastic-linear and non-linear, elastoplastic and time dependent rheological models. Numerical modeling of mine roadways. Convergence prediction for roadways.

Kidybinski A. & Kwasniewski M. (Eds); Modelling of Mine Structures, A.A. Balkema, Rotterdam, 1988.
Kidybinski A. & Dubinski J. (Eds); Strata Control in Deep Mines, A.A. Balkema, Rotterdam, 1990.

MN 415 INDUSTRIAL ENGINEERING & MANAGEMENT (3-0-0)3

Concepts of Management and Organisation, Functions of Management, Organisational Structures, Basic concepts related to Organisation Departmentation, Motivation, Leadership, Group dynamics, Conflict management, Work study, Time study, Job Evaluation, Project management, Network techniques, Human Resource Management.

Khanna, O.P., Rai, D. Industrial Engineering and Management, 2005.
Stoner, Freeman, Gilbert, Management, 6th Ed, Pearson Education, New Delhi, 2005.
Ralph M Barnes, Motion and Time Studies, John Wiley and Sons, 2004.
Chase, Jacobs, Aquilano, Operations Management, TMH 10th Edition, 2003.

MN 449 PROGRAMME MAJOR PROJECT- I (0-0-6)3

A small project of relevance to mining will be taken up by the student

MN451 MINE LEGISLATION (4-0-0)4

Important statuary provisions related to Payment of Wages Act, Provident Fund Act, Mines Act- 1952, Mines Rules- 1956, Coal Mines Regulations-1957, Metalliferrous Mines Regulations-1961, Mines and Minerals (Regulation and Development) Act, Mineral Conservation and Development Rules, Mineral Concession Rules, Mines Rescue Rules-1984, Vocational Training Rules-1966, Indian Electricity Rules-1956.

Rakesh and Prasad, Legislation in Indian Mines – A critical appraisal, Ashalata Pub., Varanasi, 1986.
Singh, C.P. Occupational Safety and Health in Industries and Mines, Tata McGill, 2004.

MN 452 PRACTICAL TRAINING (0-0-0)2

Comprehensive report about the short visits made to different mines and other industries will be submitted at the end of VIII Semester

MN 460 COAL WASHING AND HANDLING (3-0-0)3

Coking and non-coking coal. Coal washeries, sink and float tests on coal, washability index, optimum degree of washability and washability number, application of jigs, heavy media cyclone, Coal cleaning techniques for fine coal and coarse coal, coal flotation, beneficiation of non-coking coal, automation and quality control in preparation plants. Environmental management in coal preparation. Coal gasification, liquefaction and new products from coal. homogenization and blending systems.

Weiss, N.L., Mineral Processing Handbook- Volume-II, Published by SME, 1985.
Krishnamoorthy, K.K., Modern Ore Testing, Khanna Publishers, Delhi, 1983.

MN 461 PLANNING OF SURFACE MINING PROJECTS (3-0-0)3 PREREQ *Exposure to* MN301

Preliminary investigations. Stages of planning. Feasibility Report. Planning inputs. Monitoring of projects. Estimation of mine life. Openpit slope angles. Ultimate pit limit. Interrelation and planning of unit operations. Transport and dumping subsystems. Ore Blending. Equipment selection. Design of haul roads. Extraction methods for beach sand deposits, mining of developed coal seams, selective mining, Estimation of profitability, productivity and quality control.

Rzhevsky, V.V. Opencast Mining Unit Operations, Mir Publisher, 1983.

Rshensky V.V. Opencast Mining Technology and Integrated Mechanisations, Mir Publishers, 1985.

MN 462 PLANNING OF UNDERGROUND COAL MINING PROJECTS

(3-0-0)3 PREREQ *Exposure to* MN303

Objectives and Stages of Planning. Project report. Determination of mine parameters. Planning of exploitation by Bord and Pillar and Longwall Mining. Selection of face and underground transport equipment. Exploitation of thick coal seams. Planning and design layouts for ventilation, drainage and power supply. Ventilation management. Productivity and quality control; Planning of deep underground coal mines; Automation in underground coal mines.

Peng, S.S. Longwall Mining , Department of Mining Engineering, West Virginia University, 2006
Mathr, S.P. Coal Mining, M.S. Enterprises Bilaspur, 1999.

MN 463 PLANNING OF UNDERGROUND METAL MINING PROJECTS

(3-0-0)3 PREREQ *Exposure to* MN351

Planning and scheduling of insets, shaft bottoms, winding and transportation systems. Surface lay outs including mill and concentrator plants. Determination of number and dimensions of stopes. Planning and scheduling of a cycle of operations. Concept of ore blending. Overall planning and scheduling of activities in metal mining and processing. Case studies of planning of mining operations.

Agoshkov M., et. Al., Mining of Ores and Non- Metallic Minerals, Mir Publishers, Moscow, 1983.
Hartman, H.L. Introductory Mining Engineering, John Willey & Sons, 2007.

MN464 COMPUTER APPLICATIONS IN MINING (3-0-0)3

Development of algorithm and flow charts related to mining projects. Computer applications in ore reserve estimation, pit limits determination, equipments selection, blast design, ventilation planning, Computer aided production planning and scheduling for surface mines.

Ram, R. V. et. al. Computers in Mineral Industry, Oxford & IBH, 1994
Husterilid, Open Pit Mine Planning and Design, Bulkema, 1995.

MN465 ENVIRONMENTAL MANAGEMENT AND SUSTAINABLE DEVELOPMENT (3-0-0)3

Environmental problems due to mining. Land degradation. Pollution due to mining in terms of air and water. Acid Mine Drainage, Socio-economic impacts. Control measures. Pollution due to noise and vibrations. Reclamation of mined out and subsided areas. Mine closure. Environmental policies. Environmental Management Plan. Environmental Impact Assessment. Risk Analysis. Disaster management plan. Preparation of EMP for various mineral industries. Cost of environmental management. Environmental audit.

Dhar, B.B., Environmental Management of Mining Operations, Ashish Publication House, New Delhi, 1991.
Chadwick et al., Environmental Impacts of Coal Mmining and Utilization, Pergamon Press,1992.

MN 466 MINE ECONOMICS (3-0-0)3

National mineral resources. National mineral policy and strategies for development of mining industry. Resource conservation. Technology import, taxation, royalty and subsidies. Mineral trade. Concept of derivatives in mineral trade. Pricing mechanism of minerals. Sampling. Estimation of reserves. Valuation of mines and mineral properties, Life of a mining project. Project evaluation. Determination of optimum size of mine. Risk analysis in mineral investment decisions.

Alwyn E. Annels, Mineral Deposit Evaluation: A Practical Approach, Chapman Hall, 1991.
Deshmukh R.T. Mine and Mineral Economics, Emdee Publishers, 1986.

MN 467 TECHNOLOGY MANAGEMENT (3-0-0)3

Role and importance of technology management. Status of technological advances; Technology life cycle; Diffusion and growth of technology. Process technology development. Manufacturing practices.

Technology development and acquisition; Models of technology transfer; Technology support systems: Financing, Venture capital; Criteria for evaluating R&D projects; Information systems; Organizing for technology at enterprise level. Management of technological innovations. Team approach. Organizational culture; Managerial style and practices supportive of creativity; Role of managerial leadership; Building a learning organization.

Rastogi, P.N. Management of Technology and Innovation: Competing Through Technological Excellence, Sage Publications, New Delhi, 1999.

Drucker Peter, F. Managing for the Future: The 1990s and Beyond, Tata McGraw Hill, New Delhi, 1992.

MN 468 KNOWLEDGE MANAGEMENT (3-0-0)3

Concepts, definitions and taxonomy of knowledge; value of knowledge in an organization. Managing knowledge in organization: need, drivers(knowledge- based, technology- based; process-based and people centric); Approaches for managing knowledge in organizations, Developing a KM frame work; KM system components and implementation strategies; KM models(Boynton and Nonaka);Knowledge Mapping; Knowledge Architecture; Related applications: Competitive intelligence, Environment scanning, knowledge/ information Audit, KM metrics and techniques for measuring knowledge; costs and benefits of KM programs in organizations. Role of knowledge Managers in an organization; case studies of KM in: sevice firms, core industry, IT firms and others

Sudhir Warier E; Knowledge Management, vikas Publishing Hourse Pvt.Ltd., New Delhi,2003

Archana Shukla and R. Srinivasan, Designing Knowledge Management Architecture: How to implement successful knowledge Management Programms, Response books, New Delhi, 2002

Awad E. M Hassan M. Ghaziri, Knowledge Management, Pearson Eduction India, New Delhi, 2004

Davenport, Thomas and Lourence Prusak, How corporations Manage What they know, Boston: Harvard Business School Press, 2002.

MN490 SEMINAR (0-0-2)1

A topic of relevance to the mining industry to be chosen and the seminar be delivered with audio – visual aids. A write up of the same should also be submitted.

MN 499 MAJOR PROJECT- II (0-0-9)5

The student will work on a topic of relevance to mining in depth and shall submit a report of the same at the end of the semester.

Department of Computer Science & Engineering

CO110 COMPUTER PROGRAMMING (3-1-0) 4

Concepts, definitions, taxonomy and history of Computer Programming, Operating systems and Program Execution basics. Problem solving and programming: strategies, programming paradigms, software development lifecycle. C programming language: C fundamentals, operators and expressions, Data input and output, Control statements, Functions, Arrays, Pointers, Dynamic memory allocations, Structure and unions, Files, Low- level Programming and Macros, Introduction to Cyber Security/Information Security.

Brian W. Kernighan & Dennis M. Ritchie, The C Programming Language, Second edition, PHI.
Byron S. Gottfried, Program with C, second edition, Schaums Outline series.
Yashavanth Kanetkar, Let us C – BPB Publications. 2002

CO111 COMPUTER PROGRAMMING LAB (0-0-2) 1

Introduction to fundamentals of DOS and Windows, C Programming exercise on simple statements, Control structures, Arrays, Matrices, Strings, Functions and Recursions, Structures and Unions, Bit Operations, Pointers, Dynamic Memory allocation, Files and Macros.

Brian W. Kernighan & Dennis M. Ritchie, The C Programming Language, Second edition, PHI.
Byron S. Gottfried, Program with C, second edition, Schaums Outline series.
Yashavant Kanetkar, Let us C- - BPB Publications.2002

CO200 COMPUTER ORGANIZATION AND ARCHITECTURE (3-1-0) 4

Logical organization of computers; Processor basics, CPU organization, Data Representation, Instruction Sets, Data path design, Fixed Point arithmetic, ALU design, Control design: Basic concepts, Micro programmed Control & hardwired; Introduction to parallel processing: Principles of pipeline and vector processing. Multiprocessor architectures and programming.

J.P.Hayes Computer Architecture and organization III Edition, McGraw Hill, 1998.
Hwang and Briggs, Computer Architecture and parallel processing, McGraw Hill, 1985.
David A. Patterson & John L. Hennessy, Computer Organization and design, Morgan Kaufmann Publ.,3rd edition.

CO201 THEORY OF COMPUTATION (3-1-0) 4

Formal Languages and Automata Theory: Generative grammar, Chomsky hierarchy, Finite state Automata: Definition, Concept of Non-determinism, Equivalence of deterministic and Nondeterministic Automata; Relation between CFL and Type3 grammars; Pumping Lemma for CFL; Closure properties. Push down Automata: Definition, Equivalence between NPDA and context free grammars, Pumping Lemma for C.F.L's, Decision problems, Closure properties. Turing machines: Definition, extension to Turing machines: Multi-track, Multi-tape, and Non determinism. TM as an acceptor, TM as a computing device; Relation between TM and type-0-grammars. Universal Turing Machine, Concept of computability, Undecidable problems. Recursive function theory: Primitive recursive functions, general recursive function, relation between general recursive functions and Turing machines, Church's thesis, P, NP, NP-Hard & NP- Complete problems.

J.E.Hopcroft and J.D.Ullman, Introduction to automata, Languages and computation, Addison Wesley.
H.E.Lewis and C.H. Papadimitiou, Elements of the Theory of Computation, Prentice-Hall of India, 1981.
Derickwood, Theory of Computation, John Wiley & Sons.

CO202 DESIGN OF DIGITAL SYSTEMS (3-1-0) 4

Switching algebra and logic circuits; combinational and sequential circuits and their algorithmic synthesis; Computer aided synthesis and optimization (introduction); Hardware modeling using VHDL; Logic optimization: two level, multi level, circuits; Introduction to VLSI design: MOS devices, system level design; Introduction to VLSI testing: fault models, testing combination and sequential circuits.

Alan B.Marcovitz, Intro. To Logic Design, TMH, 2002.
Giovanni De Micheli, Synthesis and Optimization of Digital circuits, 2000
Zvi Kolavi, Switching and finite automata theory, Tata McGraw Hil 2000

CO203 DATA STRUCTURES AND ALGORITHMS (3-1-0) 4

Algorithm analysis and design techniques. Basic data structures –Stack, Queue and List –their sequential and linked representations, variations, operations with algorithms on these; Trees and graphs and sets - variations, operations and representation methods. Algorithms for Searching & Sorting. Data structures and algorithms for external storage.

Alfred V Aho, John E Hoperoft, Jeffrey D. Ullman. Data structures and Algorithms- Addison Wesley.2003
Horowitz and Sahni , Data Structures and Algorithms using C/C++, 2003
Mark Allen Weiss, Algorithms Data structures and problem solving with C++, Addison Wesley

CO204 DESIGN OF DIGITAL SYSTEMS LAB (0-0-3) 2

Design of basic gates, adders, subtractors, encoders, decoders, shifters: up, down, up-down, counters, flip flops, code conversion, multiplexers (All using behavioral modeling). Introduction to structural modeling: Adders, subtractors, multiplexors, counters, multiplier (array multiplier), Design of FSM: Moore machine, Melay machine.

J. Bhasker, VHDL primer, 3rd edition, Addison Wesley Longmen Singapore Pvt. Ltd.
Douglas Perry, VHDL by McGraw Hill International, 1998.
Peter Ashenden, The Designer Guide to VHDL by 1998

CO205 DATA STRUCTURES AND ALGORITHMS LAB (0-0-3) 2

Implementation of array operations: Stacks, Queues, Circular Queues, Multiple stacks and queues. Implementation of linked lists: stacks, queues, polynomial operations. Doubly linked lists. Tree traversal: AVL tree implementation, application of trees. Hash Table. Searching and sorting.

Alfred V Aho, John E Hoperoft, Jeffrey D. Ullman. Data structures and Algorithms- Addison Wesley.2003
Horowitz and Sahni , Data Structures and Algorithms using C/C++, 2003
Mark Allen Weiss, Algorithms Data structures and problem solving with C++, Addison Wesley

CO250 DATA COMMUNICATION (3-1-0) 4

Evolution of Data Communication and Networks; Transmission fundamentals: Signals, media, encoding and modulation, multiplexing, devices, error detection and correction, Data link control and protocols, data transmission over networks - switching techniques and LAN.

William Stallings, Data and Computer Communications and Networking, 2nd Edition, TMH, 2002.
Behrouz A Forouzan, Data Communications and Networking, 2nd edition, TMH, 2002
Leon, Garcia and Widjaja - Communication Networks, TMH 2002.

CO251 SOFTWARE ENGINEERING (3-1-0) 4

Introduction to software engineering, Software development life cycle & various models, requirements engineering, software specification, software metrics, software design, Object Oriented software engineering, Software testing & various testing mechanisms, Software verification and validation, Verifying performances, Verifying reliability, Software cost estimation models, Software development tools including CASE Tools, Software Project management.

R.S. Pressman, Software Engineering, McGrawHill, 2002

Pankaj Jalote, An Integrated Approach to software Engineering, Narosa Pub., 2002

CO252 OPERATING SYSTEMS (3-1-0) 4

Introduction to O.S, File Systems, CPU scheduling, Memory management, Disk Scheduling algorithms, virtual memory concept, Deadlocks, Concurrent processes, Performance Evaluation, Operating system Security, Case Studies - The UNIX operating system

Silberschartz, Galvi & Gange, Operating System Concepts, 9th Edition, john Wiley & Sons, 2013.
Melin Milenkovic, Operating Systems: Concepts and Design, McGraw Hill, New York, 2000.
Sumitaba Das, Unix concept and applications

CO253 DESIGN AND ANALYSIS OF ALGORITHMS (3-1-0) 4

Models of computation, various performance measures, General techniques of algorithm design, Analysis of different algorithms for sorting and selection, Data structures for efficient manipulation of sets and partition, Efficient Graph algorithms based on Depth first search, Strassen's matrix multiplication algorithm, Efficient algorithms for matrix inversion and LUP decomposition, Modular arithmetic, NP-complete problems and approximation algorithms.

Aho, Hopcroft and Ullman the design and analysis of Computer Algorithms, Addison Weseley.
Horowitz and Sahni, Fundamentals of Computer Algorithms, Galgotia Publications, 2000.
Knuth D.E., The Art of Computer Programming, Vol. I: Fundamental Algorithms, Addison Wesley.2000

CO254 OPERATING SYSTEMS LAB (0-0-3) 2

Linux and/or other OS based exercises to practice/simulate: scheduling, memory management algorithms; concurrent programming; use of threads and processes; kernel reconfiguration, device drivers and systems administration of different operating systems, Writing utilities and OS performance tuning

Silberschartz, Galvi & Gange, Operating System Concepts, 9th Edition, john Wiley & Sons, 2013.
Melin Milenkovic, Operating Systems: Concepts and Design, McGraw Hill, New York, 2000.
Sumitaba Das, Unix concept and applications

CO255 SOFTWARE ENGINEERING LAB (0-0-3) 2

Mini project to be designed to give exposure to the latest developments in Software Engineering and to understand the use of Project Management skills; use of CASE tools.

R.S. Pressman, Software Engineering, McGrawHill, 2002
Pankaj Jalote, An Integrated Approach to software Engineering, Narosa Pub., 2002

CO260 PRINCIPLES OF PROGRAMMING LANGUAGE (3-0-0) 3

Imperative Programming Paradigm: Syntax, Semanaties, and Pragmatics. Basic Constructs, Data abstraction. Procedural abstraction: Names, bindings, scope, parameter passing methods, interface. Functional Programming Languages: implementation, case study. Logic Programming Languages: implementation, case study.

Ravi Sethi. Programming Languages: Concepts and Constructs. Addison Wesley 1996.
Benjamin C Pierce. Types and Programming Languages, MIT Press, 2002
Michael L Scott ,Programming Language Pragmatics. Elsevier. 2004.

CO261 INFORMATION SYSTEMS (3-0-0) 3

Information System Design and Development - phases; System analysis methods - Data, Process, Network and Object modeling; System design approaches / methods - architectures and processes, input and output, prototyping; system implementation, safety & security, maintenance.

Jeffrey.L.Whitten, Lonnie.D.Bentley, System analysis and design methods 4th edition, TMH, 2002
James.A.Senn, Analysis and Design of Information System, 2nd edition, McGraw Hill, 2002

CO262 SYSTEMS PROGRAMMING (3-0-0) 3

Introduction to system software, Desirable characteristics of systems programs, Introduction to Assemblers, loaders and text editor, Study of detailed machine language structure and PDP-11 Input/ Output operations in PDP-11; subroutines and coroutines; concurrent I/O; supervisor mode. Macro facilities in PDP-11, Macro facilities in PDP-11, Design of an assembler, Linkers and loaders, Design of a simple text editor.

Schneider, Principles of Computer Organization, Wiley International Edition
Mac Ewan, Introduction to Computer Systems through PDP-11 & Pascal, McGraw Hill
D.M. Dhamdhere, Introduction to system software, Tata McGraw Hill, New Delhi, 2002.

CO263 OBJECT ORIENTED PROGRAMMING (1-0-3) 3

Principles of Object oriented programming, OO Paradigms, Basic Principles, Applications of OO programming using Java.

Brac J Cox, Object Oriented Programming: An evolutionary approach – Addison Wesley Publishing Company
Patrick Naughton and Herbert Schildt, Obsorne, The Complete Reference Java2.
Ira Pohl, "Object oriented programming using C++", Pearson Education Asia, 2003

CO280 OBJECT ORIENTED PROGRAMMING CONCEPTS (3-0-0) 3

Principles of Object oriented programming, OO Paradigms, Basic Principles, Applications of OO programming using Java.

Brac J Cox, Object Oriented Programming : An evolutionary approach – Addison Wesley Publishing Company.
Patrick Naughton and Herbert Schildt, Obsorne, The Complete Reference Java2.
Ira Pohl, "Object oriented programming using C++", Pearson Education Asia, 2003.

CO300 COMPUTER NETWORKS (3-1-0) 4

Introduction, Layered Architecture of Computer Networks, OSI and TCP/IP architectures & layers with protocols, Internetworking & routing, Network management current trends

Behrouz A. Forouzan, Data Communications & Networks, third edition, Tata McGraw Hill.
James F. Kurose, Keith W. Ross, Computer Networking: A Top-Down Approach, 6/E, Pearson Publication.
Andrew. S. Tannenbaum, Computer Networks, Prentice Hall of India, 2nd Edn, 2002.

CO301 DATABASE MANAGEMENT SYSTEMS (3-1-0) 4

Introduction; E-R Models, Relational Models, Relational Algebra & Calculus, SQL Queries, programming and triggers, Data Storage, File Handling, Security, Parallel & distributed data, Internet database, Data Mining, Object Database systems, Real Time Database systems,

R. Ramaksrishnan & Johannes G, Database Management System, McGraw Hill Publishers.
J.O. Ullman , Principles of Database systems, Galgotia Publishers
Stamper & Price, Database Design and Management-An Applied Approach, McGraw Hill Publications.

CO302 COMPUTER NETWORKS LAB (0-0-3) 2

Exercises comprising simulation of various protocols and performance study; TCP/IP Level Programming, Routing Algorithms and internetworking.

Kris Jamsa, Ken Cope, Internet Programming, Galgotia.
Fred Halsall, Data Communications, Computer networking on OSI, Addison Wesley Publishing Co., 2nd Edition, 2002.

Behrouz A. Forouzan, Data Communications & Networks, third edition, Tata McGraw Hill.

CO303 DATABASE MANAGEMENT SYSTEMS LAB (0-0-3)2

Assignment in Design and Implementation of Database systems or packages for applications such as office automation, hotel management, hospital management; deployment of Forms, Reports Normalization, Query Processing Algorithms in the above application project; Distributed data base management & other related exercises

R. Ramaksrishnan & Johannes G, Database Management System, McGraw Hill Publishers.
J.O. Ullman , Principles of Database systems, Galgotia Publishers
Stamper & Price, Database Design and Management-An Applied Approach, McGraw Hill Publications.

CO310 MICROPROCESSOR SYSTEMS (3-0-0) 3

Microprocessor Architecture, 8086, Instruction set, Subroutines, Programming examples, Software development with Interrupts; Intel 80286, 80386; Programmable peripheral devices, 8255, 8253,8259, 8257, Motorola 68000 Processors, 68020, 68030; Mother boards, I/o bus, I/o channel, BIOS,DOS, PC bus, Multibus I & II, VME, CRT Controller, Floppy disc Controller, Hard disc Controller, CDROM Drive, Serial Communication Controller, Pen drive, Mouse drive.

Doughlas V. Hall, Microprocessors & Interfacing
Barry B. Brey, "The Intel Microprocessors: Architecture, Programming & Interfacing" PHI, 6th Edition,2003.
Lice & Gibson, "Microcomputer System 8086 / 8088" PHI, 2nd Edition.

CO311 UNIX NETWROK PROGRAMMING (3-0-0) 3

Introduction to Unix. TCP & UDP, TCP Sockets, UDP sockets, Name and address conversion, I/O functions, Non Blocking I/O, Daemon Process, Raw sockets.

Brian W.Kernighan, The Unix Programming Environment, Pearson Education 2003
Jeff Horwitz,Unix System Management-Primer Plus, Sams / Pearson Education, 2003
W. Richard Stevens, Bill Fenner, Andrew M. Rudoff, *Unix Network Programming: The Sockets Networking Api, Volume 1, Addison-Wesley Professional, 2004*

CO312 COMPUTER GRAPHICS & MULTIMEDIA (3-0-0) 3

Introduction to computer graphics: basic raster graphics algorithms for drawing 2D primitives, 2D transformations, window-to-viewport transformation, input devices and interactive techniques. 3D graphic: viewing in 3D, projections, basics of solid modeling, 3D transformations. Multimedia building blocks: audio - basic sound concepts, music, speech, MIDI versus digital audio, audio file formats, sound for the web, images and graphics- basic concepts, computer image processing. Video and animation -basic concepts, animation techniques, animation for the web.

Foley J. D., Van Dam A., Feiner S. K., & Hughes J. F., Computer Graphics Principles and Practice, Second Edition, Addison Wesley
Hearn D. & Baker P.M, Computer Graphics, Prentice Hall India
Koegel Buford J. F., Multimedia System, Addison Wesley

CO313 NUMBER THEORY & CRYPTOGRAPHY (3-0-0) 3

Elementary number theory, Finite fields, Arithmetic and algebraic algorithms, Secret key and public key cryptography, Pseudo random bit generators, Block and stream ciphers, Hash functions and message digests, Public key encryption, Probabilistic encryption, Authentication, Digital signatures, Zero knowledge interactive protocols, Elliptic curve cryptosystems, Formal verification, Hard problems, Randomness and Pseudo randomness and Testing.

Koblitz, N. Course on Number Theory and Cryptography, Springer Verlag, 1986

Menezes, A, et.al. Handbook of Applied Cryptography, CRC Press, 1996
Ivan Niven, Herbert S. Zukerman, Hugh L.Montgomery, An Introduction to the Theory of Numbers.

CO314 SIMULATION AND MODELING (3-0-0) 3

Introduction to Modeling and simulation concepts. Levels of simulation for digital, analog & mixed mode circuits. IC CAD Overview. Device Simulation. Electrical simulation techniques. Relaxation based simulation techniques. Gate level simulation, Switch level timing simulation. Mixed mode interface, simulation and implementation, analog multi-level simulation. Discrete time models, Event driven simulation, Logic simulation, timing verification in ICs, setup and hold times for clocked devices.

R. Saleh, S. Jou & A.R.Newton, Mixed mode simulation and analog multilevel simulation, Kluwer Academic Pub. 1994.
V.Litovski & M. Zwolinski, VLSI circuit simulation & Optimization, Chapman & Hall, 1997.
J Baker, Li & Boyce, CMOS Circuit Design & Simulation, PHI, 2000.

CO315 OBJECT ORIENTED SYSTEMS (3-0-0) 3

Introduction to object technology and applications; object oriented decomposition vs. structured decomposition in software development, concepts and applications of object oriented analysis and design, object oriented databases, application development using programming language JAVA

Grady Booch, Object Oriented Analysis and design and applications
James Rumbaugh, O. O. Modeling. 2005, Thomson Education.
Booch, G., Rumbaugh, J. and Jacobson, I. (1999). The Unified Modeling Language user guide. Addison Wesley Longman, Inc. Reading, MA.USA.

CO316 COMPUTER ARCHITECTURE LAB (1-0-3) 3

This lab will be based on assembly programming on of RISC processor simulator SPIM.

J.P.Hayes Computer Architecture and organization III Edition, McGraw Hill, 1998.
Hwang and Briggs, Computer Architecture and parallel processing, McGraw Hill, 1985.
David A. Patterson & John L. Hennessy, Computer Organization and design, Morgan Kaufmann Publ.,3rd edition.

CO317 INTRODUCTION TO GRAPH THEORY (3-0-0) 3

Basic concepts on Graphs- degree, paths, cycles, connectivity, trees and other graph parameters, Matchings – Matchings in bipartite graphs: Konig's theorem, Halls' Theorem, Matchings in general graphs, Vertex Cover, Vertex Coloring- upper bound and lower bounds, degeneracy, Edge Coloring-bipartite graphs, upper bound: Vizing's theorem, Connectivity-2-connectivity and ear decomposition, Menger's minmax theorem relating connectivity and vertex disjoint paths, Planarity- Eulers formula, 5-coloring, Hamiltonian Graphs.

Reinhard Diestel: Graph Theory, Springer, 2010.
Douglas B. West: Introduction to Graph Theory, Prentice Hall, 2001.
A. Bondy and U. S. R. Murty: Graph Theory with Applications, Elsevier, 1976.
B. Bollabas: Modern Graph Theory, Springer, 1998.

CO330 PROBLEM SOLVING TECHNIQUES IN COMPUTERS (3-0-0) 3

Basic problem solving strategies, problem simplification and decomposition techniques, algorithmic solutions and their correctness, recursion, simulation, decision trees, graphs and networks, computer organization and programming constructs and basic operating system and debugging tools.

Delores M. Etter. Engineering Problem Solving with C, 3rd Edition, Prentice Hall, 2005.
Jeri R. Hanly and Elliot B. Koffman, Problem Solving and Program Design in C, Pearson Education, Inc., ISBN: 0-321-21055-7,

D.S. Malik , Thomson, C++ Programming: From Problem Analysis to Program Design, Third Edition, Course Technology, 2007

CO331 BIOINFORMATICS (2-1-0)3

Introduction to Bio informatics. Introduction to Algorithms and Complexity. Restriction mapping and motif finding algorithms. Greedy Algorithms in Genome Assembly. DNA Sequence comparison: Dynamic programming approaches. Sequence Alignment - Graph algorithms. Combinatorial pattern matching. Clustering and trees in Gene expression analysis. Randomized algorithms in Bio informatics. Hidden Markov Models.

Neil C. Jones and Pavel A. Pevzner. An Introduction to Bioinformatics Algorithms. MIT Press, 2004. ISBN-10: 0262101068, ISBN-13: 978-0262101066.

Marketa Zvelebil and Jeremy Baum. Understanding Bioinformatics. Garland Science, 1st Edition, 2007. ISBN-10: 0-8153-4024-9, ISBN-13: 978-0-8153-4024-9.

Warren J. Ewens, and Gregory R. Grant. Statistical Methods in Bioinformatics, 2e. Springer, 2005. (Soft cover) ISBN 978-1-4419-2302-8. (Hard cover) ISBN 978-0-387-40082-2.

David W Mount. Bioinformatics: Sequence and Genome Analysis. Cold Spring Harbor Laboratory Press,U. S. 2nd Revised edition. 2004. ISBN-10: 0879697121. ISBN-13: 978-0879697129.

CO332 HETEROGENEOUS PARALLEL COMPUTING (3-0-0) 3

Heterogeneous Computing, CUDA C, Kernel-Based Parallel Programming. Memory Model for Locality, Tiling for Conserving Memory Bandwidth, Handling Boundary Conditions, and Performance Considerations. Parallel Convolution Pattern. Parallel Scan Pattern. Parallel Histogram Pattern and Atomic Operations. Data Transfer and Task Parallelism. OpenCL, C++AMP, OpenACC**.** Other Programming Models – Thrust, Bolt, and CUDA FORTRAN**.**

David Kirk and Wen-mei Hwu, Programming Massively Parallel Processors: A Hands-on Approach (Applications of GPU Computing Series), 2nd Edition , Morgan Kaufmann (Elsevier), 2013.

Benedict Gaster, David R. Kaeli, Lee Howes, Perhaad Mistry, Heterogeneous Computing with OpenCL, Morgan Kaufmann Publishers, 2011.

NVIDIA, NVIDIA Programming Guides.

AMD, AMD Accelerated Parallel Processing OpenCL Programming Guide, 2013.

CO350 COMPILER DESIGN (3-1-0) 4

Introduction to compiler design, Lexical analyzer, Regular expressions and finite automata, Introduction to context free grammars, BNF notation, Parsing Techniques: Top-down parsing and Bottom-up parsing, Error recover strategies for different parsing techniques, Intermediate code generation, symbol table, Runtime storage allocation, Code Optimization, Code generation.

Alfred V. AHO, Ravi Sethi & Jeffrey D. Ullman, Compilers; Principles, Techniques & Tools, Addison-Wesley Publication, 2001.

William A. Barrett et.al, compiler Construction, Theory and Practice, Galgotia 2000

Holub A.I., Compiler Design in C, Prentice Hall India.2000

CO351 COMPILER DESIGN LAB (0-0-3) 2

The laboratory course would consist of building a mini compiler (possibly subsets of Standard Compilers like PASCAL or other languages) and executing Simple problems to demonstrate the Compiler capabilities. LEX & YACC of Unix to be used.

Alfred V. AHO, Ravi Sethi & Jeffrey D. Ullman, Compilers; Principles, Techniques & Tools, Addison-Wesley Publication, 2001.

William A. Barrett et.al, compiler Construction, Theory and Practice, Galgotia 2000

Holub A.I., Compiler Design in C, Prentice Hall India.2000

CO352 COMPUTER GRAPHICS MINI-PROJECT (1-0-2) 2

2D and 3D conversion, Transformation and curves. Implementation of 2D packages which support graphics editor with classical input techniques, transformation and animation.

Van Dam, Foley, Feimer, Hugher, Computer Graphics Principles and Practice in C-, Addison Wesley
Hearn D. & Baker P.M, Computer Graphics, Prentice Hall India
Koegel Buford J. F., Multimedia System, Addison Wesley

CO360 ADVANCED DATA STRUCTURES (3-0-0) 3

Data structures and its operations, trees, Heaps, Advanced Graph Algorithms and application, Internet Algorithms, Compression algorithms, search engine algorithms, spiders and crawlers, Integer and polynomial Arithmetic, modular Arithmetic, NP-Completeness and approximation algorithms.

Thomas Cormen, Charles E Leiserson and Ronald D River, Introduction to Algorithms, PHI, 2001.
Mark Allen Weiss, Algorithms, Data Structures and Problem Solving with C++, Addison Wesley, 2002.
Fundamentals of data structures in C++, by E. Horowitz, S. Sahni, and D. Mehta, Second Edition, Silicon Press, 2007.

CO361 LOGIC FOR COMPUTER SCIENCE (3-0-0) 3

Propositional logic, syntax of propositional logic, main connective, semantics of propositional logic, truth tables and tautologies, tableaus, soundness theorem ,finished sets, completeness theorem,. Predicate logic, syntax of predicate logic, free and bound variables, semantics of predicate logic,, graphs, tableaus, soundness theorem, finished sets, completeness theorem, equivalence relations, order relations, set theory. Linear time Temporal Logic(LTL), syntax of LTL, semantics of LTL, Buchi Automata, Buchi recognizable languages and their properties, Automata theoretic methods, Vardi-Wolper Construction, Satisfiability problem of LTLl, Model checking problem of LTL. Software Verification: Tools used for software verification. SPIN and SMV. Introduction to both tools. Method of verification by the tools.

Jerome Keisler H. Joel Robbin, Mathematical Logic and Computability, McGraw-Hill International Editions, 1996.
Papadimitriou, C. H., Computational Complexity, Addison Wesley, 1994
Gallier, J. H., Logic for Computer Science: Foundations of Automatic Theorem Proving,, Harper and Row, 1986.

CO362 INFORMATION SECURITY (3-0-0) 3

Basic concepts, access control, Protection, Secure coding, Cryptography, Network security, Firewalls, Confining untrusted code, Security on the Internet and the World Wide Web, Attack Techniques, Case studies.

Matt Bishop, Computer Security, Arts & Science, Pearson Education, 2003.
Pceprzyk et.al., Fundamentals of Computer Security, Allied Publishers, 2004.
Derek Atkins and 9 others, Internet Security, Techmedia 2nd edition, 1997.

CO363 WEB ENGINEERING (3-0-0) 3

Requirements specification and analysis, Web-based systems development methodologies and techniques, Migration of legacy systems to Web environments, Web-based real-time applications development, Testing, verification and validation, Quality assessment, control and assurance, Configuration and project management, “Web metrics”- generating metrics for estimation of development efforts, Performance specification and evaluation, Update and maintenance, Development models, teams, staffing, Integration with legacy systems, Human and cultural aspects, User-centric development, user modeling and user involvement and feedback, End-user application development.

Journal of Web Engineering, Rinton Press, IEEE & ACM Publications.

Cato & John, User Centered web design, Pearson Education, 2001.
Kappel, G., Proll, B. Reich, S. & Retschitzegger, W. Web Engineering, 1s ed. Wiley & Sons.

CO364 SOFT COMPUTING (3-0-0) 3

Introduction to learning systems -Feed forward Neural Networks - Multilayer Perceptron propagation algorithm and its variants - Improving generalization. Recurrent Neural Networks - Hopfield net - Boltzmann machine and Mean field learning –combinational optimization problems using recurrent Neural Networks. Unsupervised Neural Networks. Competitive learning - Self organizing maps - Growing cell structures Principal component analysis. Basics of fuzzy sets. Genetic algorithms: Population based search techniques, evolutionary strategies, mathematical foundations of genetic algorithms, search operators, genetic algorithms in function and combinational optimization, hybrid algorithms, application to pattern recognition

S. Haykin, Neural Networks: A comprehensive foundation, Pearson, 1999
J. M. Zurada, Introduction to artificial neural networks, Jaico publishing, 1997.
B. Yajnanarayana, Artificial Neural Networks, PHI, 1991

CO365 ADVANCED COMPUTER NETWORKS (3-0-0) 3

In Depth review of network and transport layer protocols, Congestion control algorithms and QOS, network virtualization, overlays sensor network, mesh network.

1. *Richard Stevens,* **TCP/IP Illustrated, Volume 1: The Protocols** *PHI, 2001.*
Behrouz Forouzan, TCP/IP Protocol Suite, 3/e, McGraw Hill
Larry L. Peterson, Bruce S. Davie*Computer Networks: A Systems Approach, Elsevier*

CO366 FORMAL METHODS (3-0-0) 3

Formal Methods in Computing Specification; Formal Description Techniques in Communication Software Systems; Formal Methods in Object Orientation and Software Engineering, Proof Methods and Techniques, Temporal and Model Logic

Jan Ven Lecuwen—Formal Model and Semantics, Elsevier-MIT Press, 1992
Arindama Singh—Logic for Computer Science, PHI, IEEE, 2003
Programming Perl. Larry Wall, Tom Christensen, and Randal Schwartz.1996. O'Reilly & Associates, Inc.

CO367 DISTRIBUTED COMPUTING (3-0-0) 3

Introduction Distributed Systems and applications, Message Passing mechanisms IPC and RPC, Distributed Operating Systems – resources/process/thread management, Distributed File Systems and Services, Shared data, Synchronization Transaction and Concurrency Control, Distributed databases, Name service, Timing & Coordination, Replication, Security and Fault Tolerance.

Pradeep Sinha, Distributed Operating Systems- Concepts and Design, PHI, 2000
George Couloris, Jean Dollimore & Time Kindberg, Distributed Systems: Concepts & design, 2nd ed, Addision Wesley 2003.
A.S. Tanenbaum and M.V. Steen, Distributed Systems – Principles and Paradigms, PHI.2003
V. Rajaraman, C. Siva Ram Murthy, Parallel, Computers Architecture & Programming, PHI.

CO368 INTERNET TECHNOLOGY AND APPLICATIONS (1-0-3) 3

Internet & Web Technology, Infrastructure and tools for Internet Commerce /E-Commerce Current Trends in E-Commerce applications development, Enterprise level E-Commerce: SCM, CRM, EDI, B2Bi, ERP.

Henury Chan et al. E-commerce-Fundamental and applications, John Wiley & Sons, 2002
G. Winfield Treese and Lawrence C.S. Designing Systems for Internet Commerce, Pearson Edison, LPE, 2002.
Thomas Powell ,The Complete Reference to HTML, Osborne/McGraw-Hill

CO369 QUANTITATIVE COMPUTER ARCHITECTURE (2-1-0)3

Fundamentals of Superscalar processors, Vector processors and Graphical Processing Unit architectures. Interconnection networks in multicore processors. Computer architecture of warehouse computers. Architectural optimizations in Cache Memory. Uniprocessor, Multiprocessor and Full system simulators. Recent, relevant architectural advances from literature.

John L I Iennessy and David A Patterson, Computer Architecture - A quantitative approach, 5th edition, Morgan Kaufmann.

Classic papers from literature concerning Computer Architecture.

Rajeev Balasubramonian, Norman Jouppi, Naveen Muralimanohar,
Multi-core Cache Hierarchies. Synthesis Lectures on Computer Architecture. Morgan & Claypool Publishers. ISBN-10:1598297538.ISBN-13:978-1598297539.2012.

Daniel J. Sorin, Mark D. Hill, David A. Wood. A Primer on Memory Consistency and Cache Coherence. Synthesis Lectures on Computer Architecture. Morgan & Claypool Publishers. ISBN-10:1608455645. ISBN-13:978-1608455645.March 2012.

CO380 INTERNET TECHNOLOGIES (3-0-0) 3

Internet & Web Technology, Infrastructure and tools for Internet Commerce /E-Commerce Current Trends in E-Commerce applications development, Enterprise level E-Commerce: SCM, CRM, EDI, B2Bi, ERP.

Henury Chan et al. E-commerce-Fundamental and applications, John Wiley & Sons, 2002

G. Winfield Treese and Lawrence C.S. Designing Systems for Internet Commerce, Pearson Edison, LPE, 2002.

Thomas Powell, The Complete Reference to HTML, McGraw-Hill

CO390 SEMINAR (0-0-3) 2

This course is a 2 credit course to be completed during 7th / 8th semester. Students will have to choose a topic in CSE's current trends or industry practices, prepare a write up, present it along with a suitable demonstration. Evaluation will be based on the relevance of topic, communication skills, and the reporting / documenting procedure.

CO410 ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS (3-0-0) 3

Architecture of AI & KBCS Systems, Design Issues and AI techniques, Introduction & Design of Expert Systems various applications, Introduction to fuzzy logic systems, Natural Language processing, Heuristic Search techniques, knowledge based systems.

Nilson, Artificial Intelligence: A new synthesis, 2001.

Edwin wise, Hands on AI with Java, McGraw Hill, 2004.

George Lugar, "AI-Structures and Strategies for Complex Problem Solving", 4/e, 2002, Pearson Educations

CO411 ADVANCES IN COMPILIER DESIGN (3-0-0) 3

Review of compiler fundamentals - lexical analysis, parsing, semantic analysis, error recovery and intermediate code generation; Runtime storage management; Code generation; Code improvement - peephole optimization, dependence analysis and redundancy elimination, loop optimization, procedural and inter-procedural optimization, instruction scheduling, optimization for memory hierarchy; Compilation for high performance architecture; Portability and retargetability; Selected topics from compilers for imperative, object-oriented and mark-up languages, parallel and distributed programming and concurrency.

Alfred V. Aho, Ravi Sethi, Jeffrey D. Ullman, Compilers: Principles, Techniques and Tools, Addison-Wesley.

Michael L. Scott, Programming Language Pragmatics, Elsevier.

Andrew W. Appel, Modern Compiler Implementation in C/Java, Cambridge University Press.

CO412 DISTRIBUTED DATABASE SYSTEM (3-0-0) 3

Distributed database architecture, distributed database design, distributed query processing, query decomposition and optimization of distributed queries, distributed transaction management and concurrency control, distributed DBMS reliability, distributed database operating systems, Distributed multi database systems, Client/Server database systems, Peer-to-Peer Systems,
Location-based Applications, Parallel DBMS.

Principles of Distributed Database Systems, M.T. Ozsu and P. Valduriez, Prentice-Hall, 2nd Ed. 1999.
Ceri and Pelagatti, Distributed Database Principles and Systems, McGraw Hill. 2000
D. Bell and J. Grimson, Distributed Database Systems, Addison-Wesley, 1992.

CO413 GAME THEORY (3-0-0) 3

Introduction to game theory and strategic thinking, Ideas such as dominance, backward induction, Nash equilibrium, evolutionary stability, commitment, credibility, asymmetric information, adverse selection, and signaling, Applications.

D. Fudenberg and J. Tirole, Game Theory, MIT Press, 1991.
Martin J. Osborne. An Introduction to Game Theory. Oxford University Press. Indian Edition, 2003.
Roger B. Myerson. Game Theory: Analysis of Conflict. Harvard University Press, 1991.
Y. Narahari, Dinesh Garg, Ramasuri Narayanam, Hastagiri Prakash. Game Theoretic Problems in Network Economics and Mechanism Design Solutions. Springer, London, 2009.

CO414 DIGITAL IMAGE PROCESSING (3-0-0) 3

Introduction and Fundamentals, Image sensing and acquisition, Image sampling and quantization, Image enhancement in the spatial domain, Image enhancement in the frequency domain, Image restoration, Color image processing, Morphological image processing, Image segmentation.

Rafael C. González, Richard E. Woods, "Digital Image Processing", 3rd Ed., PHI, 2007.
Anil K. Jain, "Fundamentals of Digital image Processing", Prentice Hall, US Ed., 1989.
Rafael C. González, Richard Richard Eugene Woods, Steven L. Eddins, "Digital Image Processing using MATLAB", Pearson Education India, 2004.

CO415 OPTIMIZATION TECHNIQUES IN COMPUTING (3-0-0) 3

Basic OR techniques, requirements, networks, design, role and methods, databases, compilers, optimization and performance in web computing, internet application, performance measurement tools, case studies.

Kanth, Introduction to computer system performance evaluation, McGraw Hill, 1992
David K smith, Network Optimization in Practice, ellise, Horrwood publications, 1982
Hiller and Lieberman, Introduction to Operation Research (Seventh Edition) Tata McGrawHill Publishing Company Ltd

CO416 WIRELESS NETWORKS (3-0-0) 3

Wireless Communications, Wireless Networks , Mobile Networking : Mobile IP, Mobile Networking, mobility in a higher layer , micro mobility , Ad Hoc Networks , Ad Hoc Routing , Wireless Protocols - Wireless TCP , Data Board casting , Mobile Data Management, Location Dependency/Awareness, Disconnected/Weak-connected Operations ,Adaptation, Mobile Applications/Services, User Interface Issues , Security Issues , Satellite Networks , New Topics.

William Stallings, Wireless Communications and Networks, , Prentice Hall, second edition, 2005.
Vijay Garg, Wireless Communications & Networking, Morgan Kaufmann, June 2007. .
Theodore S. Rappaport, Wireless Communications: Principles and Practice

CO417 SOFTWARE PROJECT MANAGEMENT (3-0-0) 3

Data Collection and Analysis in software engineering, Product Metrics, Quality Metrics, Management Metrics, Conventional Software Management, Life cycle Phases, Iterative process planning,, Modern Project Profiles, Next generation cost models.

K. Conway, Software Project Management: From Concept to Development, IDG Books, 2001

I. Jacobson.G.Booch and J.Rumbaugh, The Unified Software Development Process, Addison Wesley, 1999.

Norman E- Fentar and Share Lawrence Pflieger, Software Metrics, International Thomson Computer Press 1997.

CO418 GREEN COMPUTING (3-0-0) 3

Green Computing Fundamentals: Energy- efficient, power efficient and thermal aware computing and communication Newton's cooling model and basic thermodynamics and sustainability. Middleware Support for green computing: Power states Power states Voltage and frequency scaling ACPI support for Linux and, Voltage and frequency scaling, ACPI support for Linux and Windows, compiler optimization, virtualization and server consolidation. Tools for monitoring: Sensor networks, cooling equipment and their behavior. HPC computing: Hadoop, Map-Reduce, Dynamic thermal-aware scheduling, Resource Management in Virtualized Environment. Green Mobile, embedded computing and networking: Optimizing for minimizing battery consumption, Safe and Sustainable Cyber-physical systems (Medical devices). Management Frameworks Standards and metrics for green computing

K. Kant, Data center evolution – a tutorial on state of the art issues and challenges, Elsevier Computer Networks, 53(2009)2939-2965

L. Barraso and Holzl, Case for Energy Proportional Computing, IEEE Computer Dec 2007

CO419 DISTRIBUTED COMPUTING LAB (0-0-3) 2

Implementation of concurrent echo client-server application, concurrent day-time client-server application. Configure following options on server socket and tests them: SO_KEEPALIVE, SO_LINGER, SO_SNDBUF, SO_RCVBUF, TCP_NODELAY. Incrementing a counter in shared memory. Create CORBA based server-client application. Design XML Schema and XML instance document. WSDL based: Implement Arithmetic Service that implements add, and subtract operations / Java based: Implement Trigonometric Service that implements sin, and cos operations. Configuring reliability and security options. Monitor SOAP request and response packets. Analyze parts of it and compare them with the operations (java functions) headers.

M.L.Liu Addison Wiselly, Distributed Computing : Concepts & Applications

Nicolai M. Josuttis , SOA in Practice: The Art of Distributed System Design Prentice Hall Publication

Pradeep K. Sinha, Distributed Operating Systems: Concepts and Design

CO420 SOFT COMPUTING LAB (0-0-3) 2

MATLAB Fuzzy Logic Toolbox: Implement fuzzy set operations, implement fuzzy relational operations, design and implement fuzzy temperature controller, design and implement Fuzzy Traffic light controller, write and illustrate the concept of Fuzzy C – means Clustering, design a self executable fuzzy logic controller. MATLAB Neural Network Toolbox: Write programs to test the learning rules of Hebb, Perceptron, Delta, and Widrow Hoff in MATLAB learning rule. To implement the Back propagation algorithm, write and test a program for the linear separability of the input domain, write and implement a Hopfield algorithm, write a program for pattern recognition, design a self executable neural classifier.

Jyh, Chuen-Tsai, Eiji Mizutani "Neuro-Fuzzy and Soft Computing: A Computational Approach to Learning", Prentice Hall. 1997

Chin –Teng Lin and C.S. George Lee - "Neural Fuzzy Systems" – A neuro fuzzy synergism to intelligent systems Prentice Hall International. 1996

Yanqing Zhang and Abraham Kandel - "Compensatory Genetic Fuzzy Neural Networks and Their Applications" World Scientific. 1998

CO421 SOFTWARE TESTING (1-0-3) 3

Software testing concepts & principles, Testing Strategies, Testability and Related Issues, Methods for developing the strategy, Life Cycle Testing, Installation Phase Testing and Various Phases of Testing; Tools and Techniques for Software Testing, Testing Object Oriented Software.

Glenford J. Myers, The Art of Software Testing, John Wiley & Sons, 1979.

Boris Beizer, Black Testing: Techniques for Functional Testing of Software and Systems, John Wiley & Sons, 1995

William Perry, Software Testing : Effective Methods for Software Testing, John Wiley, 1995

Cem Kaner, Jack Falk, Hung Quoc Nguyen, Testing Computer Software, 2nd Ed, Intl. Thomson Computer Press.

CO422 COMBINATORIAL OPTIMIZATION (3-0-0)3

Introduction; mathematical preliminaries; shortest paths variants: Label setting and label correcting methods, Yen's improvement, linear programming interpretation and relaxation procedures, M shortest paths; network flows: maximal flows , max-flow min-cut, minimum cost flows, the out-of-kilter method and improvements, project scheduling and transportation problems, multi-terminal and multi-commodity flows; bipartite matching: cardinality matching algorithms, max-min matching, Gilmore-Gomory matching; Non bipartite matching: weighted matching algorithm, Chinese postman's problem; matroids and greedy algorithms: matching, traversal and partition matroids, matroidaxiomatics, Prims spanning tree algorithm, the Steiner problem.

Eugene Lawler, Combinatorial Optimization – Networks and Matroids, Dover Publication 2002.

William J. Cook, William H. Cunningham, William R. Pulleyblank, Alexander Schrijver, *Combinatorial Optimization, Wiley 1997.*

CO440 PRACTICAL TRAINING/EDUCATIONAL TOUR (0-0-2) 1

The Student has to undergo a training programme or any equivalent programme fixed by the institution / department. This will be done during the third or fourth year. A report will be submitted by the student. Evaluation is based on the seminar and report.

CO449 MAJOR PROJECT- I (0-0-6) 4

The Student has to select a project work based on a topic of interest. Periodically the implementation will be evaluated by the guide. This work, started in VII semester continues through eighth semester, at the end of which, the student will be evaluated internally and externally.

CO460 HIGH PERFORMANCE COMPUTING (3-0-0) 3

High performance computing architectures, cluster components, monitoring tools. Fundamentals of Superscalar processors, Vector processors and General Purpose Graphical Processing Unit (GPGPU) architectures. Virtualization and architecture of virtual machines. Instruction Level Parallelism: Pipelining, Hazards, Branch prediction, Static and Dynamic Scheduling, Speculation. Multicore Memory Hierarchy: Caches, Virtual Memory, DRAM, Cache aware programming. Multiprocessors: Symmetric and Distributed architectures, Cache coherence protocols, Memory Consistency Models. Interconnection network design – Topologies, Performance, Routing, Flow control, Switch design. Benchmark suites.
Recent, relevant high performance computing advances from literature.

Dennis Abts, John Kim, High Performance Datacenter Networks - Architectures, Algorithms, and Opportunities. Mark Hill/Margaret Martonosi (eds.). Synthesis Lectures on Computer Architecture, Morgan and Claypool, 2011.

David B. Kirk, Wen-mei W. Hwu, Programming Massively Parallel Processors: A Hands-on Approach (Applications of GPU Computing Series) Elsevier-2014
David j. Kuck, "High Performance Computing", Oxford Univ Pr, 1996
Gary W. Sabot, "High Performance Computing", Addison-Wesley, 1995
John L Hennessy, David A Patterson, Computer Architecture - A quantitative approach, 5 th edition, Morgan Kaufmann.

CO461 DATA WAREHOUSING AND DATA MINING (3-0-0) 3

Data Warehousing: Data warehousing components and building data warehouse. Data Mining –Objectives, examples, data mining process, Data mining techniques, Generalization, Data mining knowledge representation.

Raph Kimball, Data Warehouse Toolkit, John Wiley & Sons Publications
Michael. J. Berry, Gordon Linoff, :Data Mining Techniques: Marketing, Sales, Customer support. John Wiley & Sons.

CO462 NETWORK MANAGEMENT (3-0-0) 3

Network management standards and models, network management protocols, SNMP. Management information base (MIB), Network Configuring Proto (NETCONF), Heterogeneous Network and network security management, Network Management tools and applications.

M. Subramanian, Network Management: Principles and Practice, Addison- Wesley, 2000
J. Burke, Network Management Concepts and Practice, A Hands-On Approach, Pearson Education,2000.
William Stallings, SNMP, SNMPv2, SNMPv3, AND RMON 1 and 2, Addison Wesley, Third Edition, 1999.

CO463 CLOUD COMPUTING (3-0-0) 3

Introduction to Cloud Computing, Infrastructure as a Service (IaaS),Virtualization, Platform as a Service (PaaS),Software as a Service (SaaS),Cloud issues and challenges, Current techniques for large data processing (Google GFS, BigTable, and Map-Reduce),Cloud resource management, Energy efficiency in data centers, Cloud simulation and Semantic cloud

Antohy T Velte, Cloud Computing: A Practical Approach, McGraw Hill,
J. Lin and C. Dyer, Data-Intensive Text Processing with MapReduce, , Morgan and Claypool, 2010
T. Velte, A. Velte, R. Elsenpeter, Cloud Computing, A Practical Approach, McGraw-Hill, 2009.

CO464 NETWORK SECURITY (3-0-0) 3

Introduction - Attacks, services and mechanisms - Classical encryption techniques - DES -Block cipher - Design principles and modes of operation. Encryption Algorithms - Hash functions - Triple DES - RC5 - Key management – Public key cryptography - RSA algorithm - Digital signatures and authentication protocols. System Security - Backups - Integrity management - Protecting against programmed threats, viruses and worms - Physical security - Personnel security. Network Security - Protection against eavesdropping - Security for modems - IP security -Web security - Electronic mail security - Authentication applications. Security Tools - Firewalls - Wrappers - Proxies - Discovering a break-in - Denial of service attacks and solutions - Cryptographic security tools: Kerberos, PGP, SSH, SRP, OPIE.

William Stallings, "Cryptography and Network Security – Principles and Practice", II Edition, Pearson Education, 2000,
Steve Burnett, Stephene Paine, "RSA Security's official guide to cryptography", RSA Pren, Tata McGraw Hill Edition, 2001
E. Nemeth, G. Snyder, s. Seebass, T.R. Hein, "UNIX System Administration Handbook", III Edition, Pearson Education, Asia, 2001

CO465 DISTRIBUTED ALGORITHMS (3-0-0) 3

Role of Distributed Algorithms in designing applications, Synchronous algorithms, asynchronous network algorithms, distributed algorithms for memory management and web computing.

Nancy & Lynch, Distributed Algorithms, Harcour Asia, 2001.
Distributed Computing: Fundamentals, Simulations, and Advanced Topics 2nd Ed., Hagit Attiya and Jennifer Welch. Wiley 2004 (ISBN 0-471-45324-2).
Gerard Tel. Introduction to Distributed Algorithms. Cambridge University Press, Cambridge, UK, 2ndedition, 2000.

CO466 INFORMATION RETRIEVAL (3-0-0) 3

Introduction to Information Retrieval: unstructured and semi-structured text. Inverted index and Boolean queries. Text Indexing, Storage and Compression: Text encoding: Retrieval Models: Performance Evaluation: Text Categorization and Filtering: Text Clustering: Advanced Topics: Web Information retrieval.

Manning, Raghavan and Schutze, Introduction to Information Retrieval, Cambridge University Press.
Baeza-Yates and Ribeiro-Neto, Modern Information Retrieval, Addison-Wesley.
Soumen Charabarti, Mining the Web, Morgan-Kaufmann.

CO467 SOFTWARE QUALITY ASSURANCE (3-0-0) 3

Evaluation, Role, maturity in development, life cycle, models, maintenance issues, specification, object oriented design, management, testing, mechanisms, verification and validation, cost estimation, tools, debugging, simulators, ISO 9000 standards, Quality Assurance.

Pankaj Jalote, An Integrated Approach to Software Engineering, Narosh Publication, 1995.
John J Marciniack, Editor in chief Encyclopedia of Software Engineering, John Wiley and sons, 1994.
Isabel Evans, Achieving Software Quality through Team Work, Allied Publishers, 2004.

CO468 COMPUTER VISION (3-0-0) 3

Concept of application of computer vision, functional architecture of a vision system visual sensory model and camera calibration, processing tools, 3D vision, 3D representative schemes, High level vision and navigation.

Sonka M., Hlavac V., Boyle R., Image Processing Analysis and Machine Design. PWS Publishers
Ballard D., Brown C., Computer Vision, Prentice Hall
Bratt W., Digital Image Processing, John Wiley & sons

CO469 MOBILE COMPUTING (3-0-0) 3

Introduction to Medium access control – Telecommunication Systems, Standards Wireless Lan – IEEE 802.11 HIPERLAN – Bluetooth, Adhoc Networks, Characteristics-Performance issues-Routing in mobile hosts, Network Issues Mobile IP – DHCP, Mobile transport layer, Indirect TCP, Wireless application protocol, Dynamic DNS – File systems – Synchronization protocol-Context-aware applications-Security-analysis of existing wireless network.

J. Schiller, Mobile Communications, Addison Wesley, 2000.
William C.Y.Lee, Mobile Communication Design Fundamentals, John Wiley, 1993.
Theodore S. Rappaport, Wireless Communications, Principles & Practice, 2nd edition, Pearson.

CO470 SERVICE ORIENTED COMPUTING (3-0-0) 3

SOA Reference Model and Service Models, SOA Business Case, Service Design Principles, BPEL, Modeling SOA with CPN and OPNET, SOA, SOAP and REST, SOA Infrastructure, SOA Governance, Web Services, Identity and Security, Technologies, Tooling and Vendors.

Thomas Erl, Service-Oriented Architecture: Concepts, Technology and Design, 2006
Mark Hansen, SOA Using Java Web Services,.

CO471 PARALLEL PROGRAMMING (1-0-3) 3

Introduction to Parallel Computers, Message-Passing Computing and Programming, Shared Memory Computing and Programming.

Communication Costs in Parallel Machines, Routing Mechanisms for Interconnection Networks, Process-Processor Mapping and Mapping Techniques, Parallel Algorithm Design - Decomposition Techniques, Tasks and Interactions, Mapping Techniques for Load Balancing.

Communication Operations in Parallel Computers. Analytical Modeling of Parallel Programs - Overheads, Performance Metrics, Scalability, Asymptotic Analysis.

Dense Matrix Algorithms, Graph Algorithms, Search algorithms for discrete optimization problems, Sorting Algorithms, FFT, Image Processing algorithms. Programming Paradigms: Shared Address Space (OpenMP), Message Passing (MPI), GPGPU (CUDA), Heterogenous Parallel Computing (OpenCL and Intel MIC programming).

Maurice Herlihy, Nir Shavit, The Art of Multiprocessor Programming, MK, 2008.

Ananth Grama, Anshul Gupta, George Karypis, Vipin Kumar, Introduction to Parallel Computing, Second Edition, Addison Wesley, 2003.

Barbara Chapman, Gabriele Jost, Ruud van der Pas, Using OpenMP - Portable Shared Memory Parallel Programming, The MIT Press, 2008.

David B. Kirk and Wen-mei W. Hwu, Programming Massively Parallel Processors - A Hands-on Approach , MK. 2nd edition, 2014.

Wen-mei W. Hwu, GPU Computing Gems - Jade and Emerald Editions, MK, 2011.

Benedict R. Gaster, Lee Howes, David R. Kaeli, Perhaad Mistry, Dana Schaa, Heterogeneous Computing with OpenCL, MK. 2013.

Rezaur Rahman, Intel Xeon Phi Coprocessor Architecture and Tools - The Guide for Application Developers, Apress, 2013.

CO472 MACHINE INTELLIGENCE (3-0-0)3

Introduction to Machine Intelligence, Using versions space for learning, Care-based Reasoning, Inductive logic programming, Explanation based learning, Induction of Decision Tress, Learning from Observations, Basics of resolution.

Nils J. Nilson: "Artificial Intelligence & Expert Systems- A New Synthesis". Harcourt Asia Pvt. Ltd

Elaine Rich Kevin Knight, Shivshankar B Nair: "Artificial Intelligence", TMH, Third Edition

Stuart Russel, Peter Norvig: "Al Modern Approach" (Second Edition PHI)

CO473 ALGORITHMIC GRAPH THEORY (3-0-0) 3

Basic definitions and terminology of graphs and digraphs, and introduction to simple complexity theory, How choice of graph traversals (e.g., depth-first and breadth-first searches) affect algorithmic efficiency, Spanning Trees, connectivity. Circuit space, Planarity testing, genus of a graph, Networks and flows: max-flow/min-cut theorem and max-flow algorithms, Matchings in weighted and un-weighted graphs, Eulerian and Hamiltonian tours, Chinese postman and travelling salesman problems, Dominating sets, independence and cliques, Colouring graphs (including the famous 4-colour problem of planar graphs)
NP-completeness and its importance in graph algorithms.

Alan Gibbons, Algorithmic Graph Theory, Cambridge University Press, 1985.

Cormen, Leiserson and Rivest, Introduction to Algorithms, McGraw-Hill, 1986.

James McHugh, Algorithmic Graph Theory, Prentice-Hall, 1989.

CO480 MANAGEMENT INFORMATION SYSTEMS (3-0-0) 3

Functions of Management, Organization Environment, Organization Structure, System Concepts, Stakeholders Analysis, Framework for Information Systems (IS), Decision making process, Problem solving Process, Definition of Management Information System (MIS), EIS, DSS, Artificial Intelligence,

Expert Systems, Computer hardware, Hardware standards, Computer Software File and Database Management, Communication Systems, Common Network components, Distributed systems, Design of MIS, Applications of MIS to business, Case studies.

Kenneth C. Laudon and Jane Price Laudon, Management Information Systems, Managing the Digitalfirm, Pearson Education, Asia, 2002.

Gordon B. Davis, Management Information System: Conceptual Foundations, Structure &Development, McGrawHill, 1974.

Joyce J Elam, Case series for Management Information Systems', Simon and Schuster Custom Publishing, 1996.

CO481 DECISION SUPPORT SYSTEM (3-0-0) 3

Designing and Developing DSS, Communications-Driven and Group Decision Support Systems (GDSS), Data-Driven DSS, Model-Driven DSS, Document-Driven DSS, and Knowledge-Driven DSS.

Power, D. J. Decision Support Systems: Concepts and Resources for Managers.

J., D. Oja, R. Ageloff and P. Carey, New Perspectives on Microsoft Excel 2000

CO482 HIGH PERFORMANCE COMPUTING (2-1-0) 3

Fundamentals of Superscalar processors, Vector processors and Graphical Processing Unit architectures. Interconnection networks in multicore processors. Computer architecture of warehouse computers. Architectural optimizations in Cache Memory. Uniprocessor, Multiprocessor and Full system simulators. Recent, relevant architectural advances from literature.

John L Hennessy and David A Patterson, Computer Architecture – A quantitative approach, 5th edition, Morgan Kaufmann.

John P. Shen and Mikko H. Lipasti. Modern Processor Design - Fundamentals of Superscalar Processors. Tata McGraw Hill.

William J Dally and Brian Towles. Principles and Practices of Interconnection Networks. Morgan Kaufmann. 2004.

Mark Hill/Margaret Martonosi (eds.). Synthesis Lectures on Computer Architecture, Morgan and Claypool, 2006 – 2014.

Jean-Loup Baer. Microprocessor Architecture: From Simple Pipelines to Chip Multiprocessors. Cambridge University Press, 2009.

Bruce Jacob, Spencer Ng, David Wang. Memory Systems: Cache, DRAM, Elsevier, 2007.

Publications from reputed conferences such as ISCA, HPCA, MICRO.

CO499 MAJOR PROJECT - II (0-0-6) 4

The Student has to select a project work based on a topic of interest. Periodically the implementation will be evaluated by the project guide. This work, started in VII semester continues through eighth semester at the end of which, the student will be evaluated internally and externally.

Department of Electronics and Communication Engineering

EC110 ELEMENTS OF ELECTRONICS & COMMUNICATION ENGINEERING (3-0-0) 3

RC & RL Circuits – low pass, high pass, transient analysis for pulse input; Diode: Principle, Characteristics, Applications (Rectifier, Clipping circuits) & Types (Zener Diode, LED, Photo diode); Transistor: Principle, Operation, Biasing (DC analysis of CE, CB and CC configuration), Transistor as a switch; Digital Circuits: Basic Logic gates, Universal gates, Boolean Algebra, Combinational circuit (Half-Adder, Full-Adder, Decoder), Latch, Flip-Flop, Counters and Registers (brief description about ripple counter, SISO Register); Op-amps & its Applications: Terminal characteristics of Op-amp, Inverting and Non-inverting amplifier, Summing amplifier, Integrator.

Introduction to few systems (only Block level) : ADC, DAC, Linear power supply, SMPS, UPS, Principles of Communication Systems: Need for Modulation, AM and FM modulation concept & Block schematic of Super-heterodyne receiver.

Albert Malvino, Electronic Principles, Tata McGraw Hill, 1995
Boylstead and Nashelsky, Electronic Devices and Circuits, PHI, 1998
George Kennedy & Bernard Davis, Electronic Communication System, Tata McGraw Hill, 1996
Wayne Tomasi, Electronic Communication Systems, Pearson Education, 2003
Ramakant A Gayakwad, OP-AMPS and Linear Integrated Circuits, Prentice Hall, 1999

EC220 DIGITAL ELECTRONICS & COMPUTER ARCHITECTURE (3-1-0) 4

Combinational logic analysis and design: logic minimization methods, Combinational design using MSI, LSI and PLDs, Number systems and arithmetic, Logic families, Delay, Hazards. Sequential logic design: latches and flipflops, Setup and Hold time , Clock frequency, Finite state machine design, state minimization, state assignment, synthesis using D-FF and JK-FF, counters, shift registers, MSI devices as state machines. Introduction to computer architecture: Instruction Set Architecture, System Software; Processor Design: Data path, Control unit, Instruction types, addressing modes.

J.F.Wakerly, Digital Design Principles and Practices, PH, 1999.
D.D. Givone, Digital Principles and Design, TMH, 2002
M. Raffiquzzman & Rajan Chandra, Modern Computer Architecture, Galgotia Publications, 1990.
David Patterson and John Hennessy, Computer Organization and Design, Elsevier, 2007.
David Harris Money and Sarah Harris, Digital Design and Computer Architecture, Morgan Kaufman, 2007.

EC221 LINEAR SYSTEMS AND SIGNALS (3-1-0) 4

Review of DC circuit analysis, Time domain analysis of continuous-time signals & systems: properties of signals & systems, linear-time invariant systems, impulse response, convolution, correlation, causality and stability; Analysis of RL and RC circuits, representation of systems using differential equations, solution of linear differential equations, Concept of transient and steady state, time constant, Mutual inductance, RLC circuits, characteristic equation, concept of damping and natural frequency, representation of RLC circuits using state variable description, time-domain specifications. Transform domain analysis of systems: Laplace Transform - Definition and properties, inverse transforms, transform circuits, application to transient analysis of networks, transfer function. Network Theorems: Superposition, Thevenin, Norton, Maximum power transfer. Sinusoidal steady state analysis: Steady state response of R, L, C and M elements to sinusoidal excitation, resonance, frequency domain specifications. Frequency domain analysis of continuous time signals and systems: Fourier series, properties, Fourier transform, properties of Fourier transforms and applications to systems. Bode plots, Gain and phase margins

M.E. Van Valkenburg, Network Analysis, Pearson Education, 2006
J.W. Nilsson and S.A. Riedel, Electric Circuits, PHI, 2000
Simon Haykin, Signals & Systems, John Wiley, 1998
B.P.Lathi, Linear systems and signals, OUP, 2002

EC222 ELECTROMAGNETIC WAVES (3-1-0) 4

Review of Static Electric and magnetic fields, Time varying fields and Maxwell's equations, Wave propagation in free space, dielectrics and conductors, Plane waves at boundaries and dispersive media, Transmission lines, Antenna fundamentals.

W.H Hayt, J.A Buck, Engineering Electromagnetics (Seventh edition), Tata-McGraw Hill,2006.
M.N.O. Sadiku, Elements of Electromagnetics (Third Edition), Oxford University Press, 2001.
M.A Plonus, Applied Electromagnetics, Mcgraw-Hill Kogashuka, 1984.
E.C Jordan, K.A Balmain,Electromagnetic Waves and Radiating Systems, Prentice Hall of India,1968.

EC223 ANALOG ELECTRONICS (3-1-0) 4

Two port networks : Two-port network parameters (z, y, h, ABCD), parameter conversion, interconnection (series, parallel and cascade), ladder networks. Feedback Concepts : Feedback topology (Z, Y, H and G feedback), Positive and Negative feedback, Sensitivity factor, Effect of Negative feedback on basic amplifiers, Instability in amplifiers, Barkhousen condition for Oscillations, Nyquist stability criterion. MOSFET - Review of current equation, regions of operation, small signal model. Current mirrors : Basic current mirror, Cascode current mirror, High swing cascode current mirror, Wilson current mirror. Single-ended amplifiers : CS amplifier – with resistive load, diode connected load, current source load, triode load, source degeneration. CG and CD amplifiers. Power Amplifiers : Classification (A, B, AB & C), transformer coupled amplifiers, push-pull arrangements, theoretical efficiency.

A.S. Sedra & K.C. Smith, Microelectronic Circuits, Oxford Univ. Press, 2004
Richard C. Jaeger and Travis N. Blalock, Microelectronic Circuit Design, McGraw Hill, 2007
Donald A. Neamen, Electronic Circuit Analysis and Design, Irwin Publications, 1996.
R. R. Spencer & M. S.Ghousi, Introduction to Electronic Circuit Design, Pearson Education, 2003

EC224 MATHEMATICS FOR ELECTRONICS & COMMUNICATION ENGG. (3-1-0) 4

Linear Algebra: Basis, Vector Spaces and Subspaces, Inverse by partitioning, Linear Transformations, Rank and Echelon matrices, Homogeneous linear equations, Basic Solutions, Similarity, Symmetric matrices, Diagonalization, Quadratic forms, Rotation of co-ordinates, Orthogonal Transformations.

Probability Theory and Applications: Random Variables and Transformations, Bernoulli, Binomial, Poisson, Uniform, Gaussian, Raleigh, Ricean probability distributions, Expectations, Moments and generating functions, Inequalities, Limit Theorems, Random Processes, Markov and Poisson Random processes, Error function, Complementary Error function, Q function and their applications

Theory of Complex variables: Functions of Complex variables, Cauchy-Riemann equations, Properties of analytic functions, Conformal mapping, Line Integrals in a complex plane. Cauchy's Theorems, Evaluation of standard real line integrals using contour integration.

Numerical Methods: Introduction, Solution of equations by iteration, Interpolation, Numerical Integration and Differentiation, Solution of Linear equations and Differential equations.

Finite fields and PN sequences: Polynomials and Euclidean algorithm, Constructing finite fields, subfields, Properties of PN sequences, Generation of PN sequences application of PN sequences

E. Kreyszig, Advanced Engineering Mathematics, John Wiley and Sons, 1993.
G. Strang, Linear Algebra and its applications, Cenage Learning, 2006
C.W. Therrien and M. Tummala, Probability for Electrical and Computer Engineers, CRC Press, 2005.
T.K Moon and W.C Stirling, Mathematical Methods and Algorithms for Signal Processing, Pearson Education, 2000.

EC225 DIGITAL ELECTRONICS LAB (0-0-3) 2

Digital Circuit design using SSI/MSI :

Combinational Circuit design using gates, MUX, decoders, arithmetic circuits, ALU

Sequential Circuits design - counters, shift registers, sequence generators, signature detectors.

Design Project

EC226 ANALOG ELECTRONICS LAB (0-0-3)2

Hardware Experiments :

Clipping circuits, Clamping circuits; Design of full wave rectifier; Regulated Power Supply.
Design with RC circuits – AC analysis – Frequency response of First order RC Low pass filter and First order RC High pass filter; Transient analysis – Pulse shaping using RC circuits
Effect of negative feedback on gain and bandwidth of a voltage amplifier.
Power amplifier: Class B push-pull amplifier, Class AB push-pull amplifier

Simulation Experiments:

NMOS and PMOS characteristics (output and transfer), CMOS current mirrors, Single stage amplifiers : Common-source, Common-gate and Common-drain amplifiers,

EC230 ELECTRONIC INSTRUMENTATION (3-0-0) 3

Transducers, Measurement of Physical Quantities: Measurement of Length, Thickness, Linear Displacement, Temperature, Force, Weight, Pressure, Flow, Humidity, Acidity, Density, Sound, level, Motion, Chemical Analysis, Instrumentation Systems, Principles of Telemetry, Process Monitoring and Control, Bio-medical Instrumentation: Bio-medical Electrical Quantities: Bio-potential, Electrodes, ECG, EEG and EMG measuring techniques. Biological Non-Electrical Parameters: Pressure, Blood flow, Pulse rate, Temperature, pH, CO_2, O_2- Measuring methods. Diagnostic Systems Electronic Instruments for affecting the human body: Diathermy, Pace makers, Defibrillators, Respirators, Blood pumps, Lasers.

P.H .Mansfield, Electrical transducers for Industrial Measurement, Butterworth, London, 1973.
George C. Barney, Intelligent Instrumentation, Prentice hall of India, New Delhi, 1988.
C.S.Rangan et. el., Instrumentation, Devices and Systems, Tata McGraw Hill, 1989.
H.K.P. Neubert, Instrument Transducers, Clarendon Press, Oxford, 1975.

EC231 BIOMEDICAL INSTRUMENTATION AND IMAGING (3-0-0) 3

Action potential, ECG, EEG and EMG signals, their origin and applications in medical diagnosis. Electrodes for recording ECG, EEG and EMG signals, Instrumentation amplifiers, signal conditioners, A/D and D/A converter interfaces to the PC, Computerised automatic analysis. Biotelemetry. Transducers for physiological parameter reading, their characteristics. Diagnostic methods, ultrasound, CT and MRI. Lasers and applications of lasers in medical diagnostics and therapy. Prosthesis and prosthetic devices. Patient safety, electrical shock hazards incorporation of safety aspects in Biomedical instrumentation.

L. Cromwell, F. Weibell and E. A. Pfiffer, Biomedical Instruments and Measurements, PH, 1980.
R.S.Khandpur, Handbook of Biomedical Engineering, Tata McGraw Hill Publishing, 1992.
Jerry L. prince, Jonathan Links, Medical Imaging Signals and Systems, 2nd Ed., Pearson Publications, 2014
Andrew G. Webb, Introduction to Biomedical Imagging , Wiley –IEEE Press, 2003
John G Webster, Medical Instrucmention Application and Design , 4th Edtion, 2010

EC232 DATA STRUCTURES AND ALGORITHMS (3-0-2) 4

Review of program performance. Array based representation. Linked representation. Arrays and matrices. Stacks and queues, implementation and applications. Skip lists and hashing. Binary and other trees. Heap and heap sort. Binary search trees. Graphs, Greedy method, shortest path and spanning trees. Divide and conquer method. Dynamic programming.

Sartaj Sahni, Data Structures, Algorithms and Applications in C++, Universities Press, 2005
A.V. Aho, J.E. Hopcroft and J. D. Ullman, Data structures and Algorithms, Pearson, 2004.
T.H.Cormen, C.E. Leiserson, R.L. Rivest, C. Stein, Introduction to Algorithms, PHI, 2004
Mark Allen Weiss, Algorithms, Data structures and problem solving with C++, Pearson, 2002.

EC270 ANALOG COMMUNICATION (3-1-0) 4

Introduction to Analog Communication, amplitude modulation, circuits for AM generation / detection, AM receiver systems and circuits, Angle modulation (FM/PM), Circuits for (FM/PM) generation and detection,

commercial applications, frequency division multiplexing systems, noise performance of analog communication system (AM / FM / PM).

S. Haykin, Communication systems, John Wiley, 2001.
W. Tomasi, Electronic Communication systems, Pearson-Education, 2003.

EC271 MICROPROCESSORS (3-1-0)4

Introduction to computer organization, CISC and RISC processors, concept of pipelining, concept of microcomputer and microcontroller. Introduction to ARM based processor: Processor overview, introduction to programming model, processor and memory organization, concept of stack, introduction to processor instruction set, addressing modes, instruction encoding. Processor implementation, organization and execution: Instruction datapath, timing, processor modes, exceptions, protected mode operation. Hardware interfacing: Introduction to memory, IO interfacing, Concepts of memory mapped and IO mapped IO.

Steve Furber, "ARM System Architecture", Edison Wesley Longman, 1996.
William Hohl, "ARM Assembly Language- Fundamentals and Techniques ", CRC Press, 2009
Andew N. Sloss, Dominic Symes, Chris Wright, "ARM System Developer's Guide Designing and Optimizing System Software", Elsevier, 2004.
D.A. Patterson and J. Hennessy, Computer Organization & Design, The Hardware/software interface, Elsevier Inc, ARM Edition, 2010.

EC272 DIGITAL SIGNAL PROCESSING (3-1-0)4

Time domain analysis of discrete-time signals & systems: properties, linear-time invariant systems, representation of LTI systems, solution of difference equations. Transform domain analysis of discrete-time signals & systems: Z transforms, application of Z transforms to discrete-time systems, Frequency domain analysis of discrete-time signals and systems: Discrete-time Fourier series, Discrete-time Fourier transform, properties and applications of Fourier representation, Sampling in time and frequency domain; Discrete Fourier transform: properties, linear convolution using DFT, Fast Fourier Transform algorithms. Digital Filter Design: Filter Structures; FIR filter design: FIR filter design by window method, frequency sampling method, least squares approximation, optimal FIR filter design; IIR Filter Design: Impulse invariant and bilinear transformation methods, Filter design using Butterworth, Chebyshev and elliptic approximations, Spectral transformation technique for HP, BP and BS filter design. Direct design of IIR filters.Applications of DSP.

J.G.Proakis and D.G.Manolakis, Introduction to Digital Signal Processing, PHI, 2007
Ashok Ambardar, "Digital Signal Processing – A Modern Introduction", Thomson, 2007
Sanjit K. Mitra, Digital Signal Processing: A computer based Approach, TMH, 2006

EC273 MICROPROCESSORS LAB (0-0-3)2

Introduction to assembly language programming, C language programming, use of evaluation Boards, interfacing various peripherals and using them.

EC274 DIGITAL SIGNAL PROCESSING LAB (0-0-3) 2

Simulation exercises on linear equation solvers: Digital Filter Design, DFT and spectral analysis, identification of sinusoids in noise. Speech processing, Image processing, Real time experiments using fixed point DSP processor (Assembly language programming) and FPGAs: Waveform generation, Data I/O – effect of sampling and quantization, Digital Filter Implementation – FIR and IIR filter, Implementation of FFT. Design Project

EC280 DIGITAL SYSTEM DESIGN (3-0-2) 4

Review of Combinational and Sequential logic design, digital system design and implementation options, ASICs, PLDs, FPGAs. Programmable ASICs. Digital system modeling, Hardware description based on Hardware Description Languages, VHDL/ Verilog, data path and control path synthesis, Design case

studies, computer aided design tools, Design flow, commercial CAD packages, clocking techniques, Functional simulation, timing analysis, testability and fault tolerance in design.

C.H. Roth, Digital system design using VHDL, PWS Publising, 1998
Samir Palnitkar. "Verilog HDL -A Guide to Digital Design and Synthesis." Pearson Education, 1999.
Zainalabedin Navabi, "Verilog Digital System Design", 2nd Ed., McGraw Hill, 2006.
Michael D. Ciletti, "Modeling, Synthesis, and Rapid Prototyping with the Verilog (TM) HDL", Prentice Hall 1999.
T. R. Padmanabhan and B. Bala Tripura Sundari, "Design through Verilog HDL", John Wiley & Sons, 2004.
Peter Ashenden, The Designer's Guide to VHDL, Morgan Kaufman, 2002
J. Bhaskar, "Verilog HDL Synthesis – A Practical Primer", Star Galaxy Publications, 1998.
Donald Thomas and Philip R. Moorby, "The Verilog Hardware Description Language", Springer publications, 2008.

EC281 RADIATING SYSTEMS (3-1-0) 4

Review of EM theory and Antenna fundamentals, Antenna Radiation characteristics, Wire Antennas, Aperture antennas, Antenna Arrays, Antennas for terrestrial and deep space communication, Radio Wave propagation in various environments.

C.A Ballanis, Antenna Theory, John Wiley, 2005.
J. D Kraus, Antennas, McGraw Hill, 2001.
A.R Harish, M. Sachidananda,Antennas and Wave Propagation, Oxford University Press, 2007.

EC282 CONTROL SYSTEMS (3-1-0) 4

System Modeling: modeling of Electrical and Mechanical (Translational and rotational) Systems. Signal Flow Graphs. Basic requirements of a control system. Steady state error. Root locus technique. Review of Bode plot, phase margin and gain margin. Control System Design : Compensators and Controllers, Lead, lag compensators, proportional, Integral and derivative, PI,PD, PID Controllers, Design of controllers using Bode plots. State Space representation and state space analysis.

B.C.Kuo, Automatic Control Systems, PHI 1995
K.Ogata, Modern Control Engineering, Pearson Education, 2002
R.C.Dorf and R.H. Bishop, Modern Control Systems, Pearson 2008

EC320 ANALOG INTEGRATED CIRCUITS (3-1-0) 4

Operational Amplifier & Linear Applications: Difference amplifiers, Instrumentation amplifiers, voltage to current converters.

Filters : Second order filter transfer function (low pass, high pass, band pass and band reject) , Butterworth response, 2nd order passive filters (RC, RLC), Emulation of inductor using Transconductors-Capacitors, and opamps-R-C, Salen-Key biquadratic filters, Tow-Thomas biquad, Realization of higher order filters, All-pass filter (active phase shifters).

Non-linear application of opamps : Opamp as a comparator, Schmitt trigger (inverting & non inverting), astable multivibrator, Triangular wave generator, Precision rectifiers.

Non idealities of opamps and their effects: Finite gain, finite bandwidth, Offset voltages and currents, Common-mode rejection ratio, Power supply rejection ratio, Slew rate.

CMOS differential amplifiers: DC analysis and small signal analysis of differential amplifer with Restive load, current mirror load and current source load, Input common-mode range and Common-mode feedback circuits. OTAs vs Opamps. Slew rate, CMRR, PSRR.

Two stage amplifiers, Compensation in amplifiers (Dominant pole compensation).

Introduction to Voltage Controlled Oscillators and Phase Locked Loops

Sergio Franco, Design with OPAMPS and Linear Integrated circuits, Tata McGraw Hill, 2002.
Sedra and Smith, Microelectronics Circuits, Oxford Univ. Press, 2004
Coughlin, Driscoll, OP-AMPS and Linear Integrated Circuits, Prentice Hall, 2001.

Carson Chen, Active Filter Design, Hayden, 1987

EC321 DIGITAL COMMUNICATION (3-1-0) 4

Introduction to digital communication systems, Pulse modulation systems, Non-uniform quantization and companding, Waveform coding techniques; Line codes; Base band pulse transmission, Matched filter and Inter symbol interference; Pass Band digital transmission, Digital modulation schemes; Digital signaling over a channel with inter-symbol interference and additive Gaussian noise, Signal design for band limited channels. Optimum demodulator for inter-symbol interference and additive Gaussian noise, coded modulation for bandwidth constraint channels-PSK, QAM & Trellis coded modulation, Linear equalization, decision feedback equalization, adaptive equalization. Introduction to spread spectrum systems. Introduction to coding theory – Entropy, mutual information, Shannon encoding algorithm Shannon Hartley law, source and channel coding theorems, Huffman and Shannon Fano coding, Error control coding: Linear block codes - Hamming Codes, Cyclic codes and Convolutional codes.

S.Haykin, Communication systems, John Wiley 2001
B.Sklar, Digital Communications, Pearson Education, 2001
J.G.Proakis, Digital Communications, McGraw Hill, 2000.

EC322 ANALOG INTEGRATED CIRCUITS LAB (0-0-3) 2

Hardware Experiments :

OPAMPS Linear application: Voltage follower, Non-inverting amplifier and Non-inverting summing amplifier, Inverting amplifier, Inverting summing amplifier, Difference amplifier, Instrumentation amplifier, Voltage to current converter. Inverting integrator, Allpass
filter, Salen-Key biquad,
OPAMP non-linear applications: Opamp based Comparator, Schmitt Trigger (Inverting and non-inverting), astable multivibrator, Triangular wave generator.

Simulation Experiments :

CMOS differential amplifiers : resistive load and Current mirror load, Current source load. Common-mode feedback circuit. Input common-mode range, CMRR and PSRR, Transconductor-Capacitor biquad filter.

EC323 COMMUNICATIONS LAB - I (0-0-3) 2

AM and FM modulation and demodulation, Active equalizers, Video IF, RF timer response, Radio receiver characteristics, Design of active filters, Pulse code modulation, PAM, PWM, PPM, DSB-SC, SSB modulation and demodulation, Carrier recovery, Frequency division multiplexing, Simulation exercises.

EC330 SOFT COMPUTING (3-0-0) 3

Introduction to learning systems - Feed forward Neural Networks - Perception - Multilayer Perceptron propagation algorithm and its variants - Improving generalization by various methods.
Recurrent Neural Networks - Hopfield net - Boltzmann machine and Mean field learning - solving combinational optimization problems using recurrent Neural Networks.
Unsupervised Neural Networks. Competitive learning - Self organizing maps - Growing cell structures Principal component analysis. Basics of fuzzy sets. Genetic algorithms: Population based search techniques, evolutionary strategies, mathematical foundations of genetic algorithms, search operators, genetic algorithms in function and combinational optimization, hybrid algorithms, application to pattern recognition

S. Haykin, Neural Networks : A comprehensive foundation, Pearson, 1999
J. M. Zurada, Introduction to artificial neural networks, Jaico publishing, 1997.
B. Yegnanarayana, Artificial Neural Networks, PHI, 1991

EC331 SATELLITE COMMUNICATION (3-0-0) 3

Introduction to satellite Communications, Space craft, space craft sub systems, Altitude and orbit control systems, Telemetry, tracking and command, Power Systems, Communication sub systems, description of

communication systems, transponders, Space craft antennas, Equipment reliability and space qualification, Multiple access systems, FDMA, FDM/FM/FDMA, TDMA, CDMA spread spectrum transmission and reception. Applicability of CDMA to commercial systems, demand access in the INTELSAT. TDMA system, SPADE, the INMARSAT system, Earth station, Satellite television networks .

T. Pratt, Satellite communications, John Wiley, 2002
T. T. Ha., Digital satellite communication, Collier Macmillan, 1986

EC332 RADAR & ELECTRONIC NAVIGATION SYSTEMS (3-0-0) 3

Introduction to Radar, Basic concepts, Radar equation, Radar systems, elementary Radar signal processing, RADAR cross section, RADAR detection, range & Doppler measurements, tracking, Electronic counter measures, Hyperbola system of navigation, Instrument landing system, Microwave landing systems, Satellite navigation systems.

M.Skolnik, Introduction to Radar system, McGraw Hill 2002.
J.C Toomay, Principles of Radar, Sci-Tech, 2004
R.J Sullivan, Radar foundation for imaging & advanced concepts, PHI, 2004.

EC333 COMMUNICATION NETWORKS (3-1-0) 4

Switching techniques, Multiplexing and Multiple Access techniques, Packet Switched Networks.
OSI and TCP/IP Models, Internet protocols and addressing, networking devices, data links and transmission, LANs and Network of LANS, Wireless Networks and Mobile IP, Routing and internetworking, transport and end to end protocols, congestion control techniques, Application Layer and network management, Network Security. Packet Queues and delays, Little's theorem, Birth and death process, Queuing disciplines, M/M/1 Queues, Burkes and Jackson theorems. Traffic models, ISDN, ATM Networks, Quality of service and resource allocation, VPNs and MPLS, Cellular Telephone and Optical networks, VOIP and Multimedia networking. Mobile Adhoc Networks and Wireless Sensor Networks

Nader F. Mir, Computer and Communication Networks, Pearson Education, 2007
Garcia and Widjaja, Communication Networks, McGraw Hill, 2006
J.F. Hayes, Modelling and analysis of Computer Comm. Networks, Plenum, 1984.
Jean Walrand & Pravin Varaiya, High Performance Communication Networks , Morgan Kaufmann Publishers, 2002

EC334 DIGITAL PROCESSING OF SPEECH & AUDIO SIGNALS (3 – 0 – 0) 3

Speech Production – human speech production mechanism, acoustic theory of speech production, digital models for speech production. Speech perception – human hearing, auditory psychophysics, JND, pitch perception, auditory masking, models for speech perception. Speech Analysis – Time and frequency domain analysis of speech, speech parameter estimation, Linear prediction. Speech compression – quality measures, waveform coding, source coders, Speech compression standards for personal communication systems. Audio processing – characteristics of audio signals, sampling, Audio compression techniques, Standards for audio compression in multimedia applications, MPEG audio encoding and decoding, audio databases and applications. Speech synthesis – text to speech synthesis, letter to sound rules, syntactic analysis, timing and pitch segmental analysis. Speech recognition – Segmental feature extraction, DTW, HMMs, approaches for speaker, speech and language recognition and verification

Douglas O'Shaugnessy, Speech Communication – Human and Machine, IEEE Press, 2000
L R Rabiner, Digital Processing of Speech Signals, Pearson,1978
T.F Quatieri , Discrete-time speech signal processing: Principles and Practise Pearson,2002
Zi Nian Li, Fundamentals of Multimedia, Pearson Education, 2003

EC335 APPLICATION OF SIGNAL PROCESSING ON IMAGE & VIDEO (3–0–0) 3

Digital image fundamentals – image acquisition, representation, visual perception, quality measures, sampling and quantization, basic relationship between pixels, imaging geometry, color spaces, Video spaces, analog and digital video interfaces, video standards. Two dimensional systems – properties,

analysis in spatial, frequency and transform domains. Image transforms - DFT, DCT, Sine, Hadamard, Haar, Slant, KL transform, Wavelet transform. Image enhancement – point processing, spatial filtering, Image restoration – inverse filtering, de-blurring Video processing – display enhancement, video mixing, video scaling, scan rate conversion, Image compression – lossless and lossy compression techniques, standards for image compression – JPEG, JPEG2000. Video compression – motion estimation, intra and interframe prediction, perceptual coding, standards - MPEG, H.264 Image segmentation – feature extraction, region oriented segmentation, descriptors, morphology, Image recognition

R. C. Gonzalez and R E Woods, Digital Image Processing, Pearson Education, 2002
A K Jain, Fundamentals of Digital Image Processing, Pearson Education,1989
W Pratt, Digital Image Processing, Wiley, 2001
Al Bovik, Handbook of Image and Video, Academic Press, 2000
Keith Jack, Video Demystified, LLH, 2001

EC336 EMBEDDED SYSTEMS (3-0-2)4

Embedded Processing: Evolution, Issues and Challenges. Embedded systems and Processor architecture. Memory Systems Architecture: memory devices and their characteristics, Introduction to concept of memory hierarchy, virtual memory and caches. Embedded systems I/O: Interfacing bus, protocols, Timers, Interrupts, DMA, USB, AD and DA converters. Embedded communication: Parallel, serial, network and wireless communication. Embedded Systems software: constraints and performance targets, introduction to RTOS, concept of device drivers. Testing of Embedded systems: performance analysis and optimization.

Steave Heath, "Embedded system design", 2nd edition 2003, Elsevier
K.V.K.K Prasad, "Embedded / Real time systems: Concepts Design & Programming Black Book Black book", Revised edition, DreamTech Press
Jonathan W Valvano, "Embedded Microcomputer Systems: Real Time Interfacing" , Cengage Learning, Jan-2011.

EC340 DIGITAL SYSTEMS & COMPUTER ORGANISATION (3-0-0) 3

Combinational Logic Design, Arithmetic Circuits. Sequential Logic Design, Finite State Machines. Memory, Introduction to Computer Architecture, Programming Model, Hardware Interfacing of Memory & Peripherals, Typical application of Microprocessors

M. Morris Mano & Charles Kime, Logic & Computer Design Fundamentals, Prentice Hall, 2008
M.Morris Mano, Computer System Architecture, Prentice Hall, 2007
John P.Uyemura, A First Course in Digital Systems Design - An Integrated Approach, Brooks/Cole, 2000.

EC341 PRINCIPLES OF COMMUNICATION ENGG (3-0-0) 3

Introduction to Analog and Digital Communication: Bandwidth and Information capacity, Transmission modes, Signal analysis, Noise considerations. Modulation and Demodulation concepts (AM, FM, PM), TDM and FDM concepts. Super Heterodyne receivers and Direct Conversion receivers, Color TV Transmission and reception. Digital and Data Communication: Sampling Theorem, Coding and Decoding, Pulse modulation, FSK, PSK Modem, Serial and Parallel interface, Computer Network configurations and Protocols; OSI Reference model; Internet Protocol; packet switching. Satellite communication: Orbital patterns, geostationary satellites, frequency band allocation. Optical Fiber Communication: Mode of signal transmission, signal source and detectors, attenuation and channel capacity. Digital Telephony, PSTN and Cellular telephony, Voice over packet.

Wayne Tomasi, Electronic Communication Systems: Fundamentals through Advanced, Pearson Education, 2008.
Kennedy, Communication Systems, McGraw Hill,1996
Gary Miller, Modern Electronic Communication, PHI, 2008
Andrew S. Tannenbaum, Computer Networks, PHI, 2003

EC342 COMPUTER NETWORKS (3-0-0) 3

Basics of circuit switching, packet switching, cell switching. ISO-OSI model, need for the model, reasons, advantages etc. Link layer & local area network, Computer network architecture, TCP/IP protocol suite, Routing protocols, Asynchronous transfer mode (ATM), Frame relay concepts, Wireless LAN, Multicasting, Internet security, Voice over IP (VOIP), Storage networks, Socket programming, IPV6, need for IPV6, addressing space, difference between IPV6 and IPV4 etc.

D. E Comer, Internetworking with TCP / IP – Vol. I, Prentice Hall, 2006

James F. Kurose, Keith W. Ross, Computer Networking A Top – Down Approach, Featuring the Internet, Pearson Education, 2005

Andrew S. Tanenbaum Computer Networks, PHI, 2003

EC343 APPLICATIONS OF SIGNAL PROCESSING (3-0-0) 3

Time, frequency and transform domain analysis of signals & systems, Spectral Analysis, Digital Filter Design, Applications of Signal Processing communication, multimedia, entertainment, medicine, surveillance, motion control, embedded systems. Design and simulation tools, Implementation of DSP algorithms options and issues.

James McClellan, RW Schafer, Signal Processing First, Pearson Education, 2003

EC Ifeachor, B W Jervis, DSP, A practical Approach, Pearson Education,2002

Steven W. Smith, The Scientists and Engineers Guide to DSP, (http://www.dspguide.com)

EC344 MICROPROCESSORS AND MICROCONTROLLERS (3-0-0)3

Introduction to Microprocessor Systems:. Introduction to architecture, operation, and application of microprocessors; microprocessor programming; address decoding; system timing; parallel, serial, and analog I/O; interrupts and direct memory access; interfacing to static and dynamic RAM; Introduction to microcontrollers: Overview of the architecture of microcontroller, Assembly language programming and hardware interfacing. Applications of microcontroller.

Douglas V. Hall, Microprocessors & Interfacing, McGraw Hill International Edition, 1992.

Jonathan W Valvano, Embedded Microcomputer Systems: Real Time Interfacing , Cengage Learning,Jan-2011.

Steve Furber, ARM System Architecture, Edison Wesley Longman, 1996.

William Hohl, ARM Assembly Language- Fundamentals and Techniques, CRC Press, 2009

EC370 VLSI DESIGN (3-1-0) 4

Introduction to MOSFETs, MOSFET Equivalent Circuits. MOSFET logic circuits: NMOS inverter, CMOS inverter, CMOS Processing Technology. Layout design rules. CAD tools for VLSI Design. MOSFET Logic gates. CMOS combinational, sequential logic circuits, Flip flop and latch timings, Clocking. Circuit characterization and performance estimation: Resistance, capacitance estimation, Switching characteristics, Delay models. Power dissipation, Packaging, Scaling of MOS transistor dimensions. CMOS subsystem design. Datapath operations: Addition, Multiplication, Counters, Shifters, Memory elements.

Jan M. Rabaey, A. Chandrakasan, and B. Nikolic, Digital Integrated Circuits: A design Perspective, Pearson Education, 2002

S.M.Kang & Y. Leblebici, CMOS Digital Integrated Circuits, McGraw Hill, 2002

Ken Martin, Digital Integrated Circuit Design, Oxford Press, 2000.

EC371 RF AND MICROWAVE ENGINEERING (3-1-0)4

Review of electromagnetic and circuit theory, Micro wave Transmission line theory and co-axial lines. Microwave waveguides and components. Microwave network analysis. Passive and active Microwave devices/circuits, RF amplifiers, oscillators,filters and mixers, RF – Microwave system Design.

David M Pozar , MICROWAVE ENGINEERING, John Wiley, 2004

Samual Y Liao, Microwave devices and circuits PHI 3 rd edition

Reinhold Ludwig and Pavel Bretchko, RF circuit Design: Theory and Applications, PH,2000.

EC372 VLSI DESIGN LAB (0-0-3) 2

Design, Simulation and layout of basic digital blocks
Tools to be used: TANNER, CADENCE, MAGIC, SPICE, ELECTRIC Design Project

EC373 COMMUNICATION LAB - II (0-0-3) 2

Experiments with Klyston bench, Gunn source bench, Antenna characteristic – pattern gain measure, Optical fibres experiments, Simulation exercises

EC380 WIRELESS MOBILE COMMUNICATION (3-0-0) 3

Concepts of cellular communication, Geometry of hexagonal cells; Co-channel interference, cellular system design in worst case, co-channel interference with the use of directional antennas, Cell splitting, Frequency allocation in mobile, Power control, JDC, JDC frame structure, TDMA, TDMA frame, delayed in TDMA, advantages CDMA, Capacity Comparison of FDM /TDM systems and cellular CDMA. Standards for Wireless mobile communication, Micro cells, high way micro cells, spectral efficiency, traffic carried, Signaling and call control; Mobility management, Location tracking. Wireless data networking.

G.L. Sterber, Principles of Mobile Communications, Kluwer Academic, 1996.
T.S .Rappaport, Wireless communications, Principles and Practice, , Pearson Edn, 2002.
William C.Y. Lee, Mobile cellular telecommunication systems: Analog & Digital Systems, McGraw Hill, 1995.

EC381 SPREAD SPECTRUM COMMUNICATIONS (3-0-0) 3

Spread spectrum overview, Spreading techniques, Pseudo noise sequences, Direct sequence spread spectrum system, Frequency hop spread spectrum system, Hybrid systems, Synchronization, Jamming considerations, Commercial applications, Cellular systems, Performance of spread spectrum systems.

R.L.Peterson, Introduction to spread spectrum communication, PH,1995.
B.Sklar, Digital Communications, Pearson Education, 2001.
M.K.Simon, Spread spectrum communications Handbook, McGraw-Hill, 2001.
J.S.Lee, CDMA Systems Engineering handbook, Artech House, 1998

EC382 INFORMATION THEORY AND CODING (3-0-0) 3

Communication systems and Information Theory, Measures of Information, Coding for Discrete sources, Discrete memory-less channels and capacity, Noisy channel coding theorem, Techniques for coding and decoding, Waveform channels, Source coding with Fidelity criterion.

Thomas M Cover & Joy A Thomas, Elements of Information Theory, John Wiley,1991
R.G.Gallagher, Information Theory and Reliable Communication, Addison Wesley, 1987.
A.J.Viterbi & J.K. Omura, Principles of Digital Communications and Coding, McGraw Hill, 1979.

EC383 ERROR CONTROL CODING (3-0-0) 3

Coding for reliable digital transmission and storage. Groups, Rings, Vector Spaces, Galois Fields, Polynomial rings, Channel models, Linear Block codes, Cyclic codes, BCH codes, Reed Solomon Codes, Berlekamp-Massey and Euclid decoding algorithm, Decoding beyond the minimum distance parameter, Applications of Reed-Solomon codes, Convolutional codes, Decoding algorithms for Convolutional codes, Viterbi, Stack and Fano algorithms, Application of Convolutional codes. Codes based on the Fourier Transform, Algorithms based on the Fourier Transform, Trellis coded modulation, Combinatorial description of Block and Convolutional codes, Algorithms for the construction of minimal and tail biting trellises, Soft decision decoding algorithms, Iterative decoding algorithms, Turbo-decoding, Two-way algorithm, LDPC codes, Use of LDPC codes in digital video broadcasting, belief propagation (BP) algorithms, Space-Time codes.

Shu Lin and Daniel J. Costello Jr., Error Control Coding: Fundamentals and Applications, Prentice Hall, 2003.
S. B Wicker, Error Control Systems for Digital Communication and Storage, Prentice Hall International, 1995.
Blahut R. E, Theory and Practise of Error Control Codes, Addison Wesley, 1983.
Blahut R.E., Algebraic codes for Data transmission, Cambridge University Press, 2003.

EC384 ADHOC AND SENSOR NETWORKS (3-0-0) 3

Mobile ad hoc networks and wireless sensor networks concepts and architectures. Routing: proactive routing, Broadcasting and multicasting, TCP over mobile ad hoc networks,Wireless LAN (WiFi) standards, Medium Access Control Protocol issues power control, spatial reusability, and QoS, Bluetooth, Wireless sensor networks architecture: hardware and software components of a sensor node, OS for WSN, WSN MAC layer strategies; naming and addressing; Clock Synchronization; Node Localization; WSN Routing.

C Sivarama Murthy and B S Manoj, Ad-Hoc Wireless Networks, Architectures and Protocols, PH , 2004.
Labiod.H, Wireless Adhoc and sensor networks, Wiley, 2008.
Li,X , Wireless ad hoc and sensor networks: theory and applications, Cambridge University Press,2008

EC385 OPTICAL COMMUNICATION SYSTEMS AND NETWORKS (3-1-0)4

Introduction to Optical Fibers, Ray Optics-Optical Fiber Modes and Configurations. Signal degradation in Optical Fibers. Optical Sources and Detectors. Optical Communication Systems and Networks. Basic concepts of SONET/SDH Networks.

J.Senior, Optical Communication, Principles and Practice, Prentice Hall of India, 1994/latest edition.
Gerd Keiser, Optical Fiber Communication McGraw –Hill International, Singapore, 3rd ed., 2000/latest edition
J.Gower, Optical Communication System, Prentice Hall of India, 2001.

EC386 CRYPTOGRAPHY AND DATA SECURITY (3-0-0) 3

Elementary Number Theory, Finite series, Arithmetic and Algebraic Algorithms, Secrete key and Public key Cryptography, Pseudo Random bit generators, Block and Stream Ciphers, Hash functions and Message digests, Public key encryption, Authentication, Digital Signatures, Zero Knowledge Interactive Protocols, Elliptic curve cryptosystems, formal verification, Crypt analysis, Hard Problems.

Koblitz N., A Course on Number Theory and Cryptography, Springer Verlag, 1986.
Menezes A. et. all, Handbook of Applied Cryptography, CRC Press, 1996

EC387 COMPUTER ARITHMETIC (3-1-0) 4

Number Representation : Numbers and Arithmetic, Representing Signed Number, Redundant Number Systems, Residue Number Systems, Double base number systems, Addition/Subtraction: Basic Addition and Counting, Carry-Look ahead Adder, Variations in Fast Adders, Multi-Operand Addition, Multiplication: Basic Multiplication Schemes, High-Radix Multipliers, Tree and Array Multipliers, Variations in Multipliers, Division: Basic Division Schemes, High-Radix Dividers, Variations in Dividers, Division by Convergence, Real Arithmetic: Representing the Real Numbers, Floating-Point Arithmetic, Arithmetic Errors and Error Control, Precise and Certifiable Arithmetic, Function Evaluation: Square-Rooting Methods, The CORDIC Algorithms, Variations in Function Evaluation, Arithmetic by Table Lookup, Implementation Topics : High Throughput Arithmetic, Low-Power Arithmetic, Fault-Tolerant Arithmetic, Past, Present, and Future

I. Koren, Computer Arithmetic Algorithms, 2nd Edition, A. K. Peters (part of CRC Press), 2002
M. Ercegovac and T. Lang, Digital Arithmetic, Morgan Kaufman, 2003.
B. Parhami, Computer Arithmetic: Algorithms and Hardware Design, Oxford University Press 2000.
Literature from the web including the proceedings of IEEE Intl. Conference on Computer Arithmetic.

EC388 MATRIX THEORY AND STOCHASTIC PROCESS (3-1-0) 4

System of Equations - Homogenous equations, basic solutions, Echelon matrices, Linear independence, Rank, Inverse, Similarity, Eigen value analysis and Diagonalization, Vector Spaces: Linear Transformations, Subspaces, Linear Independence, Basis, Change of Coordinates, Orthogonal Transformations and applications. Probability - Probability space and definitions, Joint and Conditional probability, Bayes theorem. Random Variable - Definition, discrete and continuous, probability distribution and density, mass functions, Joint and conditional distributions Expectation, Moments and moment generating functions, Inequalities, limit theorems, random vectors, vectorized moments, mean and covariance, Random processes.

G. Strang, Linear Algebra and its applications, Thomson Learning, 2003.

Defranza and Gagliardi, Introduction to Linear Algebra with applications, Tata McGraw Hill, 2012

S. Lipschutz, Schaum's outline series of Linear Algebra, Tata Mc Graw Hill, 2012

H. Stark and JW Woods, Probability and Random processes with applications to signal processing, Pearson Ed, 2002

Peebles, Probability Random Variables and Random Signal Principles, McGraw Hill, 2002

EC430 ADVANCED TOPICS IN COMMUNICATION ENGG (3-0-0) 3

Fading Channels, characterizing Mobile radio propagation, Signal time spreading, time variance of channel, mitigating the degradation effects of fading, characterizing fading channels, Fundamentals of Statistical Detection Theory, Baye's Theorem, Decision theory, Neyman Pearson Theorem, Receiver operating characteristics, Bayes's risk. Multiple hypothesis testing, minimum Baye's risk detection for binary hypothesis and multiple hypothesis, Orthogonal Frequency Division Multiplexing, OFDM transmission technique, synchronization, modulation, demodulation, amplitude limitation of OFDM signals. Space Time Wireless Communications, Introduction, space time propagation, space time channel and signal models, spatial diversity, space time OFDM

B.Sklar, Digital Communications: Fundamentals and Application, Pearson Education, 2001.

J.G.Proakis & M.Salehi, Communications System Engineering, Pearson Education 2002.

Stevan M Kay, Fundamentals of Statistical signal processing, Vol. II, Detection Theory, PHI, 1998.

A.Paulraj, R.Nabar & D.Gore,Introduction to Space Time Wireless Communications, Cambridge University, 2003.

EC431 ADVANCED DIGITAL SIGNAL PROCESSING (3-0-0)3

Power spectral estimation; Parametric and non-parametric methods of spectral estimation, Linear prediction, Higher order spectral estimation; Adaptive filters and applications. Recursive estimation and Kalman filters;Multirate Signal Processing: Decimation Interpolation, DFT filter banks, QMF filter banks, Multiresolution Signal analysis wavelets theory of sub band decompositions, Sub band codingand wavelet transforms, Application of wavelet transforms.

P.P. Vaidyanathan, Multirate systems and Filter banks, Prentice Hall, 1993.

S.J. Orfanidis, Optimum Signal Processing, McGraw Hill, 1989.

S. Haykin, Adaptive FilterTheory, Pearson, 1996

EC432 MAPPING DSP ALGORITHMS TO ARCHITECTURE (3-0-0) 3

Real time signals and digital signal processing – Processor architectures General Purpose architectures and custom VLSI design, Representations of DSP algorithms dataflow graphs, recursive equations, Iteration bound, Critical paths and limits on implementation speed – Pipelining and parallel processing, Retiming methodology, Unfolding/Folding transformation, register minimization techniques Systolic architectures, mapping algorithms to array structures. Arithmetic: Fixed point, floating point and residue arithmetic, Multiply and Divide algorithms, MAC, Cordic architectures, Issues in arithmetic system design; Algorithms for fast implementation of convolution, FIR, IIR and adaptive filters, DCT, analysis of finite word length effects, Low power designs strategies

K.K. Parhi, "VLSI Digital signal processing systems: Design and implementation", John Wiley, 1999.

Lars Wanhammar, "DSP Integrated Circuits", Academic Press, 1999
Sanjit K. Mitra, "Digital Signal Processing: A computer based Approach", TMH, 2006

EC433 MULTIMEDIA COMMUNICATION TECHNIQUES (3-0-0) 3

Representation of Multimedia Data, Concept of Non-Temporal and Temporal Media, Basic Characteristics of Non-Temporal Media, Images, Graphics, Text, Basic Characteristics of Temporal Media, Video, Audio, Animation, Basics of Morphing, Hypertext and Hypermedia, Multimedia Presentations, Synchronization. Compression of Multimedia Data, Basic concepts of Compression, Still Image Compression JPEG Compression, Natural Video Compression, MPEG-1&2 Compression Schemes, MPEG-4 Video Compression, Audio Compression Introduction to Speech and Audio Compression, MP3 Compression Scheme, Management of Coded Data ,Stream management in MPEG-4 , BIFS, DMIF Multimedia System Design, General Purpose Architecture for Multimedia Processing, Operating System Support for Multimedia, Data, Resource Scheduling with real-time considerations, File System, I/O Device Management, Delivery of Multimedia data, Network and Transport Protocols, QoS issues, RTP and RSVP, Video-conferencing and video-conferencing standards, Overview of Voice over IP, Multimedia Information Management, Multimedia Data base Design, Content Based Information Retrieval, Image Retrieval, Video Retrieval, Overview of MPEG-7.

Ralt Steinmetz and Klara Nahrstedt, Multimedia : Computing, Communication & Applications, Pearson Education Publications, 2004.

EC434 REAL TIME DIGITAL SIGNAL PROCESSING (2-0-2)3

Introduction to DSP systems and architecture; Arithmetic: Fixed point, floating point and residue arithmetic, Cordic architectures; Real time implementation of SP algorithms on Digital Signal Processors: Architecture and programming; Real time implementation of SP algorithms on Reconfigurable architectures: Architecture and design flow; Issues in implementation of convolution, FIR, IIR and adaptive filters, DCT, Image Filtering, Dynamically reconfigurable architectures for SP, Software Configurable processors, Application case studies in multimedia compression and communication

BehroozParhami, "Computer Arithmetic Algorithms and Hardware Design", Oxford, 2000.
RulphChassaing, " Digital Signal Processing and Applications with the C6713 and C6416 DSK", Wiley, 2005
U. Meyer Baesse, "Digital Signal Processing with FPGAs", Springer, 2001
ShehrzadQureshi, "Embedded Image Processing on the TMS320C6000 DSP" Springer, 2005

EC435 VLSI SYSTEMS AND ARCHITECTURE (3-0-0) 3

Instruction set architectures of CISC, RISC and DSP Processors. CISC Instruction set implementation, Microprogramming approaches. Pipeline implementation of RISC instruction set. Implementation of DSP instruction set. Instruction level parallelism – Dynamic scheduling, Dynamic hardware prediction, hardware based speculation, ILP through software approaches – VLIW, IA64 architecture as a case study, Memory hierarchy design, Multiprocessors, thread level parallelism and multi-core architectures, I/O buses. Arithmetic: Fixed point, Floating point and residue arithmetic, Multiply and Divide Algorithms, Issues in arithmetic system design Issues in the applications (optimizing the hardware – software interface), ASIP, reconfigurable computing, Future microprocessor architectures.

D. A. Patterson and J. Hennessy, Computer Architecture: A Quantitative Approach, Harcourt Asia, 2003.
D. A. Patterson and J. Hennessy, Computer Organization and Design, Harcourt Asia, 1998.
Flynn and Oberman, Advanced Computer Arithmetic Design, Wiley 2001
Behrooz Parhami, Computer Arithmetic Algorithms and Hardware Design, Oxford, 2000.

EC436 SYNTHESIS AND OPTIMIZATION OF DIGITAL CIRCUITS (3-0-0) 3

Introduction to Computer aided synthesis and optimization. Hardware Modeling. Two level combinational logic optimization. Multiple level combinational optimization. Sequential logic optimization. Cell Library Binding. State of the art and future trends: System level synthesis and hardware software co-design.

Giovanni De Micheli, Synthesis and Optimization of Digital Circuits, McGraw Hill, 1994.

Srinivas Devadas, Abhijith Ghosh and Kurt Keutzer, Logic Synthesis, Kluwer Academic, 1998.

G. D. Hachtel and F. Somenzi, Logic Synthesis and Verification Algorithms, Kluwer Academic Publishers, 1996.

S. Hassoun and T. Sasao, (Editors), Logic Synthesis and Verification, Kluwer Academic publishers, 2002.

EC437 ACTIVE FILTERS (3-0-0)3

Butterworth, Chebyshev & Inverse-Chebyshev filter response and pole locations; LC ladder filter – prototype & synthesis; Frequency transformation of lowpass filter. Impedance converters; Gm-C filters – Gm-C biquad, Q-enhancement, Automatic Tuning; Active-RC filters – Comparison with Gm-C filter, Issues in realizing high frequency active-RC filters; Characterization of on-chip integrated continuous time filters.

R. Schaumann and M.E. Van Valkenburg, Design of Analog Filters, Oxford University Press, 2003.

P. V. Ananda Mohan, Current-Mode VLSI Analog Filters - Design and Applications, Birkhauser, 2003

M.E. Van Valkenburg, Analog Filter Design, Oxford University Press, 1995.

EC438 TECHNIQUES IN LOW POWER VLSI (3 – 0 – 0) 3

Introduction to Low Power VLSI. Modeling and Sources of Power consumption. Power estimation at different design levels. Power optimization for combinational circuits and sequential circuits Voltage scaling Approaches. Low energy computing using energy recovery techniques. Low Power SRAM architectures. Software design for low power. Computer Aided Design Tools. Case studies Recent trends in low-power design for mobile and embedded application.

Kaushik Roy and Sharat Prasad, Low-Power CMOS VLSI design, John Wiley, 2000.

Anantha P.Chandrakasan & Robert W. Brodersen, Low Power Digital CMOS Design, Kluwer Academic Publications, 1995.

Gary K. Yeap, Practical Low Power Digital VLSI Design, Kluwer Academic Publications, 1998

EC439 SUBMICRON DEVICES (3 – 0 – 0) 3

Review of basic device physics. MOS capacitor. Transistor theory. Scaling - Moore's law on technology scaling, MOS device scaling theory, Short channel effects, sub threshold leakage, Punch through, DIBL, High field mobility, Velocity saturation and overshoot. Reliability. Various definitions of channel length, Performance metric of digital technology, Transistor design trade-offs, Technology case studies, Silicon on Insulator (SOI) devices, Partially depleted and fully depleted SOI, Floating body effects, SOI for low power, Interconnects in sub micron technology, Foundry technology, International Technology Roadmap for Semiconductors (ITRS)

Yaun Taur, Tak H. Ning, Fundamentals of modern VLSI devices, Cambridge university press, 1998.

B. G. Streetman & S. Banerjee, Solid State Electronic Devices, Prentice Hall, 1999.

M. K. Achuthan and K. N. Bhat, Fundamentals of Semiconductor Devices, McGraw Hill, 2006

A. K. Dutta, Semiconductor Devices and Circuits, Oxford Univ. Press, 2008.

M. S. Tyagi, Introduction to Semiconductor Materials and Devices, John Wiley, 1991

ITRS Road map - http://public.itrs.net/

EC440 VLSI CAD (3-0-0)3

Introduction to VLSI CAD: VLSI design methodologies, use of VLSI CAD tools, Algorithmic Graph Theory, computational Complexity and ROBDD; Partitioning and placement: KL algorithm, FM algorithm etc.; Floor planning: Sliced and non-sliced planning, Polish expression, Simulated annealing, partition based placement; Routing: Global routing, detailed routing, graph models, Line Search, Maze

Routing, Channel routing; High Level Synthesis: Introduction to HDL, HDL to DFG, operation scheduling: constrained and unconstrained scheduling, ASAP, ALAP, List scheduling, Force directed scheduling, operator binding; Static Timing Analysis: Delay models, setup time, hold time, cycle time, critical paths, Topological vs logical timing analysis, False paths, Arrival time (AT), Required arrival Time (RAT), Slacks.

Sabih H. Gerez, Algorithms for VLSI Design Automation, John Wiley, 1998.
Majid Sarrafzadeh and C. K. Wong, An Introduction to VLSI Physical Design, McGraw Hill, 1996.
Naveed Sherwani, Algorithms for VLSI Physical Design Automation, Kluwer Academic Pub., 1999.

EC441 MEMS AND NANO TECHNOLOGY (3-0-0) 3

Introduction, emergence, devices and application, scaling issues, materials for micro- and nano-scale size domains; MEMS materials and processes; MEMS devices and applications; nanostructures in semiconductors and metals; introduction to quantum effects in nanostructures; nanostructure applications. Fabrication Technologies: MEMS Sensors and Actuators, Nanostructures, Nanoelectronic Semiconductor Devices, Quantum Devices in Nanostructures

Chang Liu, "Foundations of MEMS", Prentice Hall, 2006
Gabriel M. Rebiez, "RF MEMS: Theory, Design, and Technology", John Wiley & Sons, 2003
G.K. Ananthasuresh, K.J. Vinoy, S. Gopalakrishnan, K.N. Bhat and V.K. Aatre, Micro and Smart Systems. John Wiley & Co,2011
V.K. Varadan, K.J. Vinoy, and K.A. Jose, RF MEMS and their Applications. London: John Wiley, 2010.
Stepan Lucyszyn, "Advanced RF MEMS", Cambridge univ. Press, 2010.
Springer Handbook of Nanotechnology, 2011
Neeraj K. Jha et. al., "Nanoelectronic Circuit Design", Springer Publications, 2011
Lundstrom and Guo, "Nanoscale Transistors", Springer Publications, 2006

EC442 RF IC DESIGN (3-0-0)3

Basic concepts in RF Design – harmonics, gain compression, desensitization, blocking, cross modulation, intermodulation, inter symbol interference, noise figure, Friis formula, sensitivity and dynamic range; Receiver architectures – heterodyne receivers, homodyne receivers, image-reject receivers, digital-IF receivers and subsampling receivers; Transmitter architectures – direct-conversion transmitters, two-step transmitters; Low noise amplifier (LNA) – general considerations, input matching, CMOS LNAs; Downconversion mixers – general considerations, spur-chart, CMOS mixers; Oscillators – Basic topologies, VCO, phase noise, CMOS LC oscillators; PLLs – Basic concepts, phase noise in PLLs, different architectures.

Behzad Razavi, RF Microelectronics, Prentice Hall PTR, 1997
Thomas H. Lee, The design of CMOS radio-frequency integrated circuit, Cambridge University Press, 2006
Chris Bowick, RF Circuit Design, Newnes, 2007

EC443 VLSI TESTING AND TESTABILITY (3-0-0)3

Overview of testing and verification, Defects and their modeling as faults at gate level and transistor level. Functional V/s. Structural approach to testing. Complexity of testing problem. Controllability and observability. Generating test for a signal stuck-at-fault in combinational logic. Algebraic algorithms. Test optimization and fault coverage. Logic Level Simulation – Delay Models, Event driven simulation, general fault simulation (serial, parallel, deductive and concurrent). Testing of sequential circuits. Observability through the addition of DFT hardware, Adhoc and structured approaches to DFT – various kinds of scan design. Fault models for PLAs, bridging and delay faults and their tests. Memory testing, Testing with random patterns. The LFSRs and their use in random test generation and response compression (including MISRs), Built-in self test.

M. Abramovici, M. A. Breuer, and A. D. Friedman, Digital Systems Testing and Testable Design, IEEE Press, 1994.

M. L. Bushnel and V. D. Agarwal, Essentials of Testing for Digital, Memory and Mixed – Signal VLSI Circuits, Kluwer Academic Publishers, 2000.
Ajai Jain, Learning Module for the course - VLSI Testing and Testability, IIT, Kanpur, 2001.

EC444 ADVANCED TOPICS IN VLSI DESIGN (3 – 0 – 0) 3

Introduction to digital systems engineering, Modeling and analysis of wires; Circuits; Power distribution; Noise in digital systems; Signaling conventions; Advanced signaling techniques; Timing conventions; Synchronization; Signaling circuits; Timing circuits; Packaging of digital systems

Neil Weste and David Harris, CMOS VLSI Design : A Circuits and Systems Perspective, Addison Wesley, 2005
William J. Dallly and John W. Poulton, Digital Systems Engineering, Cambridge Univ. Press, 2004

EC445 NUMBER THEORY AND APPLICATIONS IN E&C ENGG (3-1-0) 4

Basic Number Theory: Prime numbers, Divisibility and GCD, Congruences, Powers, Fermat's Little theorem, Euler's theorem, Euler's totient function, Chinese Remainder theorem, Diophantine equations, Fibonacci Sequence and properties, Lucas Sequences. Alternate Number Systems: Need for alternate number systems, Positional and Non weighted number systems, Residue Number system (RNS), Double base
number system(DBNS), Implications on Processor architectures and Implementations. Signal Processing and Number Theory: Review of DFT and circular convolution, Number theory and DFT, Consequences of Euler's theorem for Signal Processing, Groups, Rings and Fields in DSP, Polynomial Theory, Fast Convolution Algorithms, Processor Architectures. Cryptography: Mathematical Background, Encryptions and block ciphers, DES, Prime number generation and primality tests, RSA. Communication Engg: PN sequences, Polynomials and Euclidean algorithm, Generation of PN sequences application of PN sequences.

Joseph Silverman, A friendly introduction to Number Theory, Pearson Ed. 2009
Manfred Schoreder, Number Theory in Science and Communication, Springer Verlag 2006.
Stephen Vajda, Fibonacci and Lucas Sequences and the Golden Section: Theory and Applications, Dover Publications, 2007
Bruce Schienier, Applied Cryptography, John Wiley and Sons, 1996
John McCllelan and Rader, Number Theory in Signal Processing and Applications, Prentice Hall Inc, 1979

EC447 PATTERN RECOGNITION AND MACHINE LEARNING (3-1-0) 4

Statistical foundations, Different Paradigms of Pattern Recognition, Probability estimation, Proximity measures, Feature extraction, Feature extraction, Different approaches to Feature selection, Nearest Neighbour Classifier and variants, Efficient implementations, Prototype selection. Bayes classification. Linear models, regression, logistic regression, neural networks, objective function and learning, back propagation. Kernel based methods, support vector machines. Dimensionality reduction, principal component analysis, reconstruction, discriminanant analysis. Clustering, K-means algorithm, distance measure, objective function, initialization. Anomaly detection, recommender systems. Scaling of algorithms.

R. O. Duda, P. E. Hart and D. G. Stork Pattern Classification, Wiley Publications, 2001
D. McKay Information Theory, Inference, and Learning Algorithms, Cambridge University Press 2003
C. M. Bishop Pattern Recognition and Machine Learning, Springer, 2006

EC451 DETECTION AND ESTIMATION THEORY (3-0-0) 3

Preliminaries on probability and random processes. Hypothesis testing: Neyman-Pearson theorem, likelihood ratio test and generalized likelihood ratio test, uniformly most powerful test, multiple-decision problem, detection of deterministic and random signals in Gaussian noise, detection in nonGaussian noise, sequential detection. Parameter estimation: unbiasedness, consistency, Cramer-Rao bound, sufficient statistics, Rao-Blackwell theorem, best linear unbiased estimation, maximum likelihood estimation, method of moments. Bayesian estimation: MMSE and MAP

estimators, Levinson-Durbin and innovation algorithms, Wiener filter, Kalman filter. Applications in Wireless Communication, Radar Systems, Speech, Image and Video processing and any other applicantion relevant to Engineering with emphasis on E&C.

H. V. Poor, An Introduction to Signal Detection and Estimation, Springer-Verlag, 2nd edition, 1994.

H. L. Van Trees, Detection, Estimation and Modulation Theory, Parts 1 and 2, John Wiley Inter-Science, 2002.

Steven Kay, Fundamentals of Statistical Signal Processing - Estimation Theory (Vol. 1), Prentice Hall, 1993.

Steven Kay, Fundamentals of Statistical Signal Processing - Detection Theory (Vol. 2), Prentice Hall, 1998.

M. D. Srinath, P. K. Rajasekaran and R. Vishwanathan, An Introduction to Statistical Signal Processing with Applications, Prentice-Hall, 1996.

Kailath,Sayed and Hassibi, Linear Estimation, Pearson, 2000.

EC452 DYNAMICAL SYSTEMS, CHAOS AND FRACTALS (3-0-0) 3

Preliminaries on linear equations, eigen values and eigen vectors, solutions of linear ODEs. dynamics of linear and nonlinear systems, solutions, attractors, equilibrium point, limit cycles, stability. Linear systems: solutions, stability of autonomous systems, BIBO stability, relation to frequency domain analysis. Nonlinear systems: large-scale notions of stability (Lyapunov functions), linearization.

Vector fields of nonlinear systems, limit cycles, Lorenz and Rossler equation, Chua's circuit, discrete dynamical systems, logistic maps, two dimensional maps, bifurcations, flows, phase plane analysis.

Introduction to fractals, Mandlebrot and Julia sets, iterated function systems, strange attractors, fractal dimension, stable and unstable manifolds, analysis of chaotic time series, multifractals

Applications in various fields that include, Control theory, Signal processing, Digital image modeling, synthesis and compression, Chaos communication and Cryptography. Other applications in engineering, natural and social sciences, medicine, economics, ecology, bio and life sciences, and environmental sciences.

S. Stenberg, Dynamical systems, Dover 2010.

MW Hirsch, S. Smale, RL Devaney, Differential equations, dynamical systems, and an introduction to chaos, Academic Press. 2012.

Steven H. Strogatz, Nonlinear dynamics and chaos: with applications to physics, biology, chemistry, and engineering, West-view Press, 2015.

E. Ott, Chaos in dynamical systems, 2nd ed Cambridge University Press, 2002

S. Wiggins, Introduction to applied nonlinear dynamical systems and chaos, Springer-Verlag, 1990.

Denny Gulick, Encounters with chaos and fractals, 2nd ed CRC Press, 2012

J.M. Bahi, C. Guyeux, Discrete dynamical systems and chaotic machines: theory and applications, CRC Press, 2013.

M. Barnsley, Fractals everywhere, Academic Press, 1993.

EC453 STATISTICAL ANALYSIS AND APPLICATIONS (3-0-0)3

Preliminaries on matrix theory and probability distributions. Sampling theory: random samples, sampling distribution, statistical inference, estimation of mean and variances, hypothesis testing, statistical tests, goodness of fit. Data analysis: correlation and regression, simple linear regression, multiple linear regressions, logistic regression, nonlinear regression.

The Multivariate Normal Distribution, Estimation of the Mean Vector and the Covariance Matrix,The Distributions and Uses of Sample Correlation Coefficients, The Generalized T2-Statistic, Classification of Observations, The Distribution of the Sample Covariance Matrix and the Sample Generalized Variance, Testing the General Linear Hypothesis: Multivariate Analysis of Variance, Testing Independence of Sets of Variates, Testing Hypotheses of Equality of Covariance Matrices and Equality of Mean Vectors and Covariance Matrices, Principal Components, Canonical Correlations and Canonical Variables, The Distributions of Characteristic Roots and Vectors, Factor Analysis, Pattern of Dependence, Graphical Models.

Applications in various fields that include Signal and Image modeling and analysis, Communication systems analysis, Pattern recognition and machine learning. Other applications in engineering, natural and social sciences, medicine, bio and life sciences, economics and finance, any other areas.

Sam Kash Kachigan, Statistical Analysis: An Interdisciplinary Introduction to Univariate and Multivariate Methods, Radius Press, 1986.
RA Johnson, DW Wichern, Applied multivariate statistical analysis, 6th ed, PHI, 2012
T. W. Anderson, An Introduction To Multivariate Statistical Analysis, 3rd Edition, Wiley, 2003.
Sam Kash Kachigan, Multivariate Statistical Analysis: A Conceptual Introduction, Radius Press, 1991
Robert Nisbet, John Elder and Gary Miner, Handbook of Statistical Analysis and Data Mining Applications, Elsevier Inc 2009.

EC454 NUMERICAL ANALYSIS AND APPLICATIONS (3-0-0)3

Preliminaries on numerical analysis, solutions of equations, errors and measuring efficiency in numerical analysis, matrix analysis, linear systems of equations.
Solution of equations in one and multiple variables, direct method, iterative techniques in matrix algebra, elimination method, inverse of a matrix, ill conditioned systems, eigen values, eigen vectors, LU and QR factorization.
Solving nonlinear equations, bisection, Newton's method, Mullers method, fixed point interpolation, steepest descent.
Interpolation and curve fitting: interpolating polynomials, spline curves, interpolation on a surface, least square approximations.
Approximation of functions: Chebyshev polynomials, rational function approximation.
Numerical differentiation and integration, solution of ordinary differential equations: Taylor series method, Euler method, Runge-Kutta method.
Solution of partial differential equations, finite element methods, optimization.
Applications in Circuit simulators for design and analysis of circuits (including VLSI circuit simulators), Microwave techniques and antennas, Numerical Software packages,

CF Gerald, Applied numerical analysis, 7th ed Pearson 2004
RL Burden, JD Faires, Numerical analysis, 9th ed Cengage Learning 2011
LV Fausett, Applied numerical analysis using MATLAB, 2nd ed Pearson 2009
Philippe G. Ciarlet , Introduction to Numerical Linear Algebra and Optimisation, Cambridge Texts in Applied Mathematics, 1989
Gene H. Golub, Matrix computations, 3rd ed, Johns Hopkins Studies in the Mathematical Sciences, 1996.
James Demmel, Applied Numerical Linear Algebra, SIAM 1997
Biswa Nath Datta, Numerical methods for linear control systems, Design and Analysis, Elsevier 2003.

EC455 STOCHASTIC PROCESSES AND APPLICATIONS (3-0-0)3

Review of Probability theory and stochastic processes, stochastic processes and linear systems, Gaussian random process, spectral analysis of stationary processes, Power Spectral Densities, Stationarity and Ergodicity, Optimal Linear Systems, Wiener Filters, discrete and continuous time Markov chains, discrete time branching processes, birth and death processes, random walks, large deviations and Martingales, Poisson processes, renewal processes, Brownian motion, Queueing theory Diffusion processes and stochastic differential equations, the Fokker-Planck and Langevin Equations. Applications in Communication engineering and Signal processing, Wireless systems, Detection, estimation and control, Computer networks, Optical communication, Speech modeling and recognition, Modeling of neural processes, Radar and automatic control. Other applications in epidemic, competition, predation and population genetics, mathematical finance, and processes in natural and social sciences.

Richard Durrett, Essentials of Stochastic Processes (Springer Texts in Statistics) May 2001.
R G Gallager, Stochastic processes: theory for applications, 2013.
W. Paul and J. Baschnagel: Stochastic Processes – From Physics to Finance, Springer, 1999.
Frank Beichelt, L. Paul Fatti, Stochastic Processes and Their Applications, CRC Press, 2001.
Petar Todorovic, An Introduction to Stochastic Processes and Their Applications, Springer, 1992.

EC456 COMPLEX ANALYSIS WITH APPLICATIONS (3-0-0)3

Complex numbers: algebra, representation, polar forms, complex exponential, powers and roots, topological representation, Riemann sphere and stereographic representation.
Analytic functions: limits and continuity, analyticity, CR equations, harmonic functions, elementary functions: polynomials, rational functions, exponential, hyperbolic functions, complex integration: contour integrals, Cauchy's

integral theorem, bounds for analytic functions, Series representation for analytic functions: Taylor series, power series, Laurent series, singularities, Residue theory: improper integrals, Conformal mapping, Entire and meromorphic functions, applications of harmonic functions, Fourier series and Laplace transform.
Applications in Circuit Simulators, Electromagnetism (time-harmonic fields), Electrostatics (solutions to Laplace's equation), and in various other fields of engineering and, natural and applied sciences.

S Ponnusamy, H Silverman, Complex variables with applications, Birkhauser, 2006.
JH Mathews, RW Howell, Complex analysis for mathematics and engineering, Jones and Bartlett, 2001.
Edward B. Saff, Arthur David Snider, Fundamentals of Complex Analysis with Applications to Engineering, Science, and Mathematics, Pearson Education 2003
Kozo Sato, Complex Analysis for Practical Engineering, Springer, 2015.
Cohen, Harold, Complex Analysis with Applications in Science and Engineering, Springer, 2007.
JW Brown, RV Churchill, Complex variables with applications, 8th ed, McGraw Hill 2009.

EC457 FOURIER AND WAVELET SIGNAL PROCESSING (3-1-0) 4

Hilbert Spaces, Review of sequences and discrete time systems, functions, DTFT, convergence, multi rate systems, polyphase representation, stochastic processes and systems. Continuous time systems, Fourier transform, definition, existence, spectral decay, Fourier series. Sampling and Interpolation – finite dimensional vectors, sequences, functions, periodic functions, approximation and compression – polynomial and spline approximation. Localization and uncertainity.
Filter banks – Localization, two channel orthogonal filter banks, design, biorthogonal filter banks, design. Local fourier bases – N channel filter banks, exponentially modulation filter banks, cosine modulated filter banks. Wavelet bases on sequences, Tree structured filter banks, orthogonal, bi-orthogonal bases, wavelet packets, frames. Wavelet bases on functions – local fourier transforms,

Martin Vetterli Jelena Kovacevic & Vivek K. Goyal, Foundations of Signal Processing, Cambridge University Press 2015
J. Kovacevic, V. K. Goyal and Martin Vetterli, Fourier and Wavelet Signal Processing, Cambridge University Press 2013

EC458 MATHEMATICAL ALGORITHMS FOR SIGNAL PROCESSING (3-1-0) 4

Mathematical Foundations – mathematical models, random variables and random processes, markov and hidden markov models. Represenations and approximations - orthogonality, least squares, MMSE filtering, frequency domain optimal filtering, minimum norm solutions, Iterated reweighted least squares. Linear Operators – Operator norms, adjoint and transposes, geometry of linear equations, least squares and pseudo inverses, applications to linear models. Subspace methods – Eigen decomposition, KL transform and low rank approximation, Eigen filters, signal subspace techniques – MUSIC, ESPRIT. SVD – matrix structure, pseudo inverse and SVD, system identification using SVD, Total least squares, partial total least squares. Special matrices – Toeplitz matrices, optimal predictors and lattice filters, circulant matrices, properties.

Todd Moon and WC Stirling, Mathematical Methods and Algorithms for Signal Processing, Pearson Education, 2000
Steven, M. Kay, Modern spectral estimation: theory and application, Prentice Hall, 1988.

CV110 ENVIRONNEMENTAL STUDIES (1-0-0) 1

HU111 PROFESSIONAL ETHICS AND HUMAN VALUES (1-0-0) 1

EC233 MINI PROJECT IN ELECTRICAL CIRCUITS (0-0-3) 2

EC283 MINI PROJECT IN DIGITAL SYSTEM DESIGN (0-0-3) 2

EC284 MINI PROJECT IN DIGITAL SIGNAL PROCESSING (0-0-3) 2

EC337 MINI PROJECT IN COMMUNICATION SYSTEMS AND NETWORKS (0-0-3) 2

EC338 MINI PROJECT IN MICROPROCESSOR & EMBEDDED SYSTEMS (0-0-3) 2

EC339	**MINI PROJECT IN ANALOG SYSTEM DESIGN**	**(0-0-3) 2**
EC391	**MINI PROJECT VLSI DESIGN**	**(0-0-3) 2**
EC392	**MINI PROJECT IN RF DESIGN**	**(0-0-3) 2**
EC390	**SEMINAR**	**(0-0-2) 1**
EC446	**PRACTICAL TRAINING**	**2**
EC448	**MAJOR PROJECT - I**	**(0-0-6) 4**
EC498	**MAJOR PROJECT – II**	**(0-0-6) 4**

Department of Electrical and Electronics Engineering

EE110 ELEMENTS OF ELECTRICAL ENGINEERING (3-0-0) 3

Review of circuit elements, voltage sources, current sources, source transformation, mesh current and node voltage analysis of circuits. Network reduction techniques. Concept of the magnetic circuit. AC analysis of single phase systems, wave forms, phasor representation, the j-operator, concepts of real and reactive power and power factor. Extension of AC analysis to symmetrical 3-phase systems, phase sequence, measurement of three phase power under balanced condition. Introduction to transformers, equivalent circuits, phasor diagram, regulation and efficiency. Introduction to Electro-mechanical energy conversion.

Fitzgerald, D.E. Higginbotham, A. Grabel, Basic Electrical Engineering, 5th Edition, McGraw-Hill, 2009.
William H. Hayt Jr., Jack E. Kemmerly, Steven M.Durbin, Engineering Circuit Analysis, 6th Edition,TMH, 2002
Olle I. Elgerd, Basic Electric Power Engineering, Addison-Wesley, 1977.
Edward Hughes, Electrical Technology, 7th Edition, Longman, 1995.

EE200 CIRCUIT THEORY (3-1-0) 4

Review of network geometry and network reduction techniques. Network variables, identification of the number of degrees of freedom, the concept of order of a system, establishing the equilibrium equations, network modeling based on energy-indicating (state) variables in the standard form, natural frequencies and natural response of a network. Introduction to system functions, inclusion of forcing functions, solution methodology to obtain complete solution in the time-domain - the vector-matrix approach. Analysis of network response (in the time-domain) for mathematically describable excitations. Solution strategy for periodic excitations. The phenomenon of resonance and its mathematical analysis. Sinusoidal steady state analysis.. Introduction to to three phase systems

Ernst A. Guillemin, Introductory Circuit Theory, John Wiley and Sons, 1953.
Charles A. Desoer, Ernest S. Kuh, Basic Circuit Theory, McGraw-Hill, 1969.
Russell M. Kerchner, George F. Corcoran, Alternating Current Circuits, 4th Edition, Wiley Eastern, 1960.

EE207 ELECTROMAGNETIC THEORY (3-1-0) 4

Static electric and magnetic fields. E-fields, D-fields, potential fields & Laplace's equation. Time varying fields. Discussion of various laws like Ohm's, Kirchhoff's, Faraday's laws from the field theory point of view. Maxwell' equations. Concept of electromagnetic wave propagations, uniform plane wave. Introduction to computational methods in electromagnetics. Applications and analysis of few power engineering related problems.

William Hayt Jr., Engineering electromagnetic, John A Buck, 8th Edtn. McGraw Hill Publication, 2012.
Mathew N O Sadiku, Elements of electromagnetic, 5th edtn, Oxford unvieristy press, 2010.
John D Kraus and Keith R Carver, Electromagnetics, 2nd Edtn, McGraw Hill Publication, 2012.
Julius Kdame Strattion, Electromgantics, IEEE press, John Wiley and Sons inc publications, 1981.
Paul G Huray, Maxwell's equations, IEEE press, John Wiley and Sons inc publications, 2010

EE213 ELECTRICAL MACHINES – I (3-1-3) 6

Review of power network structures, principle of energy conversion. Transformers : Principle, construction (single phase, three phase), development of equivalent circuit through coupled circuit approach, phasor diagram, regulation, efficiency, autotransformers, vector groups and parallel operation of three phase transformers, tap changers, phase conversion, energisation of transformer and harmonics. Induction machines: Principle, construction, classification, equivalent circuit, phasor diagram, characteristics, starting techniques, speed control, operation under unbalanced supply conditions and harmonics, effect of single phasing, induction generator operation, linear induction motor. Single phase induction motor: Types, speed control. Testing and diagnostic procedures for machines. Introduction to design of machines.

Laboratory exercises and assignments to supplement the course.

M.G. Say, Performance and design of A.C. Machines, CBS, 1983
Albert E. Clayton and V.N. Hancock, Performance and Design of Direct Current Machines
Charles V Jones, Unified theory of Electrical Machines, Butterworth, 1967
O I Elgerd,Patrick D Van der Puije,Electric Power Engineering,2nd edition, Chapman &Hall,1998.

EE224 ELECTRICAL MEASUREMENTS AND MEASURING INSTRUMENTS (3-1-3) 6

Review of units, standards, dimensional analysis. Measurement basics: significant figures, errors, calibration. Measuring instruments: Analog and digital-Concept of true rms, DVM, multimeter DMM, resolution, sensitivity. Oscilloscope: specifications, applications. Measurement of voltage, current, power, power factor, frequency and energy; Power analyzer. Extension of meter ranges: Shunts & multipliers, CTs and PTs. Measurement of low, high resistances and applications. Measurement of earth resistance, dissipation factor and dielectric strength. Basics of cable fault location. Transducers: Classification, strain gauge, RTD, pressure transducers, inductive LVDT, capacitive, thermocouple, piezo-electric. Photo-electric, Hall effect. Laboratory exercises and assignments to supplement the course.

Golding and Widdis , Electrical Measurements and Measuring Instruments , Wheeler Publishing House, New Delhi 1979.
K. Sawhney , A Course in Electrical Measurement and Measuring Instruments ,Dhanpat Rai and Sons, New Delhi 2007
M. B. Stout , Basic Electrical Measurements
C.T. Baldwin, Fundamentals of Electrical Measurement

EE226 ANALOG ELECTRONIC CIRCUITS (3-1-3) 6

Terminal, switching and thermal characteristics of semiconductor devices, establishment of quiescent point, biasing considerations, load line concept, control of devices in switching and active zones, device cooling requirement. Introduction to usage of SPICE device models and simulation. Power amplifiers, feedback in amplifiers, filters, operational amplifiers: configurations, characteristics, applications. Sample and hold, A/D , D/A Converters. Multivibrators, voltage regulators, voltage controlled oscillators, phase locked loop.

Laboratory exercises and assignments to supplement the course.

Jacob Millman and A. Grabel, Microelectronics, Tata McGraw-Hill, 1999
Ramakant Gayakwad, Op-amps and Linear Integrated circuits, Pearson Education , 2007.
J.V. Wait, L.P. Huelsman and GA Korn, Introduction to Operational Amplifier theory and applications, 2nd Edition, McGraw Hill, New York, 1992.
P. Horowitz and W. Hill, The Art of Electronics, 2nd edition, Cambridge University Press, 1989.
A.S. Sedra and K.C. Smith, Microelectronic Circuits, Saunder's College Publishing, 4th Edition.

EE229 POLYPHASE SYSTEMS AND COMPONENT-TRANSFORMATIONS (3-1-0) 4

Balanced poly-phase circuits: Generation of poly-phase voltages, Phase sequence, three-phase 3-wire and 4-wire systems, wye and delta connections, n-phase star and mesh, power calculations in balanced systems, harmonics in wye- and delta-systems. Unbalanced poly-phase circuits: unbalanced loads, wye-wye system with and without neutral connections, neutral shift, wye-delta system, phase-sequence effects, extensions to non-sinusoidal behaviour. Introduction to symmetrical components: A brief historical review, application of the method. Calculation of unbalance faults. Multiphase systems: Resolution of multiphase systems into symmetrical components, 2-phase and 4-phase systems, Irregular systems.

Edith Clarke, Circuit Analysis of AC Power Systems – Volumes I and II, John Wiley and Sons, 1950.
C.F. Wagner, R.D. Evans. Symmetrical Components, McGraw-Hill, 1933.
J.L. Blackburn, Symmetrical Components for Power System Engineering, Marcel-Dekker,1993.

EE243: Mathematics for Electrical Engineers (3-1-0) 4

Linear Systems: Systems of linear equations and their solution sets. Matrix Algebra: Matrix Operations, Determinants, Properties of Determinants and Linear transformations. Vector Spaces; Linear Maps,

Isomorphism and Norms on vector spaces. Eigen Functions: Eigen Values, Eigen Vectors and Their Applications to Differential Equations. Orthogonality and Least squares Problems. Functions of complex variables, Cauchy Reimann equations. Properties of analytic functions. Conformal mapping. Line integrals in complex plane. Cauchy's theorems. Power series, residues. Evaluation of standard real integrals using contour integration.

David C. Lay, Linear Algebra and Its Applications, Third Edition, Pearson
Gilbert Strang, Linear Algebra and Its Applications, , Fourth Edition, Academic Press, Cengage Learning
Kenneth Hoffmann and Ray Kunze, Linear Algebra, , Prentice Hall India
R. A. Horn and C. R. Johnson, Matrix Analysis, Cambridge University Press.
Erwin Kreyszig, Advanced Engineering Mathematics, Wiley Eastern.
Lars V. Ahlfors, Complex Analysis, McGraw Hill Book Co.

EE253 COMMUTATOR MACHINES (3-1-0) 4

Constructional details, commutator action analysis, windings, mmf production, limitations, special features, fields of application, fault detection and general maintenance, preliminary design.

E. Openshaw Taylor, The Performance and Design of AC Commutator Machines.
Fitzgerald, Kingsley, Kusko. Electromechanical Energy Conversion.
Atkinson, Generalized Machine Theory.

EE255 INTRODUCTION TO ALGORITHMS AND DATA STRUCTURES (3-1-0) 4

Mathematical basis and notions for algorithm analysis. Sorting, divide and conquer, linear time sorting, elementary data structures, priority queues, BST and RBT. Design and analysis. Paradigms – Dynamic programming, Greedy algorithms, Graph algorithms.

T.H. Cormen, C.E. Leiserson, R.L. Rivest , C. Stein, Introduction to Algorithms, 2nd Edition, PHI, 2004.
D.E. Knuth, The Art of Computer Programming, Volumes I and III, Addison-Wesley, 1973.
Anany Levitin, Introduction to the Design and Analysis of Algorithms, Pearson Education, 2003.

EE256 SIGNALS AND SYSTEMS (3-1-3) 6

Signals and Systems – Classification, time-domain analysis of continuous-time and discrete-time systems, continuous-time system analysis using the Laplace transform, discrete-time system analysis using the z-transform. Fourier series, Fourier transform, sampling, applications. Laboratory exercises and assignments to supplement the course.

B.P. Lathi, Linear Systems and Signals, 2nd Edition, Oxford University Press, 2005.
Simon Haykin , Barry Van Veen, Signals and Systems, John Wiley Asia, 2003.
A.V. Oppenheim, A.S. Willsky , S. H. Nawab, Signals and Systems,2nd. Edition, Prentice-Hall Signal Processing Series, 1997.

EE258 ELECRICAL MACHINES – II (3-1-3) 6

DC Machines : Construction, classification, emf and torque equation, characteristics of DC motors, speed control, brushless DC motor, stepper motor, servomotor. Synchronous machines: Construction, prime-mover and excitation control systems. Steady state characteristics, handling of harmonics, voltage regulation calculations for salient and non salient pole machines, parallel operation, load sharing and associated capacity curves, Synchronous motors and condensors, Permanent magnet synchronous motors, Switched reluctance motors. Dynamic characteristics: Park transformation, the standard parameters of synchronous machines and simplified generator models, electromechanical oscillations, and large disturbance studies with respect to SMIB system, Introduction to equal-area criteria and numerical solutions. Introduction to design of synchronous machines. Laboratory exercises and assignments to supplement the course.

M.G. Say, Performance and Design of Alternating Current Machines, CBS, 1983.
Fitzgerald, Kingsley, Umans, Electric Machinery, 5th Edition, McGraw-Hill, 1992
Arthur R. Bergen, and Vijay Vittal, Power System Analysis, 1st Edition, Pearson Education Asia, 2001.

EE260 DIGITAL COMPUTER ORGANIZATION AND ARCHITECTURE (3-1-0) 4

Evolution of computers, instruction set design, processor design: functional unit design, micro-programmed and hardwired approaches, different architectures, control unit design, memory organization, input-output organization, introduction to system software, operating system basics.

J.P. Hayes, Computer Architecture and Organisation, 2nd Edition, McGraw-Hill, 1988.

M. Rafiquzzaman , Rajan Chandra, Modern Computer Architecture, Galgotia, 1999.

EE265 POWER SYSTEM ENGINEERING – I (3-1-0) 4

Electrical energy sources, power network structure and its components. AC, AC-DC, and DG- based systems, forms of field energy, concepts of real and reactive powers and their conventions, per unit representation. Power system operation and control: State of operation of a power system, voltage and frequency control mechanisms, power generation and demand management, tariff structure. Transmission lines: Design, modeling and performance analysis. Cables, insulators, grounding and safety.

Olle I. Elgerd, Electric Energy Systems Theory – An Introduction, TMH, 1982.

W.D. Stevenson Jr., Elements of Power System Analysis, McGraw-Hill, 1968.

Arthur R. Bergen, and Vijay Vittal, Power System Analysis, Pearson Education Asia, 2001.

I. J. Nagrath , D.P. Kothari, Power System Engineering, TMH.

EE276 DIGITAL ELECTRONIC CIRCUITS (3-1-3) 6

Logic families: TTL, ECL, NMOS, CMOS. Number systems, logic gates, boolean algebra, Karnaugh map. Combinational logic circuits: adders, subtractors, multiplexers, de-multiplexers, encoders, decoders, line drivers. Sequential logic circuits: latches and flip flops, registers and counters. Design of following finite state sequential machines using D flip-flops: Sequential code converters, sequence detectors, sequence generators and system controllers. Memories: read only and read/write memories, programming EPROM and flash. Laboratory exercises and assignments to supplement the course.

M. Mano, "Digital Design", 3rd Ed., Prentice Hall, India.

D.D. Givone, "Digital Principles and Design", Tata McGraw Hill.

J.F. Wakerly, "Digital Design Principles and Practices", Practice Hall.

R.J. Tocci, "Digital Systems Principles and Applications", Prentice Hall

Charles H Roth: Digital Systems Design using VHDL, Thomson Learning, 1998

EE281 COMMUTATOR MACHINES LABORATORY (0-0-3) 2

Laboratory exercises and assignments to provide additional support to EE253.

EE295 ELECTRICAL MACHINE WINDING CALCULATIONS – 1 (0-2-3)4

An exposition of the magnetic and electric circuits of commutator-wound machines. Exercises involving: the geometrical layout of the armature windings, brush placement, interpoles, equalizing rings. Detailing of the process of commutation and of armature reaction. Calculations in respect of winding design and of estimation of machine parameters from design data.

Clayton A.E., Hancock N.N., "The Performance and Design of Direct Current Machines", 3rd Edition, Oxford & IBH, 1986 (Indian Reprint).

Taylor O.E., "The Performance and Design of AC Commutator Motors", A.H. Wheeler & Co., 1988 (Indian Reprint).

EE296 ELECTRICAL MACHINE WINDING CALCULATIONS – 2 (0-2-3)4

An exposition of the magnetic and electric circuits of open-wound (AC) machines. Salient- and non-salient-pole windings. Exercises involving: the geometrical layout of armature windings, armature reaction, harmonics and their quantification, cage rotor, and damper windings. Estimation of machine parameters from design data.

Say M.G., "The Performance and Design of Alternating Current Machines", 3rd Edition, CBS, 1983

(Indian Reprint).
Langsdorf A.S., "Theory of Alternating Current Machinery", 2nd Edition, Tata McGraw-Hill, 1974.

EE298 ELEMENTS OF ANALOG AND DIGITAL COMMUNICATION (3-1-0) 4

Introduction to analog and digital communication: Bandwidth and information capacity, transmission modes, signal analysis, noise considerations. Modulation and demodulation concepts: AM, FM, PM, TDM and FDM concepts. Classification of amplifiers (Class A, B, and C), tuned amplifiers, oscillators, amplitude modulation, demodulation circuits, mixer, TRF, superheterodyne and direct conversion receivers. Monochrome TV transmitter and receivers.

Digital and data communication: Sampling theorem, coding and decoding, pulse modulation, FSK, PSK, Modem. Serial and parallel interface: Computer network configurations and protocols, OSI reference model, internet protocol, packet switching. Satellite communications, orbital patterns, geostationary satellites, frequency band allocation. Optical fibre communication: Mode of signal transmission, signal sources and detectors, attenuators and channel capacity. Digital telephony, PSTN and cellular telephony.

Wayne Tomasi, Electronic Communication Systems, 4th Edition, Pearson Education, 2002.
Kennedy, Communication Systems, 4th edition.
Gary Miller, Modern Electronic Communication, 7th Edition.
Andrew S. TanenBaum, Computer Networks, 3rd Edition.
William C. Y. Lee, Mobile Cellular Telecommunication, 2nd Edition.

EE303 DISTRIBUTION SYSTEMS PLANNING AND CONTROL (3-1-0) 4

Distribution systems, their importance in energy transfer, distribution loss minimization techniques, radial and ring system , voltage regulation, reconfiguration , capacitor placement , power flow analysis , sizing of conductors and transformers , fault analysis , data acquisition and control, remote reading of energy meter , role of computers in distribution system operation , state of the art.

T. M. Gonen , Electrical Energy Distribution.
C. L. Wadhwa., Electrical Energy Distribution.
Recent publication in reputed journals and conference proceedings of relevance.

EE308 POWER ELECTRONICS (3-1-0) 4

Devices: Characteristics- diode, BJT, IGBT, MOSFET, IPMs, Thyristor based devices: SCRs/TRIAC/GTOs. Reactive elements: capacitors, inductor, transformer, pulse transformer. Data sheets, switching and conduction losses, heat dissipation- heat sink, loss calculation. Drive circuit, current and voltage sensors, opto-couplers. Functional classification of converters: DC-DC converters - switched mode buck converter, switched mode boost converter: control circuit, snubber, applications. Inverters: H-Bridge, single phase, three phase inverters. Rectifiers: single phase and three phase rectifiers.AC power controllers. Simulations of power electronic converters.

Ned Mohan ,Undeland, Robbins, Power Electronics, 3rd edition, John Wiley.
M H Rashid, Power Electronics, 3rd edition, PHI.
P C Sen, Power Electronics, Tata McGraw-Hill Publishing Company Ltd.
Bimal K Bose, Modern power electronics and ac drives ,PHI.
L Umanand, Power Electronics, Wiley India Pvt Ltd

EE311 DIGITAL SYSTEM DESIGN (3-1-0) 4

Review of combinational logic design using PLD, design of synchronous sequential logic systems, introduction to VHDL, design of system controllers, design of systems using PLD / FPGA, fundamentals of data converters.

C. H. Roth, Digital System Design, PWS, 1998.
J. F. Wakerly, Digital Design, PHI, 3rd Edition., 2001
W. Fletcher, An Engineering Approach to Digital Design, PHI.

M. J. Sebastian Smith, Application Specific Integrated Circuits, Addison-Wesley, 1999.

EE312 POWER SYSTEM HARMONICS (3-1-0) 4

Harmonic Sources: Power electronic converters, transformers, rotating machines, arc furnaces, fluorescent lighting. Harmonic effects within power system- resonances, harmonic torques, static power plant, control systems, power system protection, consumer equipment, measurements, and on power factor. Harmonic effects related to communication interference: telephone circuit susceptiveness, harmonic weights, I-T and kV-T products, shielding. Harmonic effects related to biological effects. Power theory, single and three phase, non-sinusoidal conditions, Fryez and Budeno's methods. Power quality parameters. Transducers and data transmission, Hall effect voltage and current sensors. Harmonic mitigation techniques: passive filters, active filters. Algorithms for extraction of harmonic current in the line.

J. Arrillaga, Power System Harmonics, IEE Press.
G. T. Heydt , Power Quality, Stars in a Circle, 1991.
M. G. Say , Alternating Current Machines, ELBS.

EE313 DIGITAL SIGNAL PROCESSING (3-1-0) 4

Review of FT, DTFT, DFT. Circular Convolution, DFT computation methods: Radix FFTs: Decimation in time and Decimation in frequency FFT, DCT. IIR Filters: Analog filters: properties and design of Butterworth, Chebychev and Elliptical filters. Frequency transformation. Review of Z-transform and its properties. Structure of digital filters. Methods of converting analog filters to digital filter (IIR): bilinear transformation, pole-zero mapping, Impulse invariant transformation. Methods of designing the FIR filters: window-based methods, frequency sampling method. Introduction to the programmed digital systems. General architecture of Digital Signal Processors, programming of the TMS320F243, application of DFT for linear filtering.

John G. Proakis, D.G. Manolakis, Digital Signal Processing.
Ashok Ambardar, Analog and Digital Signal Processing.
L. R. Rabiner, B. Gold , Theory and Applications of Digital Signal Processing, PHI, 1975
Richard G. Lyons, Understanding Digital Signal Processing.
Roman Kuc , Introduction to Digital Signal Processing.

EE319 NEURAL NETWORKS AND APPLICATIONS (3-0-0) 3

Introduction: Biological neuron, Mc-Culloch-Pitts neuron model. Various threshold functions, Feature vectors and feature space. Classification techniques - nearest neighbour classification. Distance metrics, linear classifiers, decision regions. The single layer and multilayer perception, multilayer perception algorithm, solution of the XOR problem, visualizing the network behaviour in terms of energy functions, Mexican hat function. Learning in neural networks, linearly non-separable pattern classification, delta learning rule. Error back-propagation training algorithms, Feedback networks - Hopfield network, energy landscape, storing patterns, recall phase, Boltzmann machine, traveling salesman problem. Associative memories, retrieval and storage algorithm, stability considerations. Application of neural systems - linear programming, modeling networks, character recognition, control system applications, robotic applications.

R. Beale, T. Jackson, Neural Computing: An Introduction , IOP Publishing Ltd., 1990.
Jack H. Zaruda, Introduction to Artificial Neural Systems , Jaico Publications.

EE320 ELECTRICAL SAFETY, OPERATIONS, REGULATIONS (3-0-0) 3

Electrical safety: Safety of the self. Safety of the equipments, Safety of the public. PPE. General guidelines on earthing and protection. Operations: Sign boards, tagging system and procedures. Safe operating procedures, case studies and, safety audit basics.

Regulations: IS, IEEE standards, Indian Electricity rules and regulations.

HSC- A Practical guide VOL. 1 to 4, National Safety Council, India.
IS 5216 (Part I)- 1982, "Recommendations on safety procedures and practices in electric work".

SP 30 -1985 Special publication-National Electric Code, "Section-14: Electric Aspects of building services".
IEEE Standard 902.

EE321 LINEAR AND NONLINEAR SYSTEMS (3-1-0) 4

Characteristics of linear systems, modeling and analysis of linear time-invariant systems using state-space approach, analysis of linear time-variant systems. Characteristics of nonlinear systems, common types of nonlinearities, phase-plane analysis, describing function analysis.

Thomas Kailath, Linear Systems, Prentice-Hall, 1980.
K.Ogata, State-Space Analysis of Control Systems, Prentice-Hall, 1967.
John E. Gibson, Non linear Automatic Control, McGraw-Hill, 1963.

EE324 ELECTRONIC MEASUREMENTS AND INSTRUMENTATION (3-1-0) 4

Measurement systems, electromechanical instruments, bridges, electronic instrumentation, oscilloscopes, signal analysis, frequency, time interval measurements, physical parameter measurements, transducers, data acquisition systems.

B. H. Oliver, J. M. Cage, Electronic Measurements and Instrumentation, McGraw-Hill, 1975
Albert D. Helfrick, William D. Cooper, Modern Electronic Instrumentation and Measurement Techniques, PHI.

EE326 LINEAR AND DIGITAL CONTROL THEORY (3-1-0) 4

Introduction, classification, mathematical modeling of physical systems, introduction to discrete time control systems, z-plane analysis of discrete time control systems, transient response analysis, design specifications and performance indices, concept of stability and algebraic criteria, Root locus analysis, frequency response analysis, Bode diagrams, polar plots, Nyquist plots, stability in the frequency domain, basic control actions and response of control systems. Introduction to control system design using the root locus and frequency-domain approach.

I. J. Nagrath, M. Gopal, Control Systems Engineering, 4th Edition, New Age International.
K. Ogata, Modern Control Engineering, 3rd Edition, PHI.
K. Ogata, Discrete Time Control Systems, 2nd Edition, Pearson Education..

EE328 NETWORK SYNTHESIS (3-1-0) 4

Review of mathematics for network synthesis Partial -fraction expansion, Continued – fraction expansion, Bilinear transformation. The positive real concept - Hurwitz polynomials, analytic tests for positive real functions, positive -- definite and positive -- semi -- definite quadratic forms. Realizability conditions for networks with and without transformers (magnetic coupling) Realization of driving -- point functions -- Canonical forms – LC, RC, and RL driving -point functions.

Louis Weinberg, Network Analysis and Synthesis, McGraw – Hill, New York, 1962
M. E. Van Valkenburg, Modern Network Synthesis, Prentice – Hall, New Jersey

EE329 TRAVELING WAVES ON TRANSMISSION SYSTEMS (3-1-0) 4

Introduction to the line equations. Attenuation and distortion of traveling waves. Reflection of traveling waves. Successive reflections: The reflection lattice, construction and use of the lattice-diagram, Charging of a line from various sources, Reflection between a capacitor and a resistor, effect of short lengths of cable, effect of insulator capacitance. Traveling waves on multi conductor systems. Theory of ground-wires: Direct stroke to a tower, effect of reflections up and down the tower, tower grounding. The counterpoise: Multi velocity waves on the counterpoise, tests on the counterpoise, successive reflections on the insulated counterpoise. Induced lightning surges: The field gradient, induced surges with ideal ground wires. Arcing grounds: Normal frequency arc extinction – single-phase and three-phase,

oscillatory-frequency arc extinction, high-frequency effects, interruption of line-charging currents, cancellation waves, initiated waves, steady-state waves, recovery voltage, restriking phenomena.

L. V. Bewley, Traveling Waves on Transmission Systems, John Wiley and Sons, 1951.
H. H. Skilling, Electric Transmission Lines, McGraw-Hill, 1951.
L. F. Woodruff, Principles of Electric Power Transmission, John Wiley and Sons, 1952 .

EE331 DISTRIBUTION SYSTEMS LABORATORY (0-0-3) 2

Laboratory exercises and assignments to provide additional support to EE303.

EE334 POWER ELECTRONICS LABORATORY (0-0-3) 2

Laboratory exercises and assignments to provide additional support to EE308.

EE335 DIGITAL SYSTEM DESIGN LABORATORY (0-0-3) 2

VHDL / Verilog programming, design exercises on ECAD software, hardware realization on FPGA / CPLDs, to provide additional support to EE311.

EE337 POWER SYSTEM HARMONICS LABORATORY (0-0-3) 2

Laboratory Exercises and assignments to provide additional support to EE312. Experiments around MATLAB®, PSCAD®, OrCAD™ and laboratory measurement exercises.

EE342 ELECTRONIC MEASUREMENTS LABORATORY (0-0-3) 2

Laboratory exercises and assignments to additional support to EE324.

EE343: STATISTICAL FOUNDATION FOR ELECTRICAL ENGINEERS (3-1-0) 4

Probability: Axioms, Sample spaces (continuous & discrete), Density, Distribution and Mass functions and their applications. Random Variable: Single, Multiple, Continuous and Discrete, statistical operations and limit theorems. General Distributions and their practical significance. Functions of random variables: Probability distribution functions of functions of random variables. Random Process: Concept, Classification, Temporal and Spectral characterization, and Statistical Estimation: Estimation of variables, Estimation of parameters. Testing of hypothesis. Analysis of linear systems to Random signals and optimum linear systems, and Optimum Wiener Solutions.

Davenport W.B Jr, Probability and Random Process, An Introduction for Applied Scientists and Engineers, McGraw-Hill.
Peyton Z. Peebles JR, Probability, Random Variables & Random Signal Principles, 4th Edition, McGraw-Hill.
Leon-Garcia, Probability and Random Process for Electrical Engineering, Addition-Wesley.
Viniotis Y, Probability and Random Process for Electrical Engineers, McGraw-Hill.
Papoulis A, Probability, Random Variables and Stochastic Processes, McGraw-Hill.
Mayer P. L., Introductory Probability and Statistical applications, Second Edition, Oxford and IBH publishing Co. Pvt. Ltd., New Delhi.

EE347 DESIGN AND DEVELOPMENT TASK IN CONTROL SYSTEMS (0-0-3)2

Analog and Digital controller design and implementation for specific problems. Stability analysis, performance comparison , and optimal controller. Simulation and implemntaion issues.

EE348 DESIGN AND DEVELOPMENT TASK IN POWER ELECTRONICS AND DRIVES (0-0-3)2

Design of a specified power electronics converter. Simulation and implementation of some algorithms for power electronics controller applications.

EE350 POWER SYSTEM ENGINEERING – II (3-1-0) 4

Review of modeling of power system components: transmission lines, transformers, synchronous machines, loads etc., per unit representation, single-line diagram representation, and solution of algebraic and differential system of equations, system modeling. Steady state analysis: power flow, balanced and unbalanced short circuit analysis, generation scheduling. Analysis of system transients: time-range of transients, traveling waves, switching transients, low frequency transients. Stability analysis: Classification, angle stability solution method using equal-area criteria, frequency and voltage stability issues (qualitative treatment only). Solution methodology for large systems.

John J. Grainger and W. D. Stevenson, Power Systems Analysis, McGraw-Hill, 1994
P. Kundur, Power System Stability and Control, McGraw-Hill, 1994.
Olle I. Elgerd, Electric Energy Systems Theory- An introduction, TMH, 1982
P.W. Sauer and M.A. Pai, Power System Dynamics and Stability, Prentice Hall, Upper Saddle River, New Jersey, 1998.

EE359 ENERGY AUDITING (3-1-0) 4

Introduction to energy audit. Purpose, methodology, case studies of few selected industries, analysis of results and inference, standards, instruments used in energy auditing.

Shirley J. Hansen, James W. Brown, Jim Hansen, Investment Grade Energy Audit, Marcel Dekker, 2003.
Donald R. Wulfinghoff, Energy Efficiency Manual, Energy Institute Press.

EE360 MICROPROCESSORS (3-1-0) 4

Basics of finite state machines, Von Neumann Architecture, functional blocks of a microcomputer, architecture of 8-bit/16-bit Microprocessors/Microcontrollers [viz. Intel 8051 family, MOTOROLA 68HXX, ARM Core etc.]. Programmers' model of any one microprocessor/microcontroller chosen for detailed study, instruction set, chip configuration and programming, use of development and debug tools, interface applications. Laboratory exercises.

Intel Corporation, 8-bit Microcontroller Handbook, Intel Corporation, 1990.
ARM® Core Processor Hand book.
John B. Peatman, Design with Microcontrollers, McGraw-Hill, 1995.
Andrew N. Sloss, Dominic Symes, Chris Wright, John Rayfield, ARM System Developer's Guide, Designing and Optimizing System Software, Elsevier, 2004.

EE361 POWER SYSTEM COMMUNICATIONS (3-1-0) 4

The Electric power supply and its properties, historic development of data communication over power lines, The European CENELEC standard EN50065, channel characteristics, coupling and measuring techniques at high frequencies for PLC, estimating power line channel capacity, EMC problems and solutions, modulation schemes for PLC, communication over the electric power distribution grid.

Klaus Dostert, Franzis Verlag, Power Line Communications, PHI.

EE362 OPTIMAL OPERATION OF POWER SYSTEMS (3-1-0) 4

Economic operation of power systems: Economic load dispatch, unit commitment. Load frequency control : Modeling of components of generating systems, concept of coherent units, operation of single area. Introduction to multi-area systems. Sources of reactive power. Introduction to contingency analysis. State estimation: Importance of state estimation, DC state estimation. Energy interchange evaluation.

O. I. Elgerd, Electric Energy Systems Theory: An Introduction, McGraw-Hill, 1971.
I. J. Nagrath, D.P. Kothari, Modern Power System Analysis, TMH.
S. S. Rao , Optimisation Theory and Applications.
Allen J. Wood , Bruce F. Wollenberg , Power Generation Operation and Control, 2nd Edition, John Wiley and Sons,1996.

EE363 ADVANCED DIGITAL SIGNAL PROCESSING (3-1-0) 4

Time frequency analysis, time frequency distribution, short time Fourier transform. Multirate signal processing: Decimation interpolation, DFT filter banks, QMF filter banks. Multiresolution signal analysis. Wavelets theory of sub band decompositions, sub band coding and wavelet transforms, application of wavelet transforms. Homomorphic signal processing : Homomorphic system for convolution, properties of complex spectrum, applications of homomorphic deconvolution. Multi-dimensional signal processing : Review of convolution and correlation. 2-D signals. Linear estimation of signals and applications: Random signals, linear prediction and applications (deconvolution, least square filters). Recursive estimation and Kalman filters. Adaptive signal processing: Adaptive filters and applications.

P. P. Vaidyanathan, Multirate Systems and Filter Banks, PH, 1993.
S. J. Orfanidis, Optimum Signal Processing, McGraw-Hill, 1989.
John G. Proakis, D. P. Manolakis, Introduction to DSP, Pearson, 2002.
E. C. Ifeachor, B. W. Jervis, Digital Signal Processing: A Practical Approach, Pearson Education.

EE366 SPECIAL MACHINES AND DRIVES (3-1-0) 4

Method of control and application of brushless DC motor, PMSM, stepper motor, AC servomotor, universal motor. Electric drive, motor rating, heating effects, electric braking, modification of speed-torque characteristic of an induction motor by V/f control, starting and braking. Synchronous motor -- Speed torque and torque angle characteristics by V/f control, braking.

G.K. Dubey, Fundamentals of Electrical Drives, Narosa.
A .E. Fitzerald, C. Kingsley, S.D Umans, Electric Machinery, McGraw-Hill.
S. K. Pillai, A First Course on Electric Drives, Wiley Eastern, 1990.

EE369 EMBEDDED SYSTEM DESIGN (3-1-0) 4

Embedded controllers, basic requirements, design of embedded systems, system on chip concept. VLSI CAD application. Case study: DSP/microprocessor based or FPGA based system design.

Charles H. Roth, Digital System Design using VHDL, PWS , 1998.
User manuals of Microprocessor /DSPs

EE371 POWER ELECTRONICS APPLICATIONS TO POWER SYSTEMS (3-1-0) 4

HVDC systems: Classical HVDC systems, CCC systems, HVDC Light systems. Application of FACTS devices such as SVC, TCSC, SSS, UPFC to improve steady state and dynamic behaviour of power systems. Modeling of HVDC systems and FACTS devices to perform system studies.

N. G. Hingorani, L. Gyugi, Understanding FACTS, IEEE Press, 2001.
P. Kundur, Power System Stability and Control, McGraw-Hill, 1994.

EE373 ELECTRIC POWER STATIONS (3-1-0) 4

Choice of site for power plants. Thermal power plant: General layout, air and flue-gas circuit, fuel and ash handling circuit, cooling water circuit, steam and feed water circuit. Nuclear power plant: General layout, heat exchangers, moderators, coolants, control rods. Hydro power plant: Site selection, general layout, type of hydropower plants, hydrographs. Characteristics of hydro turbines. Electrical equipment in generating stations: General layout, excitation systems and voltage regulation. Substation layout, components of substation. bus-bar arrangements, current-limiting reactors and their location. Safety and coordination. Load forecasting and sharing: Load curve and load duration curves, load factor, diversity factor, plant factor and plant use factor, demand factor, load sharing between base and peak load stations.

M. V. Deshpande, Electrical Power Stations.
Tata Electric Co., Operator Training Manual.

EE374 ELECTRIC ENERGY SYSTEMS (3-1-0) 4

Conventional and non- conventional energy sources and systems: Generation, transmission and distribution schemes, energy conservation systems, energy efficient equipment and controllers. Energy audit.

Olle I. Elgerd , Electric Energy System Theory: An Introduction, TMH, 1982.
I.J. Nagrath, D.P. Kothari, Power System Engineering, TMH.

EE376 ADVANCED CONTROL SYSTEMS (3-1-0) 4

Introduction, review of state space approach to modeling of dynamic system. Introduction to discrete time control system, Signal processing in digital control, models of digital control devices and systems, z-plane analysis of discrete time control system, transient response analysis, design specifications and performance indices, design of digital control algorithms, state variable analysis of digital control systems, Pole placement design and state observers, linear quadratic optimal control

K. Ogata, Discrete Time Control Systems, 2nd Edition, Pearson Education.
M. Gopal, Digital Control and State Variable Methods, TMH.

EE377MODELING AND SIMULATION TECHNIQUES FOR DYNAMIC SYSTEMS (3-1-0) 4

Introduction to system dynamics, transfer function approach to modeling dynamic systems, modeling of electrical and electromechanical systems, mechanical systems, state-space approach to modeling dynamic systems, Bond graphs method, transient analysis of dynamic systems, frequency domain analysis of dynamic systems, numerical techniques applied to dynamic systems.

MathWorks Inc., MATLAB®/ SIMULINK™ Reference/User Manuals, MathWorks Inc.
K. Ogata, System Dynamics, 4th Edition, Pearson Education.
K. Ogata, Discrete Time Control Systems, 2nd Edition, Pearson Education.

EE378 SHELL SCRIPTING WITH BASH (3-1-0) 4

The Linux environment: Files and file systems, directories, inodes and links, pipe and socket files, device files. Operating the shell, Bash keywords, command basics, command-line editing; files, users and shell customization, working with files. Script basics, creating a well-behaved script, basic redirection, standard output, error and input, built-in versus Linux commands. Variables: Basics and attributes, bash pre-defined variables, expressions, arithmetic and logical expressions, relational, bitwise and self-referential operations, substitutions. Compound commands, debugging and revision control, shell archives, parameters and subshells, job control and signals. Text file basics, text file processing, console scripting, functions and script execution. Shell security aspects and network programming. Related shells and the IEEE 1003.2 POSIX shell standard.

Cameron Newham, Bill Rosenblatt, Learning the Bash Shell, O'Reilly Media, 2005.
Arnold Robbins, Nelson H. F. Beebe, Classic Shell Scripting, O'Reilly Media, 2005.
Ken O. Burtch, Linux Shell Scripting with Bash, Sams Publishing, 2004.
Stephen G. Kochan, Patrick Wood, Unix Shell Programming, 3rd Edition, Sams Publishing, 2003.
Mendel Cooper, Advanced Bash-Scripting Guide,2005.(Available on-line in pdf at http://www.tldp.org/)

EE379 INCREMENTAL MOTION CONTROL (3-1-0) 4

Introduction to incremental motion systems, Principles of operation of various types of stepper motors, static and dynamic torque characteristics of stepper motors, open loop and closed loop controls, microprocessor based controllers for stepper motors.

P.P. Acarnley, Stepping motors-A Guide to Modern Theory and Practice, 3rd Edition, Peter Peregrinus, 1992.
Takashi Kenjo, Akira Sugawara, Stepping Motors and their Microprocessor controls, 3rd Edition, Oxford University Press, 2005.

EE382 VIRTUAL INSTRUMENTATION LABORATORY (0-0-3) 2

LabVIEW™ programming, data acquisition with LabVIEW™ DAQ VIs, interfacing with GPIB and RS232/RS485 .

EE384 ENERGY AUDITING LABORATORY (0-0-3) 2

Laboratory exercises and assignments to provide additional support to EE359.

EE385 MICROPROCESSORS LABORATORY (0-0-3) 2

Programming and interfacing experiments on the target processor / microcontroller discussed in EE360.

EE386 DIGITAL SIGNAL PROCESSING LABORATORY (0-0-3) 2

Laboratory exercises and assignments to provide additional support to EE313. Exercises around MATLAB®, *MATHEMATICA®,* LabVIEW™, DSP programming.

MathWorks Inc., MATLAB® Signal Processing Toolbox Users Guide, MathWorks Inc.
C. S. Burrus et al, ComputerBased Exercises for Signal Processing, PH, 1994.
S. K. Mitra, DSP: A Computer-Based Approach, TMH, 1998.
TMS 320c54x Users Manual, Texas Instruments, 1997.

EE387 ADVANCED DIGITAL SIGNAL PROCESSING LABORATORY (0-0-3) 2

Laboratory exercises and assignments to to provide additional support to EE363.

MathWorks Inc., MATLAB® Signal Processing Toolbox Users Guide, MathWorks Inc.
C. S. Burrus et al, Computer-Based Exercises for Signal Processing, PH, 1994.
S. K. Mitra, DSP: A Computer-Based Approach, TMH, 1998.
TMS 320c54x Users Manual, Texas Instruments, 1997.

EE389 EMBEDDED SYSTEM DESIGN LABORATORY (0-0-3) 2

Laboratory exercises and assignments to provide additional support to EE369.

EE392 POWER SYSTEM OPERATION LABORATORY (0-0-3) 2

Simulation exercises and assignments to provide additional support to EE362. Experiments around MATLAB® , PSCAD®, PowerWorld™ and SKM® packages.

EE393 DYNAMIC SYSTEM SIMULATION LABORATORY (0-0-3) 2

Laboratory exercises and assignments to provide additional support to EE377.

EE397 DESIGN AND DEVELOPENT TASK IN SIGNAL PROCESSING (0-0-3)2

Application of digital Signal processing techniques for power systems or any specific applications in communication , feature extraction, or data compressions. Simulation or DSP implementation.

EE398 DISGN AND DEVELOPMENT TASK IN POWER SYSTEMS (0-0-3)2

Problem solving in the area of power system dynamics, distribution systems and high voltage engineering.

EE402 HVDC TRANSMISSION (3-1-0) 4

Need, Basic principle of conversion, economics of different configurations, The Graetz bridge circuit, analysis, overlap, firing delay, inversion, converter control, tap-changing control, power reversal, measuring devices, filters, circuit breaker, lighting arrester, DCCT, MRT. MTDC systems, interaction between AC and DC Systems, voltage stability, power modulation, digital Simulation, HVDC simulator, future of the HVDC transmission systems, research and development **.**

E. W. Kimbark, Direct Current Transmission.
K. R. Padiyar, Power Transmission by Direct Current, Wiley Eastern, 1990.

Recent Publications of relevance.

EE404 SOFT COMPUTING AND APPLICATIONS: (3-1-0) 4

Introduction to intelligent systems and soft computing, Intelligent systems, Knowledge-based systems, Knowledge representation and processing. Soft computing, Fundamentals of fuzzy logic systems, Fuzzy Sets, operations, relations, fuzzy logic, fuzzy control, Composition and inference, Considerations of fuzzy decision-making, neural networks – Single layer, multilayer networks, Features of artificial neural networks, learning, Fundamentals of connectionist modelling, BP algorithm, Major classes of neural networks, The multilayer perceptron, Radial basis function networks, Kohonen's self-organizing network, Industrial and commercial applications of ANN such as optimal control, manufacturing, power systems, robotics, etc., neuro-fuzzy systems, Architectures of neuro-fuzzy systems, Neural network-driven fuzzy reasoning, Hybrid neuro-fuzzy systems, Construction of neuro-fuzzy systems, Evolutionary computing, Integration of genetic algorithms with neural networks, Integration of genetic algorithms with fuzzy logic, Known issues in GA and applications**.**

Karray, Fakhreddine O., and Clarence W. De Silva. Soft computing and intelligent systems design: theory, tools, and applications. Pearson Education, 2004.

J. S. R. Jang, C. T. Sun , E. Mizutani, Neuro-Fuzzy and Soft Computing – A Computational Approach to Learning and Machine Intelligence, PHI, 2002.

M. Negnevitsky, Artificial Intelligence, A Guide to Intelligent Systems, Pearson Publishing, 2006

C. T. Lin and C.S. Lee, Neural Fuzzy Systems, Prentice Hall Publishing, 1995

Timothy J. Ross, Fuzzy Logic with Engineering Applications, McGraw-Hill, 1997.

Simon Haykin, Neural Networks – A Comprehensive Foundation, Prentice Hall, 1999.

David E. Goldberg , Genetic Algorithms in Search, Optimization and Machine Learning, Pearson Education, 2003.

EE406 ELECTROMAGNETIC COMPATIBILITY (3-1-0) 4

Review of EM theory. EMI from apparatus and circuits. EMI measurements. Shielding and grounding. EMI filters. Electrostatic discharge. EMC standards.

H. W. Ott, Noise Reduction Techniques in Electronic Systems.

V. Prasad Kodali, Engineering Electromagnetic Compatibility, S. Chand & Co.

EE408 SOLID-STATE DRIVES (3-1-0) 4

Separately excited dc motor drive: Operation and performance, single-phase fully controlled converter, operation on dual converter. Chopper drive: operation and performance calculation on class A, class C, and class E choppers. Induction motor drive: Stator voltage control with constant supply frequency, qualitative comparison of converter combinations, slip energy recovery scheme, VSI fed induction motor, CSI fed induction motor, synchronous motor drive, VSI drive, brushless excitation, true synchronous and self-controlled operation, performance with PMSM and synchronous reluctance motor.

S. B. Dewan, G. R. Slemon, A. Straughen, Power Semiconductor Drives , John Wiley and Sons, 1984.

W. Shepherd, L. N. Halley, D. T. W. Liang, Power Electronics and Motor Control, 2nd Edition, Cambridge University Press, 1998.

Vedam Subrahmanyam, Electric Drives – Concepts and Applications , TMH, 1994.

G. K. Dubey, Power Semiconductor Controlled Drives, Prentice Hall, 1989.

EE410 POWER SYSTEM PROTECTION (3-1-0) 4

Introduction to power system protection, Review of conventional power system protection schemes, power apparatus protection: viz. transformer, motor, generator, bus bar, transmission and distribution line protection schemes, Introduction to computer aided protection, numeric relay hardware design, digital protection algorithms, recent trends in power apparatus protection methodology, concepts of adaptive relaying and application of soft computing methods in numeric relaying.

Warrington , Protective Relays – Their theory and practice, Volumes. I, II, and III , Chapman and Hall.

Arun G. Phadke , J. S. Thorpe, Computer Relaying for Power Systems, Research Studies Press.
Gerhard Ziegler, Numerical Distance Protection: Principles and Applications.
A. T. Johns, S. K.Salman, Digital Protection for Power Systems , IEE, 1995.
M. S. Sachdev (Coordinator), IEEE Tutorial Course on Advancement in Microprocessor-based Protection and Communication, IEEE, 1979.

EE411 OPERATION OF RESTRUCTURED POWER SYSTEMS UNDER DEREGULATION (3-1-0) 4

Fundamentals of deregulation, restructuring models and trading arrangements, different models of deregulation, operation and control, wheeling charges and pricing, Role of FACTS controllers and distributed generation in restructured environment, developments in India, IT applications in restructured markets.

K. Bhattacharya, M.H J Bollen and J.E Daalder, "Operation of Restructured Power Systems", Kluwer Academic Publisher, USA, 2001.
L. Philipson and H.L. Willis, "Understanding Electric Utilities and Deregulation", Marcel Dekkar Inc. 1999.
M. Shahidehpour and M. Alomoush, "Restructured Electrical Power Systems, Operation, Trading and Volatility", Marcel Dekkar Inc. 2001.
Steven Stoft, "Power System Economics: Designing Markets for Eligibility". John Wiley & Sons, 2002

EE412 RANDOM SIGNAL PROCESSING (3-1-0) 4

Random signal processing: Review of probability and random variables, Mathematical description of random signals, response of linear systems to random inputs, Wiener filtering,. basic estimation theory, discrete Kalman filter, state-space modeling and simulation, nonlinear estimation.

Athanasios Papoulis, Probability, Random variables, and Stochastic Processes, McGraw-Hill, 1991.
R. G. Brown, P. Y. C. Hwang, Introduction to Random Signals and Applied Kalman Filtering, John Wiley and Sons, 1997.
A. P. Sage, James L. Melsa, Estimation Theory with Applications to Communications and Control, McGraw-Hill, 1971.

EE414 NON-CONVENTIONAL ENERGY SYSTEMS (3-1-0) 4

Solar energy, wind energy, chemical energy sources. Energy from the ocean and tides. MHD generation, thermo electric power. Geothermal energy. Energy from bio-mass.

G. D. Rai , Non-conventional Energy Sources.
P. S. Sukhatme , Solar Energy.

EE418 ADVANCED POWER ELECTRONICS (3-1-0) 4

Power devices, design of inductors, transformers, selection of core, design of capacitors, selection of capacitors for different applications. AC to DC converters, multilevel inverters, DC to DC converters, hard switch converters, design and analysis, isolated converters, resonant converters.

Ned Mohan, Undeland, Robbins , Power Electronics.
M. H. Rashid, Power Electronic Circuits – Devices and Applications.

EE420 POWER SYSTEM DYNAMICS (3-1-0) 4

Power system component modeling for dynamic studies: Synchronous generator modeling, exciter and turbine modeling, load modeling. System stability analysis: Angle stability (small signal and large signal), voltage stability, frequency stability.

K.R. Padiyar, Power System Stability and Control, Interline, 1996.
Prabha Kundur, Power System Stability and Control, McGraw-Hill, 1994.

EE422 SWITCHGEAR AND PROTECTION (3-1-0) 4

Fuses and switches, methods of earthing, Circuit breakers. circuit breaker ratings, auto reclosure. Protective relaying, fundamental characteristics. Relay classifications, differential protection schemes. Transformer protection. Buchholtz relay. Alternator protection: Negative phase sequence relay, loss of field protection. Line protection: Over current relays and schemes, distance relays and schemes, carrier current relaying. Induction motor protection: Abnormal operating conditions. Solid state relays: Comparators, duality between phase and amplitude comparators. Realization of directional, Ohm, reactance, impedance and Mho characteristics using the general characteristic equation, static distance relays. Computer aided relaying: Introduction to microcomputer based relays, General functional diagram of microcomputer-based relays.

Ravindranath, Chander , Power System Protection and Switchgear, Wiley Eastern, 1994.
C. L. Wadhwa, Electrical Power Systems, 2nd Edition, PHI, 1993.
Arun G. Phadke, S H Horowitz, Power System Relaying, 2nd Edition, John Wiley, 1995.
Badriram, D. N. Vishwakarma, Power System Protection and Switchgear, TMH, 1995.

EE423 SWITCHGEAR AND PROTECTION LABORATORY (0-0-3)2

Laboratory exercises and assignments to provide additional support to EE422.
The course will have experiments related to: Fuses and fuse elements. Study of Induction motor starters. Study of MCCB and ELCB. Circuit breakers and their control circuits. Over current, Earth fault, Differential protection, Phase unbalance, Under frequency, Thermal and other relays and protective schemes

EE427 COMPUTER NETWORKS (3-1-0) 4

Introduction, physical layer, data link, media Access, network layer, transport layer, ATM, applications.
Andrew S. Tanenbaum, Computer Networks, Pearson Education.

EE428 THE ARM CORE: ARCHITECTURE AND PROGRAMMING (3-1-0) 4

The ARM design philosophy, ARM processor fundamentals – registers, current program status register, pipeline, exceptions, interrupts and the vector table, core extensions, architecture revisions, ARM processor families. The ARM instruction set: Data processing instructions, branch instructions, load-store instructions, software interrupt instructions, program status register instructions, conditional execution. The THUMB instruction set, THUMB register usage, ARM-THUMB interworking. Writing assembly code, profiling and cycle counting, instruction scheduling, register allocation, looping constructs, bit manipulation, efficient switches, unaligned data handling. GNU assembler. Optimized primitives, exception and interrupt handling. Rudimentary aspects of embedded operating systems.

David Seal (Ed.), ARM Architecture Reference Manual, 2nd Edition, Addison-Wesley, 2001.
Steve Furber, ARM Sytem-on-Chip Architecture, 2nd Edition, Addison-Wesley, 2000.
Andrew N. Sloss, Dominic Symes, Chris Wright, ARM System Developer's Guide, Elsevier, 2004.
ARM Limited, ARM v7-M Architecture Application Level Reference Manual, ARM Limited, 2006.

EE430 ROBOT DYNAMICS AND CONTROL (3-1-0) 4

Prerequisite: EE326-LINEAR AND DIGITAL CONTROL THEORY

Introduction to robotics: History of robots, components and structures of robots, rigid motion and homogeneous transformations: representing position and rotation, rotational transformations, composition of rotations, parameterization of rotation, homogeneous transformations, Forward Kinematics, Inverse kinematics, velocity kinematics- the manipulator Jacobian, Dynamics: Euler-Lagrange equations, generalized expression for potential and kinetic energy, properties of robot dynamic equations, equation of motion, Independent joint control: set point tracking using classical PID control, force control, feedback linearization control. Computer vision: geometry of image formation, camera calibration, segmentation by thresholding, connected components, position and orientation of the object. Introduction to path planning and collision avoidance.

M.W. Spong, S. Hutchinson and M. Vidyasagar, *Robot Dynamics and Control* by, John Wiley & Sons, 2008.
Craig, John J. *Introduction to robotics: mechanics and control*. Vol. 3. Upper Saddle River: Pearson Prentice Hall, 2005.
Sciavicco L, Siciliano B. *Modelling and control of robot manipulators*. Springer Science & Business Media; 2012 Dec 6.

EE439 ADVANCED POWER ELECTRONICS LABORATORY (0-0-3) 2

Laboratory exercises and assignments to provide additional support to EE418.

EE443: MATHEMATICAL MORPHOLOGY AND APPLICATIONS TO SIGNAL PROCESSING (3-1-0) 4

Introduction to Mathematical morphology: Minkowski addition and Minkowski subtraction, Introduction to the lattice theory, Structuring elements and its decomposition. Fundamental Morphological Operators: Erosion, Dilation, Opening, Closing, Binary vs Greyscale Morphological operations. Hit-or-Miss transform, Skeletons, Morphological reconstructions, Thinning, Thickening: Hit-or-Miss transformation, Skeletonization, Coding of binary image Via Skeletonization, Skeletonization by influence Zones(SKIZ), Weighted SKIZ, Medial Axis Transformation(MAT), Skeletonization Via Euclidean Distance Transformation, Partial Skeletons, Morphological Shape Decomposition(MSD), Morphology Thinning, Thinking, pruning, MSD Vs SKIZ. Morphological Filtering and Segmentation:Multi-scale Morphological Transformation, Top – Hat and Bottom Hat Transformation, Alternative Sequential filtering, Segmentation, Watershed Segmentation, Connected Operators for Segmentation, Hierarchical Segmentation Vs Watersheds, Markers, Hierarchical Segmentation, Geodesic active contours. Geodesic Transformation and Metrics: Geodesic Morphology, Graph – Based Morphology. Euclidean Metric, Geodesic Distance (Shortest path), Dilation distance, Hausdorff Dilation and Erosion distances. Applications of Mathematical Morphology

J. Serra, Image Analysis and Mathematical Morphology, Academic Press London, 1982.
J. Serra, Image Analysis and Mathematical Morphology: Theoretical Advance, Academic Press, 1988.
N. A. C. Cressie, Statistics for Spatial Data, John Wiley, 1991.
P. Soille, Morphological Image Analysis, Principles and Applications, 2nd Edition, Springer Verlag. 2003.
L. Najman and H. Talbot (Eds.), Mathematical Morphology, Wiley, 2010.
B. Chanda and D. Dutta Majumdar, Digital Image Processing and Analysis, 2nd edition, New Delhi: PHI Learning Pvt. Ltd., 2011,
B. S. Daya Sagar, Mathematical Morphology in Geomorphology and GISci, Chapman & Hall/CRC Press, FL. 2013,

EE445 POWER SYSTEM SIMULATION LABORATORY (0-0-3) 2

Time–domain simulation of SMIB and multi-machine power systems in MATLAB®/SIMULINK™ to provide additional support to EE420.

EE448 SEMINAR (0-0-2) 1

This course is a 1 credit course to be completed during 7th semester. The student will make presentations on topics of academic interest.

EE449 MAJOR PROJECT-I (0-2-3) 4

EE454 FLEXIBLE AC TRANSMISSION SYSTEMS (3-1-0) 4

Transmission system performance, compensation approaches, static var systems, VSI based FACTS controllers – STATCOM, UPFC, TCSC, TCPAR, TCBR. Applications: Transient stability improvement. Introduction to custom power.

K. R. Padiyar, Power System Dynamics, Stability and Control, 2nd Edition, B.S. Publishers.

Prabha Kundur , Power System Stability and Control, McGraw-Hill EPRI Power System Engineering Series, 1994.
Narain G. Hingorani , Laszlo Gyugyi, Understanding FACTS – Concepts and Technology of Flexible AC Transmission Systems, IEEE Press, 2001.

EE456 HIGH-VOLTAGE ENGINEERING (3-1-0) 4

Electric breakdown in solid, liquid and gas dielectrics. Generation of high AC, DC and impulse voltages. Impulse current generators. Methods of measuring high AC, DC and impulse voltages and current. Partial discharge.

E. Kuffel, Zengal, High Voltage Engineering.
D. Kind, An Introduction to High Voltage Experimental Techniques.
Kamaraju, Naidu, High Voltage Engineering.
C. L. Wadhwa, High Voltage Engineering.

EE458 PHOTOVOLTAICS AND APPLICATIONS (3-1-0) 4

Overview of PV systems, relevance and adaptology, economics and efficiency, insolation and its measurement, types of cells. Elements of solar cell operation, light absorption and carrier generation in semiconductors,conversion efficiency and factors affecting it, Processing techniques. Concentrators, stand-alone inverters, grid operation, issue of energy storage, general applications, large PV power systems, rural power supply systems, Issues in developing countries, unconventional cell systems.

Chenming Hu, R. M. White, Solar cells- From Basic to Advanced Systems, McGraw-Hill.

EE464 POWER GENERATION AND ECONOMICS (3-1-0) 4

Hydro, thermal and nuclear power plants. Electrical equipments in generating stations. Load forecasting and sharing. Economic operation of power systems. Economic choice of transformers and electric motors.

Nagpal, Power Plant Engineering.
M. V. Deshpande, Elements of Power Station Design.
G. P Chalotra, Electrical Engineering Economics.
S. Domkundwar, S. C. Arora, A Course in Power Plant Engineering.

EE466 UTILIZATION OF ELECTRICAL ENERGY (3-1-0) 4

Electric Traction: Requirements of an ideal traction system, requirements of ideal traction motors, comparison and control of traction motors, mechanics of train movement, tractive effort for acceleration ,train resistance, gradient, coefficient of adhesion, speed time curves, specific energy consumption. Electric heating: methods of heat transfer, resistance heating, design of heating element , induction heating, eddy current heating, dielectric heating. Electric welding: resistance welding, arc welding. Electrolytic processes: Faraday's laws of electrolysis, Calculation of current required and related definitions, Factors governing the character of deposits, preparation of work for electroplating, electro-extraction. Illumination : Laws of illumination, lighting calculations, polar curves, Rousseau's construction.

Partab , Art and Science of Utilization of Electrical Energy.
E. O. Taylor, Utilization of Electric Energy.
C. L Wadhwa , Generation ,Distribution and Utilization of Electrical Energy.

EE467 INDUTRIAL ELECTRICAL SYSTEMS (3-0-0) 3

Overview of electrical systems in manufacturing, chemical, metallurgical, process industries, electric traction, electric heating, electric welding, electroplating, illumination and case studies.

Partab , Art and Science of Utilization of Electrical Energy.
E. O. Taylor, Utilization of Electric Energy.
C. L Wadhwa , Generation ,Distribution and Utilization of Electrical Energy.

EE468 ADVANCED ELECTRIC DRIVES **(3-1-0) 4**

Electric Drives: DC drives, modeling, analysis and simulation. Space phasors, modeling of brushless DC motor, modeling of induction motor, vector control of brushless DC motor. Induction motor drive: V/f control, vector control of induction motor, DT control of induction motor drives.

W. Leonhard, Electric Drives, Springer Verlag.

B.K. Bose, Power Electronics and AC Drives.

EE469 RENEWABLE ENERGY SYSTEMS **(3-0-0) 3**

Concept of renewable energy, design and implementation aspects of renewable energy systems employing solar energy, wind energy, chemical energy sources. Energy from the ocean and tides. MHD generation, thermo electric power. Geothermal energy. Energy from bio-mass.

G. D. Rai , Non-conventional Energy Sources.

P. S. Sukhatme , Solar Energy.

EE470 COMPUTATIONAL TECHNIQUES FOR LARGE SYSTEM ANALYSIS **(3-1-0) 4**

Solution of linear system of equations, solution of nonlinear system of equations, sparsity techniques, numerical integration techniques: explicit methods, implicit methods, fixed step methods, variable step methods, stability and accuracy-analysis of numerical methods, numerical calculation of eigenvalues, EMTP simulation techniques.

Steven C. Chapra, R. P. Canale, Numerical Techniques for Engineers, TMH, 2000.

Mariessa Crow, Computer Techniques for Large Electric Power Systems, CRC Press, 2003.

EE471 POWER SYSTEM SIMULATION LABORARORY-2 **(0-0-3)2**

Laboratory exercises and assignments to provide additional support to EE470.

Developing computer programs related to some of the techniques/methods and its application to power system analysis: Gauss elimination and its variants, Sparse matrix solution techniques, Load flow or Power flow analysis, Three phase power flow, Transient stability analysis, Optimal power flow, State estimation, Eigen value and modal analysis.

EE472 INSULATION AND TESTING ENGINEERING **(3-1-0) 4**

Introduction, review of test sources and measurement associated with insulation studies. Insulation types: solids, liquids, gases and vacuum, properties and characteristics. Dielectric strength and permittivity, methods of measurements, theories of breakdown. Testing of transformer oil, Schering bridges for tan-delta measurement. Measurement of insulation resistance of solids: Bulk and surface. PD measurements. Testing of cables IR, PI, step test, tan delta, PD. Treeing tracking. Radio interference measurements, RI and RIV. Testing of insulators, power transformers, Impulse testing, testing of rotating machines. Accelerated ageing tests and life estimation. Testing of surge diverters, bushings, insulators. Testing of rubber mats. Testing of Gas Insulated Substations.

Kamaraju, Naidu, High Voltage Engineering.

Kuffel, Zeangle, High Voltage Engineering.

Relevant Indian standards and Technical papers.

EE476 OPTIMISATION TECHNIQUES **(3-1-0) 4**

Linear Programming: Simplex method and extensions. Network models: Shortest path, maximum flow and minimum cost problems. Dynamic programming: resource allocation, production scheduling and equipment replacement problem. Non-linear programming: selected unconstrained and constrained non-linear programming algorithms like quasi Newton, reduced gradient and gradient projection methods. Penalty function methods, quadratic programming.

Lueneburger , Linear and Non linear Programming, McGraw-Hill.

Fletcher, Optimization techniques, John Wiley and Sons.

EE478 AN INTRODUCTION TO THE INTEL IA-32 ARCHITECTURE (3-1-0) 4

A brief history of the IA-32 architecture, the Intel P6 family of processors – Intel Pentium®, Xeon®, Pentium® M, Pentium® Extreme, Core™ Duo and Core™ Solo. SIMD instructions, Hyper-threading technology, Multicore technology. Basic execution environment, memory organization, paging and virtual memory, address calculations in 64-bit mode. Basic program execution registers, instruction pointer, operand addressing, memory operands, segmentation, I/O port addressing. Data types. Implementation of the IEEE 754 floating point format. Overview of FP exceptions and FP exception handling. General purpose instructions, FPU instructions, MMX instructions, SSE instructions, SSE2 and SSE3 extensions. Programming with GP instructions, Programming with the x87 FPU. Programming the IA-32 in the GNU/Linux environment.

Intel Corporation, IA-32 Intel Architecture Software Developer's Manual, Volume1:Basic Architecture, Intel Corporation, 2006.

Intel Corporation, IA-32 Intel Architecture Software Developer's Manual, Volume 2A: Instruction Set Reference, A-M, Intel Corporation, 2006.

Intel Corporation, IA-32 Intel Architecture Software Developer's Manual, Volume 2B: Instruction Set Reference, N-Z, Intel Corporation, 2006.

EE489 ADVANCED ELECTRIC DRIVES LABORATORY (0-0-3) 2

Laboratory exercises and assignments to provide additional support to EE468.

EE491 INSULATION AND TESTING ENGINEERING LABORATORY (0-0-3) 2

Laboratory exercises and assignments to provide additional support to EE472.

EE498 PRACTICAL TRAINING (0-0-3) 2

This course is a 2 credit course. A student may complete the practical training before the beginning of 8th semester (or as stipulated by DUGC) and register for it in 8th Semester. The duration and the details shall be decided by the faculty advisor, with approval from DUGC.

EE499 MAJOR PROJECT-II (0-2-3) 4

EE500 SYSTEM ANALYSIS IN DISCRETE TIME (3-1-0)4

The calculus of finite differences; Operators and their properties; Inverse operators. Difference equations and their solutions. Linear difference equations with constant coefficients, general and particular solutions. Discretization of differential equations. Modeling and analysis of LTI lumped-parameter systems in discrete time.

Kelley W.G., Peterson A.C., " Difference Equations: An Introduction with Applications", 2nd Edition, Elsevier, 2001.

Goldberg S., "Introduction to Difference Equations", 2nd Edition, Dover, 1986.

Elaydi S., "An Introduction to Difference Equations", 3rd Edition, Springer International Edition, 2008.

EE501 ANALYSIS OF NONLINEAR CIRCUITS (3-1-0)4

Nonlinear circuit elements, v-i characteristics, energy and power considerations. Time-varying elements, multiterminal elements. Resistive nonlinear circuits, graphical analysis. Dynamic nonlinear networks, autonomous and non-autonomous networks. Analysis of memristive circuits.

Chua L.O., "Introduction to Nonlinear Network Theory", McGraw-Hill, 1969.

Chua L.O., Desoer C.A., Kuh E.S., "Linear and Nonlinear Circuits", McGraw-Hill, 1987.

Department of Information Technology

MA200 MATHEMATICAL FOUNDATIONS OF INFORMATION TECHNOLOGY (3-1-0) 4

Graph Theory: Undirected and Directed Graphs, Bipartite Graphs, Connectivity, Traversability, Trees, Spanning Trees, Rooted and Binary Trees, Algorithms – Kruskal's and Prim's Minimal Spanning Tree, Dijkstra's Algorithm, Max-flow Min-cut theorem, Algorithms for computing maximum s-t flows in graphs; Probability Theory: Non-deterministic models, Finite Probability Space and related concepts, Conditional Probability, Independent and mutually exclusive events, Bayes' Theorem, Random Variables – 1D, 2D, Mathematical Expectation, Variance, Correlation, Distributions – Binomial, Poisson, Normal, Gamma, Chi-Square; Sampling Theory: Purpose and nature of sampling -uses and applications, Mean, Median, Mode, Variance, Standard Deviation; Hypothesis Testing: Formulation of hypotheses – null and alternate hypothesis, Parametric/Non-parametric tests and their applicability, Criteria for acceptance of hypothesis, Level of Significance, t/z/Chi-Square Tests with simple applications.

D. B. West, Introduction to Graph Theory, Pearson Education, ISBN 0-13-014400-2
R. Diestel, Graph Theory, Electronic Edition 2000, Springer Verlag, NY.
P. L. Meyer, Introductory Probability and Statistical Applications, Oxford & IBH Pub
S. M. Ross, Introduction to Probability and Statistics for Engineers and Scientists, John Wiley.
R. V. Hogg and A. T. Craig, Introduction to Mathematical Statistics, Macmillan NY, 4th Edition.

IT200 DATA STRUCTURES AND ALGORITHMS (3-1-0) 4

Simple Data types and data structures, Concepts of complexity analyses, worst, best and amortized analyses, Linked lists, stacks, queues, arrays; Concepts of Priority Queues, Hash Tables, Sorting, Search Trees, Graphs; Algorithms design concepts like Divide & Conquer, Dynamic Programming and Greedy.

Aho, Ullman and Hopcroft – Data Structures and Algorithms, Addison Wesley
Mark Allen Weiss, Algorithms, Data Structures and Problem solving with C++, Addison Wesley
T.H Cormen, C.E. leiserson and R.L Rivest - Introduction to Algorithms – The MIT Press, Cambridge, Massachusetts, USA, 1990.

IT201 DIGITAL DESIGN AND COMPUTER ORGANIZATION (3-1-0) 4

Combinational and Sequential Circuits, Basics of CPU, CPU Organization, Data Representation. Instruction Sets, Data Path Design, Fixed Point Arithmetic, ALU Design, Memory Organization, Control Design, Input/output Organization.

N. S. Gill, J. B. Dixit, Digital Design and Computer Organization, USP, 2008
Hamaher, V.Carl, Vranesi, Zvonko, Computer Organization McGraw Hill
J.P. Hayes, Computer Architecture and Organization, 3rd Edition, McGraw Hill, 1998
W. I. Fletcher, An Engineering Approach to Digital Design, PHI, 1999.
D.D. Givone, Digital Principles and Design, TMH, 2002

IT202 UNIX PROGRAMMING AND PRACTICE (1-0-3) 3

Introduction to UNIX OS, history, features, architecture, basic utility commands such as cp, mv, mkdir,rm, ls, grep, find, sed, file utility commands, file attributes, ownerships, permissions and other related utility commands, Usage of vi/vim editor, for programming in C/C++, compilers, debuggers, profilers (like gprof), makefiles, IDEs (for Java development like eclipse), Shell and shell programming, process control commands such as ps, nice, at, mesg, cron, etc, Assignments for lab sessions.

Sumitaba Das, UNIX Concepts and Applications
Richard W Stevens, UNIX Network Programming, Prentice Hall PTR
Roderick Smith O'Relly, UNIX Power Tools

IT203 COMPUTER SYSTEMS ORGANIZATION LAB (1-0-3) 3

Design of Adders, Substractors, Encoders, Decoders, Shifters, Counters, Flip-flops, Multiplexers, Simple ALU Design using VHDL, Assembly Level Programming with 80X86.

M. Morris Mano, Digital Design Prentice Hall, India, 2nd Ed
Enoch O. Hwang Digital Logic and Microprocessor Design with VHDL Thomson, India, 2007
D.D. Givone, Digital Principles and Design, TMH, 2002
Douglas Perry, VHDL McGraw Hill International, 1998.

IT204 DATA STRUCTURES AND ALGORITHMS LAB (0-0-3) 2

Implementation of array operations: Stacks, Queues, Circular Queues, Circular Queues, Multiple stacks and queues. Implementation of linked lists: stacks, queues, polynomial operations. Doubly linked lists; Tree traversal: AVL tree implementation, application of trees. Hash Table. Searching and sorting.

Mark Allen Weiss, Algorithms Data Structures and Problem Solving with C++, Addison Wesley

IT205 INFORMATION SYSTEMS (3-0-0) 3

Introduction to IS development, Tools for determining system requirements, Structured analysis and development strategy, Design of files, Introduction to database design, Systems engineering and quality assurance, Managing systems implementation, Hardware and software selection

James A. Senn, Analysis and Design of Information System, 2nd edition, McGraw Hill International Edition
Jeffrey. L. Whitten, Lonnie. D. Bentley, System Analysis and Design Methods 4th Edition. TMH, 2002.

IT206 PARADIGMS OF PROGRAMMING - I (3-0-2) 4

Fundamentals of Object Oriented Programming (OOP): Introduction, Objects and Classes in Java – Methods – Access specifiers – static members – constructors – finalize method – Arrays – Strings - Packages – JavaDoc comments; OOP Inheritance: Inheritance – class hierarchy – polymorphism – dynamic binding – final keyword – abstract classes – Object class – Reflection – interfaces – object cloning – inner classes – proxies; Generic Programming: Motivation for generic programming – generic classes/methods – generic code/virtual machine – inheritance and generics – reflection and generics – exceptions –exception hierarchy – throwing and catching exceptions – Stack Trace Elements -assertions – logging; Concurrent Programming: Multi-threaded programming – interrupting threads – thread states/properties –thread synchronization – thread-safe Collections – Executors – synchronizers – threads and event-driven programming.

Brac J Cox, Object Oriented Programming: An Evolutionary Approach – Addison Wesley Publishing Company.
Cay S. Horstmann, Gary Cornell, "Core Java: Volume I – Fundamentals, 8th Edition, Sun Microsystems Press, 2008.
K. Arnold and J. Gosling, The JAVA programming language, 3rd edition, Pearson Education, 2000.
Timothy Budd, Understanding Object-oriented programming with Java, Updated Edition, Pearson Education, 2000.
C. Thomas Wu, An introduction to Object-oriented programming with Java, Tata McGraw-Hill, 4th Edition, 2006.

IT250 OPERATING SYSTEMS (3-0-2) 4

Introduction to OS, File systems, CPU Scheduling, Memory management, Disc scheduling, Virtual memory concept, Deadlocks, Concurrent processes, Operating systems security, Case studies – UNIX operating system; Exercises using Linux and / or other OS to practice / simulate: scheduling, memory management algorithms; Concurrent programming; use of threads and processes; kernel reconfiguration, device drivers and systems administration of different operating systems O/S internals: Writing utilities O/S tuning.

Silberschartz and Galvin, Operating System Concepts, Addison Wesley.
Melin Milenkovic, Operating Systems - Concepts and Design, McGraw Hill, New York 1987

IT251 COMPUTER COMMUNICATION AND NETWORKING (3-0-2) 4

Evolution of Data Communication and Networks, Transmission Fundamentals: Signaling Schemes, Encoding and Modulation, Data Transmission over Networks – Switching Techniques, Layered Architecture of Computer Networks, OSI & TCP/IP Architectures and Layers with protocols, Data link Control and Protocols, Error Detection and Correction, Internetworking & Routing, Transport Layer Protocols, Applications: E-Mail, HTTP, WWW, Multimedia; Implementation of Signaling and Modulation, Bit, Byte & Character Stuffing and Error Detection/Correction Coding Techniques, TCP/IP Level Programming, Routing Algorithms, Exercises comprising simulation of various protocols.

Andrew S. Tannenbaum – Computer Networks, Prentice Hall of India, 2nd Edition, 1990

Behrouz A. Forouzan - Data Communications and Networking, 3rd Edition, Tata McGraw Hill, 2002.

William Stallings - Data and Computer Communications, 2nd Edition; Maxwell, MacMillan International Edition, 1989.

Leon, Garcia and Widjaja - Communication Network, 2nd Edition, Tata McGraw Hill, 2002.

IT252 DESIGN AND ANALYSIS OF ALGORITHMS (3-0-2) 4

Brief overview of Functions, Relations and Sets; Models of computation, various performance measures, General techniques of algorithm design, Analysis of different algorithms for sorting and selection, Data structures for efficient manipulation of sets and partition, Efficient Graph algorithms based on Depth first search, Strassen's matrix multiplication algorithm, Efficient algorithms for matrix inversion and LUP decomposition, Modular arithmetic, NP complete problems and approximation algorithms; Exercises to apply & practice the advanced algorithms: graph algorithms, internet algorithms etc. and analyze them.

Aho, Hopcroft and Ullman the design and analysis of Computer Algorithms, Addison Weseley.

Horowitz and Sahni, Fundamentals of Computer Algorithms, Galgotia Publications, 1985.

Baase S., Computer Algorithm Introduction to Design and Analysis, Addison Wesley.

Knuth D.E., The Art of Computer Programming, Vol. I: Fundamental Algorithmsa, Addison Wesley.

IT253 PARADIGMS OF PROGRAMMING - II (3-0-0) 3

Programming domains; Language Evaluation; Programming Paradigms – Imperative, Functional, OOP and Logic programming; Formal methods: syntax and semantics - Backus Naur Form, Attribute grammars; Describing semantics - Denotational semantics; Data types, Names, Variables, Bindings, Scope and lifetime, Referencing Environments; Named Constants-Variable Initialization-Subprograms-Parameter Passing – Coroutines; Even Driven Programming: Fundamentals; Case studies from Desktop to Mobile applications, VB.NET, ANDRIOD Applications; Functional programming languages - Lambda calculus - LISP; Application of functional programming languages; Logic programming languages –introduction to predicate calculus - Horn clauses - Logic programming: Prolog, Applications; Asynchronous Programming Model with a Case study (AJAX, C#...); Run-time Program Management; Virtual Machines: Java Virtual Machine, Common Language Infrastructure, Late Binding of Machine Code, Just-in-Time and Dynamic Compilation, Binary Translation, Binary Rewriting, Mobile Code and Sandboxing, Performance Analysis.

Robert W.Sebesta, "Concepts of Programming Languages", 9th Edition, 2009

Ravi Sethi, "Programming Languages - concepts and constructs", Addison Wesley, 2nd Edition, 1996.

Michael L. Scott, "Programming Language Pragmatics", Morgan Kaufmann, 3rd Edition, 2009.

Kenneth.C.Louden, "Programming Languages: Principles and Practices", 2nd Edition, Thomson Learning.

IT254 COMPUTER GRAPHICS (3-0-2) 4

Computer Graphics Hardware; Scan Conversion: lines, circles, ellipses; Filling Algorithms, Clipping Algorithms, Viewing in 3D: Projections, 2D & 3D transformations, Visible surface determination, Animation of 2D images: Implementation of 2D packages which support graphics editor with classical input techniques and animation.

Hearn and Backer, Computer Graphics Principles and Practice-2nd edition
Van Dam, Foley, Feimer, Hugher Computer Graphics Principles and Practice in C- Addison Wesley

IT255 MICROPROCESSORS AND INTERFACING (3-0-2) 4

Microprocessor history, Microprocessor architecture, 8086, instruction set, subroutines, Programming examples, software development systems, Interrupts, Polling, Daisy chain, RST instructions, Priority encoder, Programmable peripheral devices, 8255, 8253, 8259, 8257, Intel 80386, 80486 & Pentium Processors, Motorola 68000, 68020, 68030 processors, Mother boards, I/o bus, I/O channel, BIOS, DOS PC bus, Multibus I& II, VME and peripheral controllers.

Douglas V. Hall, Microprocessors and Interfacing, 2nd Edition, Tata McGraw-Hill, 2006.
Babby B.Brey, The Intel Microprocessors – Architecture, Programming & Interfacing, Pearson/Prentice Hall, 2008

IT290 SEMINAR (0-0-2) 1

This seminar is a 1 credit mandatory learning course to be completed during 4th semester. Each student will make technical presentation on a topic of academic interest as per recommendations of the DUGC of IT department.

IT300 PARALLEL COMPUTING (3-0-2) 4

Introduction to Parallel Computer Architectures, Parallel Programming with OpenMP, Parallel Programming with MPI, Advanced concepts in MPI, Recent Advances in Parallel Programming techniques like Task, Parallelism using TBB, TL2, Cilk++ etc. and software transactional memory techniques.

J. Dongara, I. Foster, G. Fox, W. Cropp et al, "Sourcebook of Parallel Programming", Morgan Kaufmann.
Barbara Chapman et.al, "OpenMP: Portable Shared Memory Parallel Programming", Scientific & Engg Computation, MIT 2008.
B. Wilkinson and M. Allen, "Parallel Programming: Techniques and Applications", Prentice Hall.
S. Akhter and J. Roberts, "Multi-Core Programming–Performance through Multi-threading", Intel Press, 2006.

IT301 DATABASE SYSTEMS (3-0-2) 4

Basic concepts, Data models and languages, Database design (conceptual and physical), System implementation techniques, Current trends in database system, Distributed databases; Design and Implementation of Database systems or packages for applications such as office automation, hotel management, hospital management; deployment of Forms, Reports Normalization, Query Processing Algorithms in the above application projects; Implementation of few important functionalities of relational database management systems

Raghu Ramakrishnan, Database Management Systems, McGraw Hill, 2000
R. Elmasri and S.B Navathe , Fundamentals of Database Systems, The Benjamin/Cummings Publishing Company, 2000
M. Tamer Özsu, Principles of Distributed Database Systems, Prentice Hall, 1999.
Silberschatz, Korth A.F., Sudarshan S., Database System Concepts, McGraw Hill,2005

IT302 WEB TECHNOLOGIES AND APPLICATIONS (3-0-2) 4

Internet and Web Technology, Infrastructure and tools for Internet Commerce / E-Commerce Current Trends in E-Commerce applications development, Enterprise level E-Commerce: SCM, CRM, EDI, B2Bi, ERP; Exercises to develop web based applications design using client server architecture; CGI programming and middleware exercises; Search engines & e-commerce related exercises; site management & server management and security studies.

Henury Chan et al. E-commerce-Fundamental and applications, John Wiley & Sons, 2002

G. Winfield Treese and Lawrence C.S. Designing Systems for Internet Commerce, Pearson Education, 2002.

IT303 AUTOMATA AND COMPILER DESIGN (3-0-2) 4

Introduction to Compiler Design, Regular Expressions, DFA, NFA, Minimization of states, Lexical analysis, usage of Lex, CFG, BNF notation, PDA, Parsing Techniques, Top-down and bottom-up parsing, Error Recovery strategies, Intermediate Code Generation, Runtime environment, Code Generation and introduction to code optimizations.

Aho, Ullman and Sethi, "Compilers: Priniciples, Techniques, Tools",
Compiler Design in C, Holub

IT304 MULTIMEDIA SIGNAL COMPUTING (3-0-2) 4

Signals in the Physical World, Signals in the Computer: Discrete Signals & Spectra; Discrete Fast Fourier Transforms - FFT Algorithms (DIT, DIF); Discrete Cosine Transforms (DCT); Discrete Wavelet Transforms (DWT); Z-Transform and Convolution; Feed-forward and Feedback Filters; Compression: Audio (MP3), Image (JPEG) and Video (MPEG4).

Ifeachor E C and Jervis B W, "Digital Signal Processing – A Practical Approach", Pearson education, 2002
Michael Stiber and Bilin Stiber, "Signal Computing: Digital Signals in the Software Domain".
J H. McClellan, R W. Schafer, and M A. Yoder, "DSP First: A Multimedia Approach", Prentice Hall, 1999.

IT305 PERFORMANCE MODELING (3-0-2) 4

Performance Evaluation methods. Analytical versus simulation modeling. Performance measurement and benchmarking. Workload modeling. Random variables. Commonly used distributions. Stochastic processes. Markov chain models of computer systems. Queuing models. Discrete event simulation. Simulation Languages. Confidence intervals. Variance reduction techniques. Case studies of analytical & simulation of computer systems.

Raj Jain, The Art of Computer Systems Performance Analysis, Jon Wisely and Sons, New York, USA, 1991.
KS Trivedi, Probability and Statistics with Reliability, Queuing and computer science, PHI 1982.
Paul & Howard, Computer systems performance Evaluation & Prediction, Elsevier, 2005.

IT306 OBJECT ORIENTED ANALYSIS & DESIGN (3-0-0) 3

Introduction to object technology and applications; object oriented decomposition vs. structured decomposition in software development, concepts and applications of object oriented analysis and design, object oriented databases, application development using programming language JAVA

Grady Booch, Object Oriented Analysis and design with applications, Addison Wesley
Michael R. Blaha and James Rumbaugh, Object Oriented Modeling and Design with UML, Prentice-Hall

IT307 ADVANCED COMPUTER NETWORKS (3-0-0) 3

Review of TCP/IP Protocol suit with latest developments, Broadband networks, advanced concepts: ATM, Frame Relay, Fiber Optic Networks: SONET, VOIP, MIPv6 etc., Remote Access and Wireless Networking: Virtual Private Networks - L2 and L3 Switches, Tunneling; BGP and Adaptive Routing, MPLS: QoS, Network Recovery/Restoration; Security Issues in TCP/IP and BGP, DoS/DDoS attacks, Mitigation with recent trends, Cryptography, Intrusion Detection; Network Management issues and protocols, Internet Management, Common Management Information services/protocol (CMIS/CMIP), Network Trouble Shooting, QoS (Integrated/Differentiated Services), Port based Network Access control, Availability, Scalability, Load Balancing and Recent Trends.

James F Kurose and Keith W Rose, Computer Networking, Pearson Education, 2003
Andrew. S. Tannenbaum, Computer Networks, Prentice Hall of India, 2nd Edition, 2002.
M. Subramanian, Network Management: Principles and Practice, Addison- Wesley, 2000.
William Stallings, Data and Computer Communications and Networking, 2nd Edition, TMH, 2002.

Behrouz A Forouzan, Data Communications and Networking, 2nd edition, TMH, 2002.
Leon,Garcia and Widjaja - Communication Networks, TMH 2002.

IT350 SOFTWARE ENGINEERING (3-0-2) 4

Introduction to Software Engineering, Software Development Life Cycle & Various Models, Requirement Engineering, Software Specification, Software Metrics, Software Design, Modular Structure, Object Oriented Software Engineering, Software Testing & Testing Mechanisms, Software Verification & Validation, Verifying Performance & Reliability, Software Cost Estimation Models, Software Development Tools incl. CASE, Software Project Management.

R.S. Pressman, Software Engineering, McGrawHill
Pankaj Jalote, An Integrated Approach to software Engineering, Narosa Pub., 1995
Ian Sommerville, Software Engineering, 5th Edition. Addison-Wesley Publication House, 1997
Bell Morry, and Pugh. Software Engineering Approach. Prentice Hall.
Dr. K.C. Shet. Software Engineering & Quality Assurance. BPB Publications, New Delhi.
Waman S. Jawadekar, Software Engineering- Principles and practice, Tata McGraw Hill

IT351 HUMAN COMPUTER INTERACTION (3-0-2) 4

Foundations: The Human, The Computer, The Interaction and Paradigms; The Process of Developing Interactive Systems: Models, Theories, Design Process and Evaluation; Interacting with Computers: Vision, Graphic Design, and Visual Displays - Touch, Gesture and Marking, Speech, Language and Audition; Psychology and Human Factors: Human Information Processing, Designing to fit human capabilities; Research Trends.

Andrew Sears and Julie A. Jacko, The Human-Computer Interaction Handbook: Fundamentals, Evolving Technologies and Emerging Applications, 2nd Edition, Lawrence Erlbaum Associates (CRC Press, Taylor and Francis Group), New York 2007.
Philip Kortum, HCI beyond the GUI: Design for Haptic, Speech, Olfactory and other Nontraditional Interfaces, Elsevier, 2008.
Alan Dix, Janet Finlay, Gregory D Abowd and Russell Beale, Human Computer Interaction, 3rd Edition, Pearson, 2004.
Ben Shneiderman, Catherine Plaisant, Designing the User Interface: Strategies for Effective HCI, 5th Edition, Pearson, 2009.
J. Preece, Y. Rogers and H. Sharp, Interaction Design: Beyond Human Computer Interaction, 3rd Edition, Wiley, 2011.

IT352 INFORMATION ASSURANCE AND SECURITY (3-0-2) 4

Cryptography, private and public key encryption, uses of encryption; Network Security: threats, controls – encryption, authentication, network security tools (firewalls, intrusion detection); Program security: non-malicious program errors such as buffer overflow, viruses, other malicious code, targeted malicious code, controls against program threats; Protection in operating systems: protected objects, methods of protection, access control, authentication; Web Security; Data security and privacy; Forensics and Incident response; Security Policies and Procedures.

William Stallings, Network Security Essentials, 4/e, Pearson Education, 2008
Atul Kahate, Cryptography & Network Security, McGraw Hill, 2004
Yi Qian et al, Information Assurance–Dependability & Security in Networked Systems, Morgan Kaufmann, 2008.
N. Nedjah, A. Abraham et al, Computational Intelligence in Information assurance and security, Springer 2007.

IT353 PERCEPTUAL AUDIO PROCESSING (3-0-2) 4

Fundamentals of Audio and Speech Processing; Speech and Audio Analysis: Transforms – STFT, DCT; Audio and Speech Compression Standards: MPEG and AAC; Human Auditory Perception; Perceptual

Audio Quality Metrics, Perceptual Processing of Digital Speech; Speech and Audio Rendering; Speech and Audio Storage and Retrieval; Applications and Research Trends.

Jacob Benesty, M. Mohan Sondhi and Yiteng Huang, Handbook of Speech Processing, Springer-Verlag, 2008.

A Spanias, T Painter and Venkatraman A, "Audio Signal Processing and Coding", Wiley-Interscience, 2007.

Hugo Fastl and Eberhard Zwicker, "Psychoacoustics: Facts and Models", Springer, 3rd edition, 2006.

Marina Bosi and Richard E. Goldberg, "Introduction to Digital Audio Coding Standards", Springer, 2002.

Ben G, Nelson M, "Speech & Audio Signal Processing: Processing and Perception of Speech and Music", Wiley, 1999.

IT354 PERCEPTUAL VIDEO PROCESSING (3-0-2) 4

Fundamentals of Image and Video Processing; Image and Video Analysis: Image Transforms - DCT, Hadamard, Haar, KL and Wavelets; Image and Video Compression Standards: JPEG, JPEG2000, MPEG1, MPEG2, MPEG4 & MPEG7; Image and Video Rendering and Assessment; Human Visual Perception; Perceptual Video Quality Metrics, Perceptual Coding and Processing of Digital Pictures; Image and Video Storage, Retrieval; Applications and Research Trends.

Perceptual Based Image Processing, Morgan & Claypool, 2009

Al Bovik, "Handbook of Image and Video Processing", Elsevier Academic Press, 2005

H. R. Wu and K. R. Rao, "Digital Video Image Quality and Perceptual Coding", CRC Press, 2005

R. C. Gonzalez and R E Woods, "Digital Image Processing", Pearson Education, 2002

William K Pratt, "Digital Image Processing", Wiley, 2001.

IT355 SOFT COMPUTING (3-0-2) 4

Optimization and Some Traditional Methods and issues, Introduction to Genetic Algorithms, Some Specialized Genetic Algorithms, Introduction to Fuzzy Sets, Fuzzy Reasoning and Clustering, Fundamentals of Neural Networks, Fundamentals biologically inspired computing, Applications and Recent Research Trends.

A. Ghosh, S. Dehuri and S. Ghosh (eds.), Multi-Objective Evolutionary Algorithms for Knowledge Discovery from Databases, ISBN 978-3-540-77466-2, Springer, 2008.

S. Bandyopadhyay and S. K. Pal, Classification and Learning using Genetic Algorithms: Applications in Bioinformatics and Web Intelligence, ISBN 978-3-540-49606-9, Springer-Verlag, Hiedelberg, Germany, 2007.

A. Ghosh, R. K. De and S. K. Pal (eds.), Pattern Recognition and Machine Intelligence, Springer, 2007.

D K Pratihar , Soft Computing , Narosa , 2007.

IT356 GENETIC ALGORITHMS (3-0-2) 4

Robustness of traditional optimization and search techniques, Simple Genetic Algorithms, Similarity templates, goals of optimization, Schema Theorem of John Holland, Computer Implementation and Applications of genetic algorithms, advanced operators and techniques in genetic algorithms, Recent research Trends.

David Goldberg, Genetic Algorithms in search, optimizations and machine learning, Addition Wesley, 1999

Charles L Karr and L Michael Freeman, Industrial applications of Genetic Algorithms, CRC Press 1998.

IT357 ARTIFICIAL INTELLIGENCE (3-0-0) 3

Problem Solving: Solving Problems by Searching, heuristic search techniques, constraint satisfaction problems, stochastic search methods, Game Playing: mini-max, alpha-beta pruning. Knowledge and Reasoning: Building a Knowledge Base: Propositional logic, first order logic, situation calculus. Theorem Proving in First Order Logic.Planning, partial order planning. Uncertain Knowledge and Reasoning,

Probabilities, Bayesian Networks. Learning: Overview of different forms of learning, Learning Decision Trees, Neural Networks. Introduction to Natural Language Processing. Applications and Recent Research Trends

Nilsson, Nils (1998). Artificial Intelligence: A New Synthesis. Morgan Kaufmann Publishers
Russell, Stuart J.; Norvig, Peter (2003), Artificial Intelligence: A Modern Approach, Prentice Hall
NPTEL Videos: Artificial Intelligence

IT358 ARTIFICIAL NEURAL NETWORKS (3-0-2) 4

Introduction to Artificial Neural Networks , Artificial Neuron Model and Linear Regression, Gradient Descent Algorithm, Nonlinear Activation Units and Learning Mechanisms, Learning Mechanisms, Associative Memory Model, Statistical Aspects of Learning, Single-Layer Perceptron, Least Mean Squares Algorithm, Perceptron Convergence Theorem, Bayes Classifier, Back Propagation Algorithm, Multi-Class Classification Using Multi-layered Perceptrons, Radial Basis Function Network, Introduction to Principal Component Analysis and Independent Component Analysis, Introduction to Self Organizing Maps, Applications and Recent Research Trends

Simon Haykin, "Neural networks - A comprehensive foundations", Pearson, 2004
*Laurene Fausett: **"**Fundamentals of neural networks: architectures, algorithms and applications**",***
Prentice Hall
James A. Anderson, "An Introduction to Neural Networks", Prentice Hall of India.
Yegnanarayana: "Artificial Neural Networks", Prentice Hall of India,2004.

IT359 FUZZY SYSTEM MODELS (3-0-0) 3

Classical /crisp set, fuzzy sets, Fuzzy numbers, Fuzzy arithmetic, Fuzzy measures, Operations on Fuzzy sets, Fuzzy relations, Multi valued logic, Fuzzy logic, Uncertainty and information, Approximate reasoning, Fuzzy decision making, Fuzzy models, case studies.

Klir and Yuan, Fuzzy Sets and Fuzzy logic, Prentice Hall of India 2001.
Li Xin Wang, A course in fuzzy systems and control, Prentice Hall
J. Yen and R. Langari, Fuzzy logic: Intelligence, control and information, Pearson Education.

IT360 DISTRIBUTED COMPUTING SYSTEMS (3-0-0) 3

Basic concepts - Computer networks, Distributed systems and Computing, Design goals, Fundamental issues and transparencies in DCS, Ordering of events, Ordering of messages and concerned protocols, Global state detection Process synchronization, Process communications, Load balancing techniques.

Mukesh Singhal and Niranjan G. Shivaratri, Advanced Concepts in Operating System, Tata McGraw Hill, 1994.
A.S Tanenbaum and M.V. Steen, Distributed Systems – Principles and Paradigms, PHI.
Randy Chow, Distributed Operating Systems and Algorithms, Addison Wesley.
G.F. Coulouies, J.D. Dollimore and T. Kindberg, Distributed Systems: Concepts & Design, Addison Wesley, 1994.

IT361 ADVANCED DATABASE SYSTEMS (3-0-0) 3

Basic concepts, Buffer management, Query optimization, Selectivity estimation, Concurrency control, Recovery, Database tuning, Distributed databases– principles, architecture, design, query processing, transaction management, Replication, Web databases, Current trends in database system.

M. Tamer Özsu, Principles of Distributed Database Systems, Prentice Hall, 1999.
Ceri S and Pelagatti G, Distributed databases: Principles and Systems, McGraw Hill, 2000.
Thomas Connolly and Carolyn Begg, Database Systems: A Practical Approach to Design, Implementation and Management, Pearson Education, 2002.

IT362 INFORMATION RETRIEVAL (3-0-0) 3

Introduction: Basic IR Models, Basic Tokenizing, Indexing, and Implementation of Vector-Space Retrieval, Experimental Evaluation of IR,Query Operations and Languages, Text Representation, Web Search, Text Categorization and Clustering, Recommender Systems, Information Extraction and Integration.

C. D. Manning, P. Raghavan and H. Schütze, Introduction to Information Retrieval, Cambridge University Press. 2008.

Richardo & Bertheir, Modern Information Retrieval, Pearson Education, 2000

Korfhage Robert R, Information Storage and Retrieval, John Wiley & Sons, Inc, 1997.

IT363 SIMULATION AND MODELING (3-0-2) 4

System models and Role of Simulation, Types of Systems, Statistical Tools and Techniques, Discrete Event Simulation Languages, Modeling and Performance Evaluation of Computer Systems, Biological and Sociological System Simulation, Verification and Validation.

A. M. Law and W.D. Kelton, Simulation Modeling and Analysis, McGraw Hill, 2000

A. M. Law, Simulation Modeling and Analysis, McGraw Hill, 4th Edition, 2008

IT364 E-COMMERCE (3-0-0) 3

Infrastructure and Tools for E-Commerce, Current Trends in E-Commerce applications development, The Business of Internet Commerce, Enterprise level E-Commerce, Security and encryption, Electronic payment systems, Search engines, Intelligent agents in E-Commerce, On-line auctions, Data mining for e-commerce, Web metrics, Recommender systems, Knowledge management, Mobile e-commerce, Legal, ethical and social issues.

Henry Chan et al., E-Commerce- Fundamental and applications, John Wiley & Sons, 2002

G.Winfield Treese and Lawrence C.S, Designing Systems for Internet Commerce, Pearson Education, LPE, 2002

Fensel, Dieter, Brodie M. L., Ontologies: A Silver Bullet for Knowledge Management/E-Commerce, Allied Publishers, 2004.

Zimmermann, Olaf; Tomlinson, Mark R.; Peuser, Stefan, Perspectives on Web Services, Allied Publishers, 2004.

IT365 NATURAL LANGUAGE PROCESSING (3-0-2) 4

Introduction and Overview, Language Modelling, History and Applications, Basic Text Processing - Word stemming, tokenization, normalization, Part of Speech tagging, Text Classification – basics and process, tools, Information Retrieval, TF/IDF, Ranked IR, Vector Space Models, Query analysis and processing, Basics of Information Extraction, Named Entity Recognition, Maximum Entropy models, Relation Extraction; Introduction to Semantics, word sense and word similarity, Basics of Wordnets, tools, Emerging trends, research issues, challenges, interesting applications in various domains.

Daniel Jurafsky and James H. Martin. Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition, 2nd Edition. Prentice Hall, 2008

Christopher D. Manning and Hinrich Schütze, Foundations of Statistical Natural Language Processing, MIT Press, 1999

Tanveer Siddiqui, U. S Tiwary, Natural Language Processing And Information Retrieval, 1st Edition

IT367 TIME SERIES ANALYSIS (3-0-0) 3

Introduction, Stochastic Processes, Stationary Time Series Process (Time Domain), Univariate Analysis: Autoregressive (AR) Process. Moving Average (MA) Process, Autoregressive Moving Average (ARMA) Process, Causality, Multivariate Analysis: Autoregressive Distributed Lag (ARDL) Model , Vector Error Correction (VEC) Model , Vector Autoregressive (VAR) Model, Spectral Analysis (Frequency Domain),Non-Stationary Time Series Process , Unit Root Tests: Dickey-Fuller Test Phillips-Peron Test Elliott-Rothenberg-Stock Test ,Schmidt-Phillips Test, Kwiatkowski-Phillips-

Schmidt-Shin (KPSS) Test , Zivot-Andrews Test, Cointegration introduction and tests, ARCH , GARCH Model , Generalized Method of Moments (GMM)

. Shumway and D. S. Stoffer (2006), Time Series Analysis and Its Applications (With R Examples, Second on). Springer, New York.
kwell, Peter J & Davis, Richard A: Introduction to Time Series and Forecasting. Springer Series in stics. Second Edition.
field, Chris: Analysis of Time Series: an Introduction. Chapman & Hall. Sixth Edition.
epohl, Helmut: Introduction to Multiple Time Series Analysis. Springer-Verlag.
ilton James D: Time Series Analysis. Princeton University Press.

IT399 MINOR PROJECT (0-0-3) 2

Design/Experimental/Simulation tasks of relatively minor intensity and scope as compared to the Major Project and in line with the guidelines formulated by the DUGC of IT Department. The Student has to select a project based on the topic of interest. Periodical implementation of the project will be evaluated by the project guide.

IT400 MOBILE COMPUTING (3-0-0) 3

Evolution of Wireless and Cellular Systems; Wireless Propagation: Encoding, Modulation, Multiplexing, and Error Handling Techniques; MAC Layer: Channel Allocation Techniques; Study of Mobile Communication Systems: Infrastructure, Registration and basic Call Establishment & Termination, Handoff, Roaming Support; Threat, Logical Migration, Mobile agents, Security issues.

Kumkum Garg, Mobile computing - Theoory and Practice, 2010
Raj Kamal, Mobile computing, Oxford University Press 2007.
Joschen Schiller, Mobile Communications, Pearson Education, 2003
Dharma Prakash Agarwal & Qing-An Zeng, Wireless & Mobile Systems, CENGAGE, 2nd Edition, 2006.
William Stallings, Wireless Communication & Networks, Prentice Hall of India, 2nd Edition, 2004.

IT401 EMBEDDED SYSTEMS (3-0-0) 3

Embedded System Design Process: Embedded Computing Platform, Program Design and Analysis, Real Time Operating Systems, Networks: Distributed Embedded Architeture, System on Chip (SOC) and the current trends.

David E Silmon, An Embedded Software Printer Pearson Edition Asia, 2001
Wayne Wolf, Computer as Components – Harcort India Pvt. Ltd. 2001

IT402 BIOINFORMATICS (3-0-0) 3

Introduction to Bioinformatics, Biological Databanks, Sequence Analysis, Structure Prediction, Protein Folding, Porteomics, Emerging Areas in Bioinformatics

Krane D.E. & Raymer M.L. Fundamental Concepts of Bioinformatics, Pearson, 2003
Attwood & Parrysmith : Introduction to Bioinformatics, Person Ed, 2003
Gibas & Jamnbeck : Developing Bioinformatics Computer Skills, O'Rielly, 2003

IT403 KNOWLEDGE MANAGEMENT (3-0-0) 3

Introduction to knowledge management, Types of Knowledge within an organization. Intellecutal capital. KM Architecture and Tools. ERP for KM. Knowledge sharing tools. Data ware housing, Knowledge strategy creation. KM practice. KM Process. Integrating knowledge sharing and learing, The chief knowledge Officer (CKO) and his/her job. T4raining programmes for organization. widelearing. Making KM work across various segments of industry and business firms. Case studies of KM practices in successful companies, Future challenges in KM

Ratnja Gogula, Knowledge management: A New Dawn, Institute of Chartered Financial Analysts of India, 2002.

IT404 SYSTEM INTEGRATION **(3-0-0) 3**

Enterprise Integration Drivers, Requirements and Strategies, The Business Imperative for Enterprise Integration. Business Drivers and Requirements. Enterprise Integration: Strategy, Architecture Overview. Current Integration Architecture Assessment. Technical Integration Architecture, Service Integration Architecture, Information Integration Architecture. Process Integration Architecture, Enterprise Integration Solutions: Application, Information, Composite Application and Process-Driven Integrations; Best Practices for Enterprise Integration.

B. G. Bernstein and W. Ruh. Enterprise Integration: The Essential Guide to Integration Solutions. Addison-Wesley.

C. Britton and P. Bye, IT Architecture, Middleware: Strategies for Building Large Integrated Systems, Addison-Wesley.

IT405 DATA WAREHOUSING AND DATA MINING **(3-0-2) 4**

Data Warehousing concepts; Components and building data warehouse. Data Mining – Objectives and examples, data mining process, Data mining techniques, Generalization, Data mining knowledge representation

Raph Kimball Data Warehouse Toolkit, John Wiley

Michael. J. Berry, Gordon Linoff Data Mining Techniques: Marketing, Sales, Customer Support, John Wiley.

IT406 MIDDLEWARE TECHNOLOGIES **(3-0-2) 4**

Introduction to Middleware Technologies, General Middleware, Service Specific Middleware, Client/Server Building blocks: RPC, Messaging – P2P, Java RMI, Computing standards, OMG, Introduction to CORBA, EJB and .NET, XML Technologies - XML, DTD, XSD, XSLT, XQUERY, XPATH, Web Services and SOA.

G. Sudha Sadasivam, Distributed Component Architecture, Wiley India Edition.

Thomas Erl ,Service Oriented Architecture: Concepts , Technology & Design, Prentice Hall

G. Brose, A Vogel and K. Duddy, Java programming with CORBA, 3rd Edition, Wiley India John Wiley and Sons

Ed Roman, Mastering Enterprise Java Beans, John Wiley & Sons Inc.

IT407 COMPUTER VISION **(3-0-2) 4**

Concept of application of computer vision, functional architecture of a vision system visual sensory model and camera calibrative, processing tools, 3D vision, 3D representative schemes, High level vision and navigation.

Sonka M., Hlavac V., Boyle R., Image Processing Analysis and Machine Design, PWS Publishers

Ballard D., Brown C., Computer Vision, Prentice Hall

Bratt W., Digital Image Processing, John Wiley & Sons

IT408 PATTERN RECOGNITION **(3-0-2) 4**

Pattern and features. Pattern recognition approaches. Discriminant functions. Statistical pattern recognition, Gaussian model. Parametric estimation. Bayesian parameter estimation, pattern classification by distance functions Cluster analysis, Syntactics pattern recognition. Features extraction and recent advances.

Earl Gose, Richard Johnsonbaugh, Steve Jost, Pattern Recognition and Image Analysis, Prentice Hall 1999.

Duda RO and Hart PE, Pattern Classification and Scene Analysis, Wiley 1973.

IT409 CLOUD COMPUTING **(3-0-2) 4**

Introduction to Cloud Computing, Cloud Computing Delivery Models, Open Source and Industry Case Studies of Cloud (Apache VCL, Amazon, IBM and Eucalyptus), Map/Reduce and Apache Hadoop Programming models for cloud computing and examples/applications, Virtualizations as an enabler for cloud computing infrastructure.

George Reese, Cloud Application Architectures, O'Reilly Publications, 2009
Tim Mather, Subra Kumaraswamy. Cloud Security and Privacy , O'Reilly, 2009
Tom White, The Hadoop – Definitive Guide, O'Reilly, 2009.

IT410 WIRELESS SENSOR NETWORKS (3-0-2) 4

Introduction to wireless communication and wireless sensor networks, Network architecture and design principles, MAC and link layer protocols, Topology control in WSN, Routing protocols, Information Aggregation, Information Storage, Query, Localization, Security issues, Applications and recent trends: Wireless multimedia sensor networks.

F. Zhao and L. Guibas, Wireless sensor networks: An information Processing Approach , Elsevier/Morgan-Kaufmann, 2004.
Carlos de Morais Ciordeiro nad Dharma Prakash Agrawal,Adhoc and Sensor Networks: Theory and Applications,World Scientific Publications, 2006.

IT411 MOBILE ADHOC NETWORKS (3-0-2) 4

Mobile ad hoc networking; imperatives, challenges and characteristics, Bluetooth networks, Routing approaches, Proactive and reactive protocols. Clustering and hierarchical routing, Multipath routing, Security aware routing, Energy efficient communication in ad hoc networks, Measuring energy consumption, Power save protocols, Maximum life time routing, Secure routing protocols, Intrusion detection, Security considerations in ad hoc sensor networks, Key management, Characterization of IP traffic, QOS classification, Self similar processes, Statistical analysis of non – real time traffic and real – time services.

C.S. Murthy & B.S. Manoj, AdHoc Wireless Networks, Pearson
T.Janevski, Traffic Analysis and Design of Wireless IP Networks, Artech House
Ozan K. Tonguz & Gianluigi, Adhoc Wireless Networks, Wiley.

IT412 SEMANTIC WEB TECHNOLOGIES (3-0-2) 4

Introduction to the Semantic Web – What is Semantics; Syntax, Structure and Semantics, Layered Cake Architecture; Structured Web Documents and Resource Description Framework – Understanding content, Metadata, metadata standards, XML + metadata specification, RDF and metadata processing; Programming with RDF/XML; Web Ontology Language (OWL) - Ontology, Domain Modeling, Logic, Inferencing, Context; Logic Reasoning for the Semantic Web - Classification and semantic metadata extraction techniques: statistical, statistical learning/AI, lexical and natural language, knowledge based; Programming with Ontology; Semantic Applications - demonstrating power of semantic technology for services, search, personalization, contextual directory and custom/enterprise applications; next generation semantic content management, Review of some of the active projects (e.g., SHOE, OntoBroker, InfoQuilt) and initiatives (OntoWeb, DAML) and Recent Trends.

Pascal Hitzler et al, Foundations of Semantic Web Technologies, Chapman & Hall, 2009.
Karin Breitman et al, Semantic Web: Concepts, Technologies and Applications, Springer, 2010.
Grigoris Antoniou and Frank van Harmelen, A Semantic Web Primer, The MIT Press, 2nd Edition, 2008.
John Hebeler, Matthew Fisher, Ryan Blace, Andrew Perez-Lopez, Semantic Web Programming, Wiley, 2009.

IT413 VIRTUAL REALITY (3-0-2) 4

Introduction to Virtual Reality Technology and its effectiveness in Real-Time Applications, Scientific Visualization, Input Devices: Trackers, Navigation and Gesture Interfaces; Output Devices: Graphics, 3D Sound and Haptic Displays; Computing Architectures for Virtual Reality, Modeling, Virtual Reality

Programming, Human Factors in Virtual Reality; Overview of Virtual Humans, Face Cloning & Face Motion Capture/Analysis and Research Trends.

Gerard Jounghyun Kim, Designing Virtual Reality Systems – The Structured Approach, Springer-Verlag, 2005.

N Magnenat-Thalmann and D Thalmann, Handbook of Virtual Humans, Wiley, 2004.

L J. Hettinger, M W. Haas, Virtual & Adaptive Environment: Apps, Human Performance, Lawrence Erlbaum, 2003.

Grigore C Burdea and Phillippe Coiffet, Virtual Reality Technology, John Wiley, 2003.

IT414 RICH INTERNET APPLICATIONS (3-0-2) 4

Web2.0 concepts, SaaS model, Evolution of Web 2.0, Web Programming concepts, HTML, XHTML, CSS, Javascript. JS Execution Environment, Overview of XML, Web Services, Building Rich Internet Applications, AJAX, XML HTTP Object, ActionScript, Products from Industry like Flex (Adobe), Flash/AIR (Adobe)., Silverlight (MS), JavaFX (SUN), OpenLazzlo technologies, Recent Trends.

Robert Sebesta, Programming the World wide web, Pearson Education, Third Edition

Nicholas C Zakas et al, Professional AJAX, Wrox publications, 2006

Chafic Kazoun, Programming Flex 2, O'Reilly publications, 2007

Colin Moock, Essential Action script 3.0, O'Reilly Publications, 2007

Steven Holzner, Ajax Bible, Wiley India edition, 2007

Justin Gehtland et al, A Web 2.0 primer Pragmatic Ajax, SPD Publications, 2006.

IT440 PRACTICAL TRAINING 2

The Student has to undergo a practical training programme or carrying out a research/practical oriented project or any equivalent training programme fixed by the DUGC of IT department. This practical training will be done during vacation period (6-8 wks) before the evaluation semester. Final evaluation is based on the report/seminar by the student.

IT449 MAJOR PROJECT – I (0-0-3) 2

The Student has to select a project based on a topic of interest. This project work will be commencing in VII semester and continued in VIII semester, at the end of each semester, the project work will be evaluated internally and externally.

IT450 WEB SERVICES (3-0-0) 3

Basic concepts, Enabling Infrastructure, Core functionality and standards, Service semantics, Web service composition, Service development and recent research trends.

Alanso G, Casati F, Web Services - Concepts, Architectures and Application Series: Data-Centric Systems and Applications, 2004

S Weerawarana et al, Web Services Platform Architecture: SOAP, WSDL, WS-Policy and More, Prentice Hall, 2005.

Thomas Erl, Service-Oriented Architecture: Concepts, Technology, and Design, Prentice Hall, 2005.

R. Allen Wyke et-al, XML Programming, WR Publishers.

J2EE Web Services, Richard Monson-Haefel, Pearson (LPE), 2005.

IT451 SOFTWARE ARCHITECTURE (3-0-0) 3

Definition and overview of software architecture, The architecture business cycle: what influences software architects, Different Architectural styles, Architecture description language, Understanding and achieving quality attributes, Attribute-driven design, Documenting/Evaluating Software Architecture and its reuse, Case studies and Recent Trends.

Mary Shaw, David Garlan, Software Architecture, Prentice Hall ,India, 2000

Bass, Len; Paul Clements, Rick Kazman, Software Architecture In Practice, Second Edition. Addison-Wesley, 2003.
Clements, Paul et al, Documenting Software Architectures: Views and Beyond. Addison-Wesley, 2003.

IT452 COMPUTER ARCHITECTURE (3-0-0) 3

Flynn's Classification, RISC Vs CISC, Data and control flow, Pipelining: Linear and non linear, pipeline hazards, instruction scheduling, Branch handling techniques, Arithmetic pipeline, VLIW architecture, Superscalar processors. Instruction level Data-Parallel architectures: SIMD architectures, Systolic and Vector architecture; MIMD architectures, Systems interconnect architecture: Network properties/routing, Static/dynamic interconnection networks. Multiprocessor architectures, models of memory consistency, cache coherence/directory protocols.

Dezso Sima, Peter Karsuk, Advanced Computer Architectures: A Design Space Approach, Addison-Wesley.
K.Hwang and F.A. Briggs, Computer Architecture and Parallel Processing, McGraw Hill Publication.
J. Hennesy and D. Patterson, Computer Architecture –A Quantitative Approach, Morgan Kaufmann, 2003

IT453 TRANSACTION PROCESSING (3-0-0) 3

Introduction and need of transaction processing, online transaction process (OLTP), OLTP program design, OLTP and system Reliability, OLTP and CICS standards in OLTP, current trends.

Gary McClain, OLTP handbook, McGraw Hill, 1997.

IT454 SOFTWARE QUALITY ASSURANCE (3-0-0) 3

Overview of Software Engineering. Requirement Engineering Analysis, software reliability. Definition and concepts of
software reliability, software quality. Introduction to software quality principles, total quality management, Quality Assurance Standards. ISO 9000 Tick-It method. Miscellanious Issues: Software maintenance. Future OF SQA

John J. Marciniak, Encyclopedia of Software Engineering. - Vol. I & II. John Wiley & Sons, 1994.
Ince Darrel. ISO 9001 and Software Quality Assurance. McGraw Hill, 1994
Pankaj Jalote, An Integrated Approach to Software Engineering Narosh Publications, 1995
Isabel Evans, Achieving software Quality through team work, Allied publishers, 2004.

IT455 INFORMATION TECHNOLOGY FOR HEALTHCARE (3-0-0) 3

Evolution of IT Enhanced Healthcare, Internet Technologies in Telemedical Systems, Wireless Systems in E-Health, Decision Support Systems in Medicine, Health Telematics Networks, Computer Aided Diagnosis and Recent Trends.

Krzysztof Zielinski, Mariusz Duplaga and David Ingram, IT Solutions For Healthcare, Springer, 2006
Robert E Hoyt, Nora Bailey, Ann Yoshihashi, Health Informatics, 5th Edition, Lulu Publishers, 2012
Kevin Beaver, Healthcare Information Systems, Auerbach Publications, 2nd Edition, 2002.

IT456 ENTERPRISE RESOURCE PLANNING & SYSTEMS (3-0-0) 3

ERP: Needs, Models, Commercial ERP Packages, Client Server and Open Technology Solutions, Supply Chain Management-Issues, Drivers and Obstacles, Coordinating SCM and ERP in E-Business

Vinod Kumar G & N.K. Venkitakrishna, ERP- Concepts and Practice, PHI, 1998
Sunil C & Peter-SCM – Strategy and Planning and Operation, Pearson Education, LPE, 2002
Pete Loshin, Paul A. Murphy, Electronic Commerce, A JAICO Book.

IT499 MAJOR PROJECT – II (0-0-9) 6

The Student has to select a project based on a topic of interest. This project work will be commencing in VII semester and continued in VIII semester, at the end of each semester, the project work will be evaluated internally and externally.

Department of Chemical Engineering

CH200 Process Calculations (2-2-0) 4

Introduction to Engineering Calculations.Physical and chemical properties of compounds and Mixtures.Techniques of problem solving.Concepts of unsteady state processes and material balance equation.Steady State Material Balances. Material balances involving Recycle by pass and purge calculations. Multiphase systems. Single component phase Equilibrium. Solutions of Solids in Liquids. Humidity charts and their uses. Energy and Energy balances.

D.M.Himmelblau, Basic Principles and calculations in Chemical Engg 5th Edition, Prentice Hall of India. 1992

R.M.Felder, R.W.Rlusseau, Elementary Principles of chemical processes 2nd Edition. John Wiley & Sons Inc. 1986

CH201 Momentum Transfer (3-1-0) 4

Properties of fluids.Fluid statics.Introduction to fluid flow. Basic equations of fluid flow. Laminar Flow.Turbulent flow.Fluid flow around immersed bodies - Boundary layer and friction drag.Motion of particles through fluids.Fluidization principles.Dimensional analysis Similitude.Mixing of liquids.Compressible flow. Flow measurement. Fluid transportation machinery

McCabe and Smith, Unit operations in Chemical Engineering, McGraw - Hill 5th Edition. 1993

Coulson and Richardson, Chemical Engineering Volume I ELBS, Pargamon 3rd Edition. 1977

CH202 Particulate Technology (3-1-0) 4

Particle Size Analysis.Industrial Screening.Storage and Conveyance of Solids.Size Reduction.Size Enlargement.Classification.Centrifugal Separation.Gas cleaning.Solid - Liquid Separation.Thickening. Froth Flotation. Magnetic separation.Electrical separation.Sorting (Separation of solids).Mixing and Agitation.

Richardson J.F and Coulson J.M, Chemical Engineering (SI Units) Vol 2; 1978.

McCabe W.L. and Smith J.C., Unit Operations in Chemical Engineering, McGraw Hill, New York, 5th edition.

CH203 Transport Phenomena (2-2-0) 4

Shell balances for momentum, energy and mass transfer. Introduction to general transport equations for momentum, energy and mass transfer in cartesian - cylindrical and spherical coordinates - simple solutions in one dimension. Simplification of general equations with time and spatial coordinates for momentum, energy, mass transport, boundary layer concepts of momentum energy and mass transport. Macroscopic balances for isothermal systems, nonisothermal systems and multi componant systems.

Robert S. Brodkey and Harey C. Hershey - Transport Phenomena - A Unified Approach, McGraw Hill Book Co., 1988.

R.B.Bird, W.E.Stewart and E.W.Lightfoot - Transport Phenomena, John Wiley &Topan, 1960.

Beek W.J. andMutzall K.M.K., - Transport Phenomena, John Willey and Sons Ltd., 1975.

CH211 Process Instrumentation (3-0-0)3

Introduction: Temperature measurement, Pressure measurement, Flow measurement, Level measurements Viscosity measurement, Moisture and humidity measurements. Conductivity meter- pH meter,

Analytical instruments – Liquid chromatography – HPLC – Mass spectroscopy - Computer aided analysis – process instruments and automatic analysis.

Instrumentation, Measurement and Analysis, B.C.Nakra and K.Chaudhry, Tata McGrow Hill Co., New Delhi, l985.

Encyclopadia of Instrumentation, Liptak B.G.,Vol.l, BG and supplement Chelton Book Co., New York, 1969.

Instrumental Methods of Analysis, Willard, Merru, Dean and Settle, C.B.S. publication, New Delhi,

1986 (Chapters 17, 18, 19, 30 & 31).
Mechanical and Industrial Measurements, R.K.Jain, Khanna Publishers, New Delhi, 1982.

CH250 Chemical Engg. Thermodynamics I (2-1-0) 3

Fundamental Concepts and Definitions. PVT relationships. First law of Thermodynamics. Application of law to different processes in closed systems. Second Law of Thermodynamics. Physical meaning of entropy. T-S diagrams. Relations among thermodynamic properties. Thermodynamic functions in terms of measurable properties. Construction of thermodynamic charts. Third Law of Thermodynamics. Thermodynamics of flow processes. Application of first law to flow processes. Power and Refrigeration Cycles.

Smith, J.M, and H.C. Van Ness -Introduction to Chemical Engineering Thermodynamics, 4th edition, McGraw - Hill.
Hougen, A., K.M. Watson and R.A. Ragatz - Chemical Process Principles, Vol. 2 (Thermodynamics), Asia Publishing House, 1960.

CH251 Heat Transfer (3-1-0) 4

Steady state conduction.Transient conduction. Insulation - critical thickness of insulation. Heat transfer with heat generation. Heat Transfer by convection. Heat Transfer with packed and fluidized beds. Heat Transfer in Jacketted vessels. Cryogenic heat transfer. Heat transfer in extended surfaces. Heat transfer with change of phase.Boiling Heat transfer.Radiation.

J.M.Coulson and J.F.Richardson - Chemical Enginering, Vol.1, 3rd ed., Pergamon and ELBS, 1977.
Krieth - Fundamentals of Heat Transfer, 4th Edition, Harper & Law, 1986.

CH252 Mass Transfer – I (3-1-0) 4

Introduction to Mass Transfer operations.Introduction to advanced separation techniques. Steady and unsteady state operations, stage wise and continuous contact operations. Diffusion Mass Transfer.Concept of Mass Transfer Coeficient. Theories of Mass transfer. Flow past solids - Analogies. Interphase Mass Transfer. Absorption and Desorption. Adsorption.

R.E.Treybal - Mass Transfer Operations. 2nd Edition, McGraw Hill, 1968.
W.L. McCabe and J.C. Smith - Unit Operations of Chemical Engineering.McGraw Hill, 1976.

CH253 Chemical Reaction Engineering – I (2-1-0) 3

Chemical Reaction Equilibrium.Kinetics of Homogeneous Reactions.Single Homogeneous Reactor Design.Multiple Reactor Systems.Multiple Reaction Systems.

Levenspiel, O. - Chemical Reaction Engineering, 3rd edition, Wiley Eastern Limited.
Scott Fogler, H. - Elements of Chemical Reaction Engineering, 3rd edition, Prentice Hall of India.

CH254 Fluid & Fluid Particle Systems Lab (0-0-3) 2

Experiments based on Momentum Transfer and Particulate Technology.

CH261 Energy Technology (3-0-0)3

Energy Scenario in India -Conventional/non-conventional renewable non renewable sources. Principles of efficient use of fuels, energy conservation and auditing. Solid liquid and Gaseous fuels. Combustion, Furnaces.Draught and chimney height. Nuclear Energy - Classification and Components.
Unconventional fuels, renewable energy sources.

Sharma S.P.andChander Mohan -Fuels and Combustions- Tata McGraw Hill Book Co., 1982.
Shaha A.K. - Combustion Engineering and Fuel Technology, Oxford Press.
Gilchrist J.D. - Fuels, Furnaces and Refractors, Pergamon Press, 1977.
Ronald F. Probstein and Hicks R.E. - Synthetic Fuels - McGraw Hill Book Co., 1982.
Manon L Smith and Keri W Stinson - Fuels and Combustion - McGraw Hill Book Co., 1952.

CH 300 Chemical Engg. Thermodynamics II (2-1-0) 3

Single Component Systems. Multicomponent Systems. Phase Equilibria. Thermodynamics of Electrolytes. Statistical Thermodynamics.

Smith, J.M. and H.C. Van Ness - Introduction to Chemical Engineering Thermodynamics, 4rd edition, McGraw - Hill

Rao Y.V.C. - Introduction to Chemical Engineering Thermodynamics, Willey Eastern, 1994.

CH301 Chemical Reaction Engineering – II (3-1-0) 4

Non-ideal Flow Reactors. Non-isothermal Homogeneous Reactions. Non-catalytic heterogeneous Reaction Kinetics. Catalytic Heterogeneous Reaction Kinetics.

Smith, J.M. - Chemical Engineering Kinetics, 2nd edition, McGraw Hill, 1970.

Levenspiel, O. - Chemical Reaction Engineering, 3rd edition, Wiley Eastern.

Scott Fogler, H. - Elements of Chemical Reaction Engineering, 3rd edition, Prentice Hall of India.

CH302 Mass Transfer – II (3-1-0) 4

Concepts of Vapour - Liquid equilibria. Multi component systems.Principles of distillation.Continuous Rectification. Method of McCabe and Thiele.Liquid-Liquid Extraction, leaching.

R.E.Treybal - Mass Transfer Operations. 2nd Edition, McGraw Hill (1968).

W.L.McCabe and J.C.Smith - Unit Operations of Chemical Engineering, McGraw Hill (1976).

Badger and Banchero - Introduction to Chemical Engineering.

CH303 Heat Transfer Operations Lab. (0-0-3) 2

Experiments based on Heat Transfer course.

CH311 Petroleum Engineering (3-0-0)3

Introduction.Composition and evaluation of properties of crude oil and refinery products.
Refining of petroleum. Types of pipe still furnaces used in refineries and their design consideration.
Cracking processes. Rebuilding processes. Product treatment processes.

Robert A. Meyers, Hand Book of Petroleum Refining Processes, McGraw Hill Book Co., l986.

BhaskerRao B.K,.Modern Petroleum Refining Processes, Oxford & IBM Publishing Co., 1984.

CH312 Biochemical Engineering (3-0-0) 3

Introduction - Principles of microbiology. The kinetics of enzyme catalysed reactions. Metabolic Pathways and Energetic of the cell. Kinetics of substrate Utilisation. Biological reactors-applications, and design Fermentation Technology.

J.E.Balley, D.F.Ollis - Biochemical Engineering Fundamentals, McGraw Hill, NY, 1977

CH351 Process Dynamics & Control (3-1-0) 4

Introduction Dynamic Behaviour of Lumped Parameter Systems. Transient analysis of control systems. Frequency response analysis. Advanced control strategies - Feed forward control, cascade control, inferential control, ratio control, adaptive control, selective control, smith predictor dead time compensator, interaction and decoupling in multi input - multi output control system.

Process Systems Analysis and Control - D.R.Coughanowr, McGraw Hill, Second Edition, 1991.

Process Dynamics and Control, D.W.Seborg, T.F. Edger, D.A.Millichamp, John Wiley & Sons, 1988.

CH352 Simultaneous Heat & Mass Transfer (2-1-0) 3

Evaporation -Concept and applications. Humidification and Dehumidification.Crystallisation. Drying Operations.

J.M.Coulson and J.F.Richardson - Chemical Enginering, Vol.1, 3rd ed., Pergamon and ELBS, 1977.

W.L.McCabe and J.C.Smith - Unit Operations of Chemical Engineering, McGraw Hill (1976).

CH354 Mass Transfer Operations Lab (0-0-3) 2
Experiments based on Mass Transfer I & II.

CH355 Chemical Process Industries (3-0-0) 3
Chlor-alkali industries.Sulphur industries. Nitrogen industries.Phosphate industries.Potash industries. Manufacture of soaps, detergents and glycerine. Manufacture of paper pulp, paper and paperboard. Manufacture of industrial alcohol, acetone and butanol. Petroleum Refining.Petrochemicals.Synthetic fibres.
C.E.Dryden - Edited and Revised by M.GopalaRao - Outlines of Chemical Technology, Edition 2, Affiliated East West Press Pvt. Ltd., New Delhi, 1973,
Austin G. T. - Shreves Chemical Process Industries, McGraw Hill Book Co., 5th Edition, 1986.

CH361 Process Modeling & Simulation (3-1-0) 4
Introduction.Numerical solutions of Mathematical equations. Lumped Parameter models: steady state and unsteady state. Distributed Parameter models: Steady state and unsteady state. Unsteady state distributed parameter models (one-dimension).
Computational Methods in Process Simulations, W.F.Ramirez, Butterworth Publishers, 1989.
Modelling and Simulation in Chemical Engineering, Boger E. Franks, John Wiley & Sons, 1972.

CH362 Separation Processes (3-1-0) 4
Adsorption separations. Membrane separation processes. Surfactant based separations. External field induced separations. Supercritical fluid extraction.
Hand Book of Separation Process Technology, R.W. Rousseau, 1987, John Wiley and Sons.
Hand Book of Industrial Membrane Technology, M.C.Porter, 1990, Noyes Publication, Park Ridge, New Jersey.

CH363 Fertilizer Technology (3-0-0) 3
Introduction.Production, transmission and storage of ammonia through various processes and raw materials; ammonia salts; nitric acid and nitrates.Production of Urea through various Processes.Phosphatic Fertilizers.Potash fertilizers.Compound fertilizers.
Fertilizer Manual, No. 13 - Development and Transfer of Technology series, United Nations Industrial Development Organisation, 1980.

CH364 Risk and Safety Management in Process Industries (3-0-0) 3
The concept of risk and safety management.Major disasters in chemical process industries. Hazard identification methods and risk quantification techniques. Fire and explosions.Hazards peculiar to various industries Safety education and training, safety management, legal aspects of industrial safety, safety audit.Concept of preparation of on-site and off-site emergency plan.
F.P.Lees - Loss Prevention in Process Industries, 2nd ed. 1996, Butterworth-Heinemann.
W. Handley - Industrial Safety Handbook, 2nd ed. 1977, McGraw Hill.

CH365 Introduction to Molecular Simulations (2-0-2) 3
Introduction and basics of molecular simulations – model systems, interaction potentials, periodic boundaries, minimum image convention, Equations of motion. Elementary statistical mechanics: ensembles, Boltzmann's distribution, and free energy. Measure and control of temperature and stress in molecular systems. Length and time scale limits of simulation methods. Molecular dynamics of simple model fluids such as hard spheres.Structure of a simulation program and introduction to programming methods. Applications in solids, liquids, and biomolecules. Demonstration using LAMMPS (Large-scale Atomic/Molecular Massively Parallel Simulator).
Allen, M.P., Tildesley, D.J. Computer Simulation of Liquids, Oxford University Press

Frenkel, D., Smit, B., Understanding Molecular Simulations: From algorithm to applications, Academic Press.
Rapport, D.C., The Art of Molecular Dynamics Simulation, Cambridge University Press.
Donald Allan McQuarrie, Statistical Mechanics, University Science Books.

CH 366 Electrochemical Engineering (3-0-0) 3

Introduction. Galvanic and electrolytic cell. Thermodynamics, electrochemical potential and Nernst equation. Double layer - structure of electrified interface, ionic cloud theory and adsorption. Electrodics - Butler Volmer equation and transport phenomena. Applications- corrosion, fuel cells and biosensors. Impedance spectroscopy. Reaction mechanism and equivalent circuits.

Bockris J.O.M. and Reddy A.K.N, Modern Electrochemistry, Vol.1,Vol2A and Vol 2B, Springer.
Bard A.J. and Faulkner L.R, Electrochemical Methods Fundamentals and Applications, John Wiley & Sons, 2001.
Newman. J and Thomas-Alyea K.E., Electrochemical Systems, John Wiley & Sons, 2004.

CH367 Energy Conservation and Management in Process industries (3-0-0)3

Energy Outlook, Energy conservation and its importance, Energy intensive industries, Global industrial energy efficiency benchmarking, Engineering fundamentals related to energy efficiency, Principles on energy management, Energy Audit, Detailed thermodynamic analyses of common unit operations, Opportunities and techniques/methods for energy conservation in equipment and utility systems in process industries, Process synthesis, Thermo-economics, Energy Management Information Systems (EMIS). Software tools for industrial energy efficiency and savings, Case studies on energy conservation and management in process industries

W.F. Kenney, Energy Conservation in the Process Industries. Academic Press Inc., 1984.
Vladimir S. Stepanov, Analysis of Energy Efficiency of Industrial Processes. 1st Edition, Springer-Verlag, 1993.
Jakob de Swaan Arons, Hedzer van der Kooi, Krishnan Sankaranarayanan, Efficiency and Sustainability in the Energy and Chemical Industries, 1st Edition, Marcel Dekker, Inc., 2004.

CH368 Fuel Cell Engineering (3-0-0)3

Overview of Fuel Cells: What is a fuel cell, brief history, classification, how does it work, why do we need fuel cells, Fuel cell basic chemistry and thermodynamics, heat of reaction, theoretical electrical work and potential, theoretical fuel cell efficiency.

Fuels for Fuel Cells: Hydrogen, Hydrocarbon fuels, effect of impurities such as CO, S and others.

Fuel cell electrochemistry: electrode kinetics, types of voltage losses, polarization curve, fuel cell efficiency, Tafel equation, exchange currents.

Fuel cell process design: Main PEM fuel cell components, materials, properties and processes: membrane, electrode, gas diffusion layer, bi-polar plates, Fuel cell operating conditions: pressure, temperature, flow rates, humidity.

Main components of solid-oxide fuel cells, Cell stack and designs, Electrode polarization, testing of electrodes, cells and short stacks, Cell, stack and system modeling

Fuel processing: Direct and in-direct internal reforming, Reformation of hydrocarbons by steam, CO_2 and partial oxidation, Direct electro-catalytic oxidation of hydrocarbons, carbon decomposition, Sulphur tolerance and removal , Using renewable fuels for SOFCs

Gregor Hoogers, Fuel Cell Technology Hand Book, CRC Press, 2003.
Karl Kordesch& Gunter Simader, Fuel Cells and Their Applications, VCH Publishers, NY, 2001.
F. Barbir, PEM Fuel Cells: Theory and Practice (2nd Ed.) Elsevier/Academic Press, 2013.
Subhash C. Singal and Kevin Kendall, High Temperature Fuel Cells: Fundamentals, Design and Applications, 2003

CH402 Process Design of Chemical Equipment (2-0-3)4

Detailed Chemical Engineering Process Design of the following equipments is to be carried out. Mechanical aspects of the design are not included here. Heat Exchangers; Packed and Tray towers for Absorption and distillation.Design of equipments mentioned above using simulation software.

Donald Q Kern - Process Heat Transfer, McGraw Hill Book CO, 1950.
J.M.Coulson and J.F.Richardson - Chemical Engineering, Vol.6, Design, Second Edition, Pergaman Press, 1993.
Robert H. Perry and Don Green - Chemical Engineers' Hand Book, 6th Edition, McGraw Hill Book Co.
Douglas J.M., Conceptual design of Chemical Processes McGraw Hill, New York, 1988.
W.D. Seider, J.D. Seader and R.L. Daniel, Product and Process Design Principles, Wiley, 2004.

CH403 C.R.E. & Process Control Lab (0-0-3) 2

Experiments based on Reaction Engg. I & II and Process Control courses.

CH411 Fermentation Technology (3-0-0) 3

Introduction, fermentors-principles and design, Manufacture of alcohol, pencillin, vitamins and other products.

Fermentation Technology, Whitaker.
Biochemical Engineering Fundamentals, J .E .Bailey and D. F. Ollis, 1997, McGraw Hill.

CH412 Pollution Control & Safety in Process Industries (3-0-0) 3

Importance of environment for human kind, flora and fauna, Types of pollution damages due to environmental pollution (industrial gas, liquid and solid effluents). Legislations to environmental pollution problems.Indian standards waste recycling.Noise pollution and its control. Waste water treatment. Air Pollution.Pollution control of effluents from different industries.Scientific and Engineering aspects of safety in industry.

S.P.Mahajan - Pollution Control in Process Industries - Tata McGraw Hill, 1990.
C.S. Rao - Environmental Pollution Control Engineering, Wiley Eastern, 1992.

CH465 Air Pollution Control and Design of Equipments (3-0-0) 3

Introduction.Air pollution laws and standards.Meteorological aspects of air pollutant dispersion, the Gaussian plume model, design of stacks and chimneys Air pollution control methods and design of equipments- control of gaseous emissions, Air pollution control in specific industries

Martin Crawford -Pollution control theory, , 1976, McGraw Hill, NY.
Joe Ledbetter - Air Pollution Part A&B, 1972,Marcel Dekker, NY.
N.Cheremissinoff - Air Pollution Control, Design Hand Book, Part I and II,1977,Marcel Dekker, NY.

CH440 Practical Training (0-0-2)1

This course is a one credit course. A student may complete the training before the beginning of 7th semester (or as stipulated by DUGC) and register for it in 7th semester. The duration and details shall be decided by the faculty advisor, with approval from DUGC.

CH448 Seminar (0-0-3) 2

This course is two credit courses to be completed during 7th semester. The student will make presentations on topics of academic interest.

CH449 Major Project - I (0-0-3) 2

The Students jointly or individually will be assigned an experimental or theoretical problem, to be carried out under the supervision of a guide. The project has to be completed in the VII & VIII semester. The students should complete the preliminary literature survey and experimental set up in the VII semester. Their work will be reviewed and evaluated.

CH499 Major Project – II **(0-0-9) 6**
Extension and completion of Major project -I started in the previous semester (CH449).

CH 263 Mineral Dressing Lab. **(0-0-3) 2**
Experiments based on Mineral dressing

Department of Mechanical Engineering

ME110 ELEMENTS OF MECHNICAL ENGINEERING (3-0-0) 3

Module-1: Introduction to Mechanical Engineering, Emerging trends & its role, Mechanics in Mechanical Engineering:
Module-2: Materials and Stresses: Mechanical design concept, Types of drives, Friction and wear
Module-3: Prime movers, Introduction to refrigeration, centrifugal pumps and compressors. Sources of energies: conventional and renewable.
Module-4: Manufacturing Processes: Basic processes like machining, casting, forging etc. welding, brazing and soldering. Manufacturing Systems
Module-5: Introduction to Mechatronics, electro-mechanical elements, working principles, construction and their applications (Sensors & actuators).

An introduction to Mechanical Engineering, J.wickert, Cengage learning, 2nd edn. 2006
Gopalkrishna K.R., Mechanical Engineering Sciences. Subhas Publications, Bangalore.1999
Roy and Choudhary, Elements of Mechanical Engineering. Media Promoters and Publishers, Bombay, 1975
Gupta, P.N., and Poona, M.P., Elements of Mechanical Engineering. 4th Edition, Standard Publications Ltd, 2009.

ME111 ENGINEERING GRAPHICS (1-0-3) 3

Orthographic Projections of points, Straight lines, Planes, Solids (Auxiliary Plane Method and Change of position method), Isometric Projections.

Gopalkrishna K. R, Engineering Graphics (Ist angle projection) Subhas Publication, Bangalore, 1999.
Bhat N. D., Engineering Drawing, Charotar Publication,1991.

ME200 WORKSHOP (0-0-2) 1

Fitting, Carpentry, Demonstration of Welding & Soldering.

Hajara H.K. and Choudhary Workshop Practice vol.I, Media Promoters and Publishers, Bombay, 2007
Workshop Technology, Choudhary and chapman, Viva publications,1996.

ME201 BASIC ENGINEERING THERMODYNAMICS (3-1-0) 4

Fundamental Concepts, system, temperature, Heat and Work, I law and II law of Thermodynamics, applications, Pure substance, Entropy, Available and unavailable energy , Analysis of cycles, Helmoltz and Gibbs Functions and its applications, Ideal and Real gases, Non reactive mixtures, properties of air and water vapour.

Spalding and Cole, Engineering Thermodynamics, ELBS Edition Longmans,1987.
Arora C.P. Thermodynamics, TMH, 1998.
Gordan J. Van Wylen and Richard E.Sountag, Fundamentals of Classical Thermodynamics, 4th Edition, Wiley, 1994.
P. K. Nag, Basic and Applied Thermodynamics, Tata McGraw Hill. 3rd Edition, 2005.
Yunus A Cengel and Michael A. Boles, Thermodynamics : An Engineering approach , Tata Mcgraw Hill, 7th Edition .

ME202 FLUID MECHANICS AND MACHINERY (3-1-0) 4

Fundamentals of fluid properties, pressure measurement, hydrostatic forces on surfaces, Buoyancy and floatation, Kinematics of fluid flow, Fluid dynamics, Compressible flow, gas nozzles, Flow of real fluids, Boundary layer theory, Flow around immersed bodies, Flow through pipes, Impact of jets, Hydraulic Machines, pumps, Turbines, Hydraulic systems.

Kumar K.L. Fluid Mechanics, Eurasis Publishing House, New Delhi, 1995.
Yahya S.M., Turbomachines, Satya Prakashan, New Delhi, 1972.
F .M. White, Fluid Mechanics, Springer-Verlag. New York. 1999.

ME 203 MECHANICS OF MACHINES (3-1-0) 4

Basics of Kinematics – Links, kinematic pair, mobility, basic mechanisms and its inversions. Position, Velocity and Acceleration analysis, Static force analysis, Inertia forces in machines, Synthesis of Mechanisms: Type, number and dimensional synthesis, Coupler curves.

R.L. Norton, Design of Machinery, McGraw Hill Boston, 1999
John J. Uicker, Jr, Gordon R Pennock and Joseph E Shigley, Theory of Machines and Mechanisms.
H.H. Mabe and C.F. Rainbotten, Mechanism and Design, John Wiley, 1987.
V Ramamurti, Mechanics of Machines , Narosa, 2010
Arthur G. Erdman, George N, Sandor, Mechanism Design –Analysis and Synthesis, Vol. I, Prentice Hall, New Jersey, 1984

ME 204 BASIC MANUFACTURING PROCESS (3-1-0) 4

Metal joining process: Gas Welding, Arc Welding, Advanced Welding processes, Welding defects, Brazing Soldering Metal removal Processes: Introduction to machine tools and classification, Lathe, Drilling Machine, Shaping Machine, Milling Machine, Advanced machine tools. Metal casting processes, special casting processes, casting defects, rising and gating design, solidification mechanisms, melting practices.

Ghosh and Mallick, Manufacturing Science, Prentice hall PTR, 2001.
Paul Degramo, Materials and Processes in Manufacturing, 9th edition, John Wiley & Sons, 2003.
Rao P. N, Manufacturing Technology. Vol I and II 2nd Edition TMH, 2001.

ME205 MATERIAL SCIENCE AND METALLURGY (3-0-0) 3

Structure & properties of Engineering materials, Solidification, Alloys and Phase diagrams, Iron carbon equilibrium diagram, Heat treatment of ferrous and non-ferrous alloys, Testing of Engineering materials, Fracture and failure of materials, An introduction to Advanced Engineering materials.

Avner H., Introduction to Physical Metallurgy– McGraw Hill, New York, 1987.
Raymond A. Higgins, Engineering Metallurgy –Part 1: Applied Physical Metallurgy, ELBS, London, 1988.
Callister W.D., Material Science and Engineering-An Introduction, John Wiley & Sons, Inc., New York, 2003.

ME206 ENGINEERING DRAWING (1-0-3) 3

Screw Thread forms and Threaded fasteners, Rivetted joints, Section of Solids, Development of Surfaces Othographic views with sections, Intersection of Solids.

Gopalkrishna K. R., Engineering Graphics, Subhas Publications, Bangalore, 1999.
Gopalkrishna K. R, Machine Drawing, Subhas Publications, Bangalore, 1985.
Bhat N. D, Engineering Drawing, Charotar Publishing House, Anand, India, 1991.
Bhat N. D, Machine Drawing, Charotar Publishing House, Anand, India, 1984.

ME207 WORKSHOP PRACTICE (0-0-3) 2

Fitting, Carpentry, Study and demonstration of hand tools in sheet metal working and foundry, Sheet metal models, Foundry models, Press working equipments, Wood working: Wood working and wood turning tools and models. Use of Power tools, Welding & Plumbing.

Hajara and Choudhary, Workshop technology vol.I &II, Median promotors & publishers, Bombay.
Khanna O. P, Workshop Practice Vol. I, Dhanpat Rai & Co , 2000.

ME250 APPLIED THERMODYNAMICS (3-1-0) 4

Compressors, reciprocating and rotary, Steam nozzles and steam turbines, Air standard cycles, Vapour power cycles, Gas turbine cycles, performance testing of IC engines, Refrigeration cycles, vapour absorption system, Psychrometric processes.

Holman J. P., Thermodynamics, McGraw Hill International Student Edition. Newyork, 1969.
Rajput R.K, Thermal Engineering, Laxmi Publications (Pvt) LTd., NewDelhi. 6th Edition , 2007.
Eastop and McConkey, Applied Engineering Thermodynamics, ELBS, 1995.

ME 251 ANALYSIS AND DESIGN OF MACHINE COMPONENTS (3-1-0) 4

Design of shafts, keys and coupling, Variable and Impact loading, structural loading, springs, cam follower mechanism Synthesis of mechanism, collar and pivot friction, Design of power screws, Design of shafts, coupling and clutch, lubrication, selection of journal & roller Bearings.

Arthur G. Erdman, George N, Sandor, Mechanism Design –Analysis and Synthesis, Vol. I, Prentice Hall,New Jersey, 1984.
R.L. Norton – Machine Design, An integrated approach, Pearson Education Asia, 2000.
J.E. Shigley and Mische, Mech. Engineering Design, Tata Mc Graw Hill -2003.

ME252 COMPUTER AIDED ENGINEERING (3-0-0) 3

Fundamental of CAD- Hardware and software requirements, methods of modeling- wire frame, surface, solid modeling and feature based modeling, Analytic and synthetic cure entities, Parametric representation of curves and surfaces, NURBS, Computer graphics: display, transformation, visualization, animation, graphics standards, translators. Product Design : Mass property calculations, assembly modeling, Finite element methods. Product Manufacturing: Part programming, CNC machine tool and control system.

Ibrahim Zeid, Mastering CAD/CAM, TMH publishing company ltd, New Delhi, 2007.
P. N. Rao, CAD/CAM Principles and Applications2nd Edition, TMH education, 2007.

ME253 MANUFACTURING TECHNOLOGY (3-0-0) 3

Milling machine, advanced machine tools, Grinding and Micro-finishing operations, Non Traditional Machining Operations and analysis, Sheet Metal Forming, Dies, Jigs and Fixtures.

Ghosh and Mallick, Manufacturing Science, Prentice Hall PTR, 2001
Paul Degramo, Materials and Processes in Manufacturing, 9th Edition, John Wiley & sons, 2003.
Rao P. N, Manufacturing Technology Vol I and II, 2nd Edition, TMH education, 2006.
P .K Mishra, Non Conventional Machining, 6th Edition Narosa Publishing house, 1997.

ME254 METROLOGY (3-0-0) 3

Standards, Errors in measurement, calibration, Linear, angle measurement, Quality control fundamentals, Standard deviation, normal curve pattern of variations, control charts for variables, Comparators, Limits and Tolerances, statistical aspect of tolerances and setting tolerances, Surface finish terminology and measurement, Optical measuring instruments, Measurement of screw thread and Gear elements, Acceptance test for machines.

I.C. Gupta, Engineering Metrology, Dhanpat Rai Publications, New Delhi, 1994.
Grant, Statistical Quality Control, Mc Graw Hill Publication. 6th Edition, 1988.

ME255 MACHINE DRAWING (1-0-3) 3

Machine components done using conventional drawing board and AutoCAD, Assembly drawing from working drawing: Swivel bearing, Machine Swivel vice, Tool head of shaper, Tailstock, Fuel pump, Fuel Injector, Rams bottom safety valve, Stop valve, Blow-off cock, Screw Jack, Centrifugal pump. Part drawing from assembly drawing: Foot step bearing, Eccentric, connecting rod, square tool post, Drill jig, Feed check valve.

Bhat N. D, Machine Drawing, Charotar Publishing House, Anand, India, 1984.
Gopalkrishna K. R. Machine Drawing, Subhas Publication, Bangalore, 1999.

Narayana K. L, Kannaiah P, Venkat Reddy K, Machine Drawing 3rd Edition, New Age International Ltd, 2006.
Goutam Pohit, Goutam Ghosh, Machine drawing with AutoCAD, Pearson Education, 2007

ME 210 MECHANICAL BEHAVIOR OF ENGINEERING MATERIALS (3-0-0)3

Elasticity Theory, Plasticity, Microstructure Aspects of plastic deformation, Strengthening Mechanisms, Fracture, Fatigue, High-temperature deformation

References

Thomas H.Courtney, " Mechanical Behaviour of Materials ", (2nd Edition), McGraw-Hill, 2000.
Mathew Philip, Bill Bolton, " Engineering Materials, Butterworth-Heiremann, 2001.
George E.Dieter, " Mechanical Metallurgy ", McGraw Hill, 1988.
R.W. Hertzberg, "Deformation and Fracture Mechanics of Engineering Materials", John Wiley and Sons, 1976.
MA Meyers and K Chawla, "Mechanical Behavior of Materials", Prentice Hall, 2005.

Detailed Syllabus

Elasticity Theory: Stress at a point, State of stress in two dimensions and in three dimensions, stress tensor, principal stress and strain, elastic behaviour of metals, ceramics and polymers. Pseudoelasticity, Viscoelasticity

Plasticity: True stress and true strain, yielding criteria for ductile metals, octahedral shear stress and shear strain, flow rules, plastic stress-strain relations

Microstructure Aspects of plastic deformation: classification of defects, thermodynamics of defects, geometry of dislocations, dislocation generation, Forces between dislocations, Partial dislocation and stacking faults, dislocation interactions, dislocation movement and strain rate, Crystallography of Slip and Independent Slip systems

Strengthening Mechanisms: Strengthening from grain boundaries, solid-solution strengthening, precipitation hardening, Fibre strengthening, strengthening due to point defects, martensitic strengthening, strain hardening

Fracture: Griffith Fracture Theory, Evolution of fracture models, Stress intensity factors, Fracture Toughness-Microstructural Issues.

Fatigue: S-N curves, Low and high cycle fatigue, Fatigue crack propagation, Effect of stress concentration, fatigue under combined stresses, Design for fatigue.

High-temperature deformation: Creep curve, mechanism of creep deformation, deformation mechanism maps, Super plasticity, creep under multi-axial loading, High temperature alloys.

ME211 FUELS & COMBUSTION (3-0-0) 3

Fuels for SI and CI engines, solid, liquid and gaseous fuels, Octane and Cetane rating method, Combustion equipments, combustion stoichiometry, Combustion phenomenon in the SI engines, combustion knock, factors affecting the combustion knock, Control of knock, Combustion chamber designs for SI engine, Combustion phenomenon in the CI engines, Delay period and Diesel knock, Factors affecting delay period, Combustion chamber designs for CI engines, Use of alternate fuels.

E.F. Obert, Internal Combustion Engine, International Textbooks & Co, 3rd Edition, 1968.
Jhon B. Heywood, Internal Combustion Engine fundamentals, McGraw Hill, 1st Edition 1988.
P.M. Heldt., High Speed Combustion Engines, Oxford & IBH publishing co, Calcutta, 1965.
Chandra Mohan and S.P. Sharma, Fuels and Combustion, Tata McGraw Hill, New Delhi, 1984.

ME212 SYNTHESIS OF MECHANISMS (3-0-0) 3

Introduction, tasks of Kinematics Synthesis, Type synthesis, Tools of dimensional synthesis, Graphical synthesis: Motion generation-two and three prescribed motions, Path generation – three prescribed positions, prescribed timings, four positions without prescribed timings, Function Generator: Three prescribed points, Introduction to Analytical synthesis, Standard Dyad form, three prescribed positions for

motion, path and function generation, circle, point and center-point circles, Freudenstein's equations for three point function generation, order synthesis, coupler curves for four-link, slider-crank and inverted slider-crank mechanisms, Application of coupler curves in design of six-link mechanism, Coupler cognate mechanisms.

Arthur G. Erdman, George N, Sandor, Mechanism Design –Analysis and Synthesis, Vol. I, Prentice Hall, New Jersey, 1984.
A.H Soni, Mechanism Synthesis and Analysis, McGraw Hill, 1984.
Robert L. Norton, Design of Machinery- An Introduction to the Synthesis and Analysis of Mechanisms, WCB Mc Graw Hill, Boston, 1999.

ME213 FUNDAMENTALS OF TURBO MACHINESTURBO MACHINES (3-0-0) 3

Dimensional analysis and principle of similitude, Terminology of aero foil and its importance in Turbomachines, Energy transfer between fluid and rotor, Thermal analysis in Turbomachines, Potential flow through cascades of blades, 3-dimensional viscous and compressibility effects, Power absorbing machines: Compressors, blower, and fans. Power producing machines: Hydraulic, steam and gas Turbines.

D. G Shephard, Principles of Turbomachinery, McMillan Co., New York, 1956.
G. T Csanady, Theory of Turbomachines, Mc Graw Hill.1964.
Yahya S.M, Turbomachines, Satya Prakashan, New Delhi, 1972.
H. Cohen and Rogers, Gas Turbines Theory, Longman Green Co., Ltd, 5th Edition, 2001.

ME214 QUALITY CONTROL (3-0-0) 3

Fundamentals of quality control, Statistics, probability theory. Control charts for variables and attributes. Acceptance Sampling, Classifications and their applications, Statistical aspects of tolerances and setting of tolerances, Reliability and factors associated with reliability.

Mahajan, Statistical Quality Control, Dhanpat Rai & Sons, 2001.
Grant, Statistical Quality Control, McGraw- Hill Publications, 1946.
Duncans, Quality Control & Industrial Statistics, Irwin Press, 5th edition, 1986.
B.L. Hanan & Prabhakar M. Ghare, Quality Control & Application, Prentice hall, 1987.

ME215 MINI PROJECT I (0-0-3) 2

Mini project will involve experimental work either in the laboratory or in the field / design tasks / prototyping / working model development / mathematical modelling/creation of experimental facility etc. Mini project will be in line with the guide line formulated by DUGC (ME)

ME310 MEASUREMENTS IN THERMAL SYSTEMS (3-0-0) 3

Measurement of specific heat, Viscosity, Thermal Conductivity, Thermal diffusivity, Heat flux, Calorific value, Thermal and solar radiation measurements, Gas composition analysis by Orsat apparatus, Gas Chromatograph, Infra-red analyzer, Mass Spectrometer, Turbulence measurements using hot wire anemometer, laser Doppler anemometer. Measurements in controlled environments, Mass transfer measurements, Shadowgraph, Schlieren and Interferometer, High speed Photography, Data acquisition and processing, Analysis of experimental data.

Landis, Lab experiment and demonstration in fluid mechanics and heat transfer. Dept of Mechanical Engg, school of Engg & science, New York University, 1964.
Sotoukhim and Afgan, Measurement techniques in heat and mass transfer-Hemisphere, New York, 1985.
Eckert and Goldstein, Measurements in heat transfer –hemisphere, Pub Corp, 2nd Edition, 1976.
Beckwith and Buck, Mechanical Measurements – Addison Wesley publishing company, 3rd Edition, 1982.
Doeblin, Measurement Systems Application and Design – Mc Graw Hill education, 5th Edition, 2003.

ME311 HYDRUALIC AND PNEUMATIC CONTROL (3-0-0) 3

Introduction, Circuit Symbols, Fluid Pumps and Motors, Control Valves, Servo Systems, Design consideration of Circuits, Pneumatic Compressors and their Working Principles, Hydro-Pneumatics,

Fluidics, Principles of Pneumatic circuit design, Maintenance of Circuits, K-V Diagrams and Electrical Controls in Pneumatic Circuits, PLC control of hydraulic and pneumatic systems.

Esposito A.P., Fluid Power, Pearson Education Asia, 2005.
Text Book of Hydraulics and Pneumatics, Festo Didactic, 4th Edition, 2001.
Andrew Parr, Hydraulics and Pneumatics, Jaico Pub, 2000.
S.R. Majumder, Pneumatic Systems – Principles and Maintenance, Tata McGraw Hill Co. 15th Edition, 2006.

ME 312: INTRODUCTION TO AIRCRAFT STRUCTURES 3-0-0 (3)

Brief History-Components of an airplane and their functions. Different types of flight vehicles, classifications. Basic instruments for flying,Physical properties and structure of the atmosphere, Temperature, pressure and altitude relationships, Evolution of lift, drag and moment. Different types of drag. Aerodynamic forces on aircraft – classification of NACA aerofoils, aspect ratio, wing loading, Mach number,centre of pressure and aerodynamic centre-aerofoil characteristics lift, drag curves. General types of construction, Monocoque, semi-monocoque.Typical wing and fuselage structure. Metallic and non-metallic materials, Use of aluminium alloy, titanium, stainless steel and composite materials.

Anderson, J.D., "Introduction to Flight", McGraw-Hill, 1995.
Kermode, A.C., "Flight without Formulae", McGraw-Hill, 1997.
Bruhn.E.F."Analysis and design of flight vehicle structures" Tri set of offset company, USA,1973.
4. Michael Chun Yung Niu."Airframe structural Design" Technical book company, Los Angeles, USA, 1989.

ME313 INTERNAL COMBUSTION ENGINES (3-0-0) 3

Fuel-air cycles, Actual cycles, Combustion in SI engines, Stages of combustion, Flame propagation, SI combustion chambers, Combustion in CI engines, Delay period, CI engine combustion chambers, Carburetion, Fuel injection, Ignition, Engine friction and lubrication. Engine cooling, Testing and performance.

M.L Mathur & R.P Sharma, A Course in Internal Combustion Engine, Dhanpat Rai & Sons, New Delhi, 2001
John. B. Heywood, Internal combustion engine fundamentals, McGraw Hill, 1st Edition, 1988.
E.F Obert, Internal combustion engines, Addision Wesley, 3rd edition, 1968,
C.F.Taylor, The Internal combustion engines theory and practice, Vol.I&II,MIT press. Cambridge, MA, 1966.
V.Ganesan, Internal Combustion Engines, McGraw-Hill, 1995.

ME314 MECHATRONICS SYSTEM DESIGN (3-0-0) 3

Introduction to Mechatronics system, Modeling and simulation of physical system, Sensors and transducers, Signals systems and control, Actuating devices, Modeling of systems, system response, transfer function and frequency response, feedback and intelligent systems, Microprocessors and Microcontrollers, Mechatronics system design, Applications in Mechatronics

Botton W., Mechatronics 3rd Ed, Pearson Education Ltd. Indian print, 2003.
N.P.Mahalik, Mechatronics, TMH publishing Co. Ltd, New Delhi India, 2003.
Bradley D. A, Mechatronics, Chapman & hall, London, 1997.
H. M .T Hand Book, Mechatronics, TMH Publication, 1997

ME 315 ROTOR DYNAMICS (3-0-0)3

Introduction to dynamics of rotating machinery.Critical speeds of rotors and factors affecting them such as gyroscopic effects, internal damping, unequal moments of inertia, fluid film effects of bearings and seals. Unbalance response and Stability of rotors under various influences, including turbo machinery effects.

Balancing of Rotors.Modelling and Calculation methods in rotor dynamics for advanced applications. Malfunction analysis ,diagnostics and condition monitoring of rotors. Applications and Case studies.

B.S.Prabhu and A.S.Sekhar, "Dynamic Analysis of Rotating Systems and Applications", Multi Science Publishing Co. Ltd, Essex, England, UK, 2008.

M.L Adams "Rotating Machinery Vibration, From Analysis to Troubleshooting", Marcel Dekker Inc. New York, 2001

E. Kramer, "Dynamics of Rotors and Foundations", Springer Verlag, Berlin, 1993

J.S.Rao, "Rotordynamics", New Age International Pvt. Ltd., New Delhi, 1996

J. M. Vance, "Rotordynamics of Turbomachinery", John Wiley and Sons, New York, 1998.

ME 316 THEORY OF ELASTICITY (3-0-0) 3

Components of stresses, equations of equilibrium, principle stresses and Mohr's diagram in three dimensions, boundary conditions, strain components, compatibility equations, stress-strain relation and the general equation of elasticity, formulation of elasticity problems, existence and uniqueness of solution, Saint-Venant's principle, principle of super-position and reciprocal theorem, Airy's stress function to solve two dimensional problem, stresses in thin disk and long cylinder, torsion of prismatic bars, soap film analogy, membrane analogy and elastic stability.

Wang C.T., Applied Elasticity, Mc-Graw Hill Book Company, New York, 1953

Timoshenko and Goodier, Theory of Elasticity, Mc-Graw Hill Book Company, 2nd Edition, 1951.

T.G. Sitharam, Applied Elasticity, Interline publishing, 2008.

L. S. Srinath, Advanced Mechanics of Solids, Tata Mc-Graw Hill Book Company, 3rd Edition, 2009.

ME317 REFRIGERATION TECHNOLOGY (3-0-0) 3

Refrigerants, Refrigeration Cycles, Air cycle refrigeration, Vapour compression system, multi pressure system, Cascade refrigeration, Vapour absorption system, Dry ice manufacturing, Ejector refrigeration system, Decicant cooling system, Pollution by refrigerants. Use of solar energy, low grade energy to run the refrigeration system, (Use of Refrigeration data handbook permitted in examination).

Arora C. P, Refrigeration and Air Conditioning, Tata McGraw- Hill Company Limited, New Delhi, 1981.

Manohar Prasad, Refrigeration and Air conditioning, Wiley Eastern Limited, New Delhi, 1983.

Manohar Prasad, Refrigeration & Air conditioning Data Hand Book, Wiley Eastern Litd, New Delhi, 1989.

Refrigeration/Thermodynamics/Heat transfer/Air conditioning data hand book.

ME318 MANUFACTURING TECHNOLOGY OF POLYMERS (3-0-0) 3

Structure and basic properties of plastics, Design criteria, Structural Design Analysis, Processing: Model Building, Molds and dies, Process Control, Inspection, Injection molding, Extrusion, Inline post forming, Blow molding, Extrusion blow molding, Forming, Auxiliary Equipment and secondary operations, testing of quality Control, Design features that influence performance.

Donald V. Rosato, David P. DiMattia and Dominick V. Rosato, Designing with Plastics and Composites,Van Nostrand Reinhold, NY, 1991.

A.S Athalye, Plastics Materials Handbook, Multi-tech publishing Co. Bombay, 1995.

N.J Mills, Plastics, Microstructure and Engineering Applications, Edward Arnold, London, 1993.

R. J. Crawford, Plastics Engineering, Butterworth-Heinemann 3rd Edition, 1998

ME319 MECHANICS OF COMPRESSIBLE FLUIDS (3-0-0) 3

Recapitulation of fundamentals: Navier Stokes equations, aerofoil theory, boundary layer separation criterion. Introduction to compressible flow, velocity of sound and Mach number, Isentropic flow, flow with friction and heat transfer, Analysis of flows with normal and oblique shock waves, Supersonic flows, Unsteady flows.

S. M. Yahya, Fundamentals of Compressible Flow, Wiley Eastern Ltd, New Delhi, 1989.

Cambel and Jennings, Gas Dynamics, Mc Graw Hill. New York, 1958.

B.T. Nijaguna, Thermal Science/Engineering data Hand Book, 1st Edition, Allied Publishers Ltd, New Delhi, 1992.
Balachandran P., Fundamentals of Compressible Fluid Dynamics, Eastern Economy Edition, Prentice Hall of India. New Dekhi, 2006.
White F.M., Fluid Mechanics, McGraw Hill, Singapore, 1999.

ME320 AUTOMATION SYSTEMS (3-0-0) 3

Introduction to Digital Control Systems, CNC technology, Evolution of Automation, Microcontrollers, Programmable Logic Controllers, Automated Process Planning, Scheduling and Management systems, Data Acquisition systems, FMS Elements, Concepts of Agile Manufacturing, STEP-NC systems.

Mikel P. Grover, Automation Production Systems and Computer Integrated Manufacturing, PHI, 2004.
P. Radha Krishna & S. Subramanian, CAD/CAM/CIM, New Age International Publishers, 2009.
Chris Mc Mohan & Browne. J, CAD CAM, Prentice Hall, 1998.
Jerome H. Fuchs, The Prentice Hall Illustrated Handbook of Advanced Manufacturing Methods, Prentice Hall, 1988.

ME321 WELDING TECHNOLOGY (3-0-0) 3

Classification and characteristics of Welding, Equipment details and working of Gas Metal Arc Welding (TIG & MIG), Carbon Arc Welding, Ultrasonic welding, Plasma Welding, Under Water Welding, Physics and Metallurgy of Welding, Welding of Jigs and Fixtures, Inspection and testing of welds, Welding defects, residual stresses, welding distortion.

Parmar, R.S, Welding processes and Technology, Khanna Publishers, 1997.
Richard L. Little, Welding & Welding Technology, McGraw Hill, 1973.

ME322 AUTOMATIC CONTROL ENGINEERING (3-0-0) 3

Overview of feedback control, mathematical models of dynamical systems, linear time invariant systems, transfer function, time and frequency response of a system, stability analysis, Feedback systems, concept of root locus, dynamic compensation, PID control, state space representation of dynamical systems.

Gene F. Franklin et.al., Feedback control of dynamic systems, Pearson Ed. Asia, 1998.
K. Ogata, Modern Control engineering, Pearson Ed, 2002.
Harison and Boilinger, Introduction to Automatic Control System, John Wiley Publication, 1976.
G. V. Reklatis, A. Ravindran, and K. M. Ragsdell, Engineering Optimization: Methods and applications, Interscience, 1983.

ME323 PRODUCTION AND OPERATIONS MANAGEMENT (3-0-0) 3

Introduction, Economic Analysis, Process Analysis, Work Study, Productivity, Value Analysis, Break Even Analysis, Layout and Location of Facilities, Balancing, Forecasting, Inventory Control, MRP, Aggregate Planning, Scheduling.

R. Panneerselvam, Production and Planning Management, PHI Learning Pvt Ltd, 2006
Samuel Eilson, Elements of Production Planning and Control, Mc Milan Company, 1962.
Joseph G. Monks, Operations Management -Theory & Problems, McGraw- Hill, 1987.
E.S. Buffa, Modern Production / Operations Management, John Wiley, New York, 1983

ME324 PRODUCT DEVELOPMENT AND PROTOTYPING (3-0-0) 3

Generic process of Product development, Concept Generation, TRIZ, Concept Selection and Testing, Computer applications in Product Development. Product Architecture, Design for Manufacture and Assembly. Prototyping,Virtual and Physical. Rapid Prototyping Technologies, Reverse Engineering.

K T Ulrich and S D Eppinger, Product Design and Development, McGraw Hill, 2000.
K Otto and K Wood, Product Design, Pearson Education, Inc. 2001
K G Cooper, Rapid Prototyping Technology, Marcel Dekker, Inc. 2001

D T Pham and S SDimov, Rapid Manufacturing, Springer-Verlag, 2001

ME325 MANUFACTURING AND DESIGN OF MEMS (3-0-0)3

Introduction to electromechanical systems and MEMS, Micro sensors and Micro actuators, Scaling and Material Issues, Micro fabrication techniques, Electro mechanics, Design of MEMS and Design realization tools. Packaging of MEMS.

J J Allen, MEMS Design, Taylor and Francis 2005
Tai Ran Hsu, MEMS and Microsystems-Design and Manufacture, TMH 2002
Nadim Maluf, An Introductionn to MEMS Engg, Artech House 2004
Stephen D Senturia, Microsystem Design, Springer 2001
Marc J Madou, Fundamentals of Microfabrication, CRC Press 2nd Ed 2002
Menz, Mohr and Paul, Microsystem Technology, Wiley VCH 2001

ME 326 FLEXIBLE MANUFACTURING SYSTEMS (3-0-0) 3

Automation In Production Systems, Automation Principles and Strategies, Industrial Control Systems, Applications of Sensors and Actuators, ADC/DAC, CNC Technology, Robot Intelligence, Material Handling and Transport Systems, Storage Systems, Manufacturing Cells, Group Technology and Cellular Manufacturing, FMS Components, Quantitative Analysis Of FMS Systems, Petri Networks, Automated Assembly And Inspection.

A.Dashchenko, Manufacturing technologies for machines of the future, Springer publ, 2003
Groover, M.P., Fundamentals Of Modern Manufacturing; materials , process and systems, Wiley publ, 1996
Luggen, W.W, Flexible Manufacturing cells and systems, Prentice hall, 1991.
Groover, M.P.,Automation production systems and computer integrated manufacturing ,PHI, 2010

ME327 METAL CUTTING AND PRESS WORKING (3-0-0) 3

Orthogonal and Oblique cutting, Tool geometry and Machining parameters, Mechanics, Force and Temperature measurements, Surface Integrity, Tool Wear, and tool life, Machinability, Types of presses, Dies and punches, Force calculations, Design principles, Economics of machining.

G. Boothryod, Fundamentals of Metal cutting and Machining, TMH, 1975.
B. L. Juneja and Shekon G. S., Fundamentals of Metal cutting and Machine Tools, 2nd Edition, New Age International publishers, 2003.
P. N. Rao, Manufacturing Technology.2nd edition, TMH, 2001.
ASME Metals Hand Book. 9th edition, 1989.
Taylor, Metal cutting, 3rd edition, ASME, 1907.

ME 328 METAL FORMING (3 – 0 – 0) 3

Introduction and classification, primary and secondary forming processes, Hot and Cold working; Process, procedure, types, equipment, application of various forming processes like forging, rolling, extrusion, drawing etc. Metal flow, effect of friction; Design of dies for forging, extrusion, drawing; Metallurgical aspects.

References:

Metal forming Handbook – Springer
Metal Forming – Mechanics and Metallurgy, by William F Hosford and Robert M Cadell
Theory and Application to Metal Forming Process -R.A.C..Slater, McMillan Press, 1977
Metal Forming - Fundamentals and Applications, T. Altan, S. Oh. H. Gegel, ASM, Ohio, 1983.

ME329 BASICS OF COMPUTATIONAL FLUID DYNAMICS (3-0-0)3

Introduction to Computational Fluid Dynamics: historical review, applications. Derivation of the fluid flow and heat transfer governing equations based onvarious fluid flow models. Mathematical aspects of the fluid dynamic equations, classification methods.Implementation of the finite difference and finite volume

methods for fundamental advection diffusion, advection- diffusion partial differential equations.Stability, consistency and convergence issues. Numerical schemes for two dimensional Navier – Stokes equations like Lax-Wendroff method, MacCormacks method, SIMPLE. Implementation of boundary conditions.Various meshing methods.Errors and Uncertainty in CFD.

Versteeg, HenkKaarle, and WeeratungeMalalasekera.An introduction to computational fluid dynamics: the finite volume method. Pearson Education, 2007.

JiyuanTu, Guan HengYeoh and ChaoqnLiu.Computational fluid dynamics A Practical approach. Butterworth Heinemann An Imprint of Elsevier, 2008.

John D. Anderson Jr . Computational Fluid Dynamics The Basics with Applications. McGraw –Hill International Eddtion, 1995. Chung Patankar S V .

Numerical Heat Transfer and Fluid Flow.Hemisphere Publishing corporation, Taylor and Francis Group New York, 1980.

ME 330 INTRODUCTION TO ROBOTICS (3-0-0) 3

Introduction: Understanding a robot, classification and applications; manipulator – The industrial robotic arm; Kinematics of a serial-link robotic manipulator, dynamics and control of a serial-link manipulator; sensors and actuators for robotics

J JCraig : Introduction to robotics: Mechanics and Control, 3rd edition, pearson Ed, 2004

AsitavaGhosal, Robotics: Fundamental concepts and Analysis, oxford University Press, 2013

ME331 MINI PROJECT II (0-0-3) 2

Mini project will involve experimental work either in the laboratory or in the field / design tasks / prototyping / working model development / mathematical modelling/creation of experimental facility etc. Mini project will be in line with the guide line formulated by DUGC (ME)

ME332 COMPOSITE MATERIALS (3-0-0) 3

Basic concepts and characteristics: Definition and characteristics of composite materials, overview of advantages and limitations of composite materials, Significance and objectives, Sciences and technology, Types and classification of typical composite materials, current status and future prospects, Micromechanical and Macro mechanical Behavior of a Lamina, Macro mechanical Behavior of a laminate, Processing of Polymer Matrix, Metal Matrix and Ceramic Matrix Composite Materials, Testing of Composite Materials.

R.M. Jones, Mechanics of Composite materials, Mc Graw- Hill Kogakush Ltd., Tokyo, 1975.

Isaac Daniel and Ori Ishai, Engineering Mechanics of Composite Materials, Oxford University press, New York, 1994.

M.W. Hyer, Stress analysis of fiber reinforced composite materials, WCB, Mc Graw -Hill, Boston, 1998.

P.M. Mallick, Fibre Reinforced composites: Materials, Manufacturing and Design, Marcel Dekker, Inc, New York, 1998.

J.W. Wheeton, D.M. Peters and K.L. Thomas, Engineers' Guide to Composite Materials, ASM International, Ohio, 1986.

ME410 NON CONVENTIONAL ENERGY SOURCES (3-0-0) 3

Different Forms of Energy, Energy resources, Renewable & Non-renewable energy resources, Energy scenario of India and World. Solar energy and its applications, Wind energy, Ocean energy, wave, tidal and ocean thermal energy conversion, geothermal energy, Biomass energy, biogas, biomass gasification system, direct energy Conversion: Thermoelectric, Thermo ionic, solar cell and Magneto-Hydrodynamic conversion Systems, Hydrogen production and Utilization.

P.D.Dunn, Renewable Energies: Sources, Conversion and Application, P.Peregrinius Ltd, London, 1986.

J.W.Twidell and A.D.Weer, Renewable Energy Sources, ELBS, 2nd Edition, Taylor & Francis, 2006.
S. Rao and B. B.Parulekar, Energy Technology- Non conventional, Renewable and Conventional 3rd Edition, Khanna Pub, 1999.
B.T. Nijaguna, Biogas Technology, New Age International Pub, 2002.

ME 411 POLLUTION CONTROL AND ENVIRONMENTAL MANAGEMENT (3-0-0) 3

Air pollution, Air quality, Definitions, Characteristics and perspectives, classification of pollutants, Their ill effects, Air quality management concepts, Meteorology and natural purification processes, Air pollution sampling and measurement, Air pollution control methods and equipment, Control of specific gaseous pollutants, Pollutants from automotive engines, Legal and necessity of legislation, Sources and classification of water pollutants, Wastewater sampling and analysis, Wastewater treatment, Solid waste management, Noise and odor pollution.

C.S Rao, Environmental pollution control Engineering, Wiley Eastern Ltd, 1994.
Howard. S Peavy, Donald R Rowe & George Tchobanoglous, Environmental Engineering, McGraw Hill Intnl. Edition, 1986.
S.P. Mahajan, Pollution control in process industries, Tata McGraw Hill, 1985.
W.L. Faith, Air pollution control, John Wiley, 1959.
Henry. C. Perkins, Air Pollution, Mc Graw Hill, 1974.
K.V.S.G Murali Krishna, Air Pollution and Control, Kaushal & Co, 1995.

ME412 OPERATIONS RESEARCH (3-0-0) 3

Definition, Formulation of LPP, Graphical Solutions, Simplex Algorithms, Sensitivity Analysis, Maximization Application, Transportation, Traveling Salesman Problems, Dynamic Programming, Game Theory, Solution Methods, Dominance Concept, Approximation Method, Waiting Line Theory, Poisson Arrival Rate, Exponential Service Times, System Characterization and Economy, Simulation, Steps, Applications and Limitations, Monte Carlo Technique, Waiting Line Situations, Networks: CPM and PERT Analysis, Total, Free and Independent Float, Network Crashing, Non-Linear Programming.

S.D. Sharma & H. Sharma, Operations Research- Theory, Methods & Applications- Kedarnath & Ramnath Publishers, 2002.
Taha H.A., Operations Research – An Introduction, 7th Edition, Prentice Hall Pub, 2002.
Shambling and Stevens, Operations Research – Fundamental Approach. McGraw-Hill Inc, US, 1974.

ME413 MICROPROCESSORS AND PLC (3-0-0) 3

PLC Architecture, General PLC programming procedure, basic PLC functions, Data Handling, Intermediate Functions, Analog PLC Operation, Networking PLCs, PID control of continuous processes, Microprocessor programming and interfacing, Case Studies on applications in manufacturing.

John W. Webb & Ronald A. Reis, Programmable Logic Controllers – Principles and Applications, Prentice Hall India, 2003.
Alan J. Crisper, PLC and their Engineering Applications, McGraw Hill Pub,1996
Douglas Hall, Microprocessor & Interfacing - Programming and Hardware, 2nd Edition, Tata McGraw Hill Pub, 2002.

ME 414 ADVANCED I.C. ENGINES (3-0-0) 3

Engine types, Engine design and operating parameters, Thermo chemistry of fuel-air mixture, Properties of working fluids, Characteristics of flames, Combustion stoichiometry, First law and Second law of thermodynamics applied to combustion, Chemically reacting gas mixtures, Unburned mixture composition, Combustion charts, gas exchange processes, Fuel injection system, Combustion in SI Engine and CI engine, Engine heat transfer, friction and lubrication, Measurement and testing of power and emissions, Heat balance, Supercharging and turbo charging of IC engines.

John.B.Heywood, Internal combustion engine fundamentals, McGraw Hill, 1st Edition, 1988.
E.F Obert, Internal combustion engines, Addison Wesley, 3rd Edition, 1968.

V.Ganesan, Internal combustion engines, 2nd Edition, TMH Education, 2002.
C.F.Taylor, The internal combustion engines theory and practice, vol. I & II, MIT press, 2nd Edition, 1985.
Colib R, Furguson, Internal Combustion Engine, Applied Thermosciences, John Willey and Sons, 2004.

ME 415 THEORIES OF ENGINEERING FRACTURE (3-0-0) 3

Introduction, Mechanics of Elastic fracture, Quasi- Elastic fracture, combined flow and fracture, Crack and craze nucleation, fracture under repeated loading, crack arrest, crack stability.

A.G.Atkins and Y.W. Mai, Elastic and Plastic Fracture, 1st Ed, Ellis Horwood Ltd, 1985.
David Broek, Elementary Engineering Fracture Mechanics, Sijthoff & Noordhoff International Publishers, Netherlands, 1978.
J.F. Knott, Fundamentals of Fracture Mechanics, Butterworths, 1973.

ME416 CRYOGENICS (3-0-0) 3

Liquefication of permanent gases, Methods of air liquefaction, separation, storage and transport, applications, Properties of solids and liquids at cryogenic temperatures, Cryogenic Insulation, Vacuum technology cryo pumping, Cryogenic heat pipe, Applications of cryogenic engineering in various fields, Food preservation process, Cryogenic Instruments.

R.B. Scott, Cryogenics Engineering, Van Nostrand & Co, 1962.
Randall F. Barron, Cryogenic Systems, McGraw Hill, New York, 1966
Arora C. P., Refrigeration and Air Conditioning, Tata McGraw Hill Company Limited, New Delhi, 1981.
Refrigeration/Thermodynamics/Heat transfer/Air conditioning data hand book.

ME 417 APPLIED FINITE ELEMENT METHOD (3-0-0) 3

Variational formulation, Ritz method, one-dimensional FEM, Finite element modeling of Beams, trusses and frames, Two dimensional formulation, plane stress/ strain for triangular and rectangular model, Solution techniques, alternative formulation, Applications of FEM, Programming for FEM.

R.D. Cook, D.S. Malkus, M. E.Plesha, R. J.Witt., Concepts and application of Finite Element Analysis, 4th Edition, John Wiley and Sons, 2002.
Singiresu S. Rao, The Finite Element method in Engineering, Elsevier, 2005.
J. N. Reddy, An Introduction to Finite Element method, 3rd Edition, McGraw- Hill, 2005.
Zienkiewicz O. C, Finite Element Method in Engineering Sciences, McGraw-Hill, 1971.

ME418 AUTOMOBILE ENGINEERING (3-0-0) 3

Automotive Chassis Layout, Frame and body Construction, I.C. Engine Construction and Components. Engine Cooling and Lubrication System, Fuel Supply System for petrol and diesel Engine, Ignition System, Clutches, Transmission System, Drive Line System, Steering System, Suspension and Shock Absorber System, Braking System, Automotive Electrical System, Maintenance, Engine Testing, Servicing and Repair.

Heitner Joseph, Automotive Mechanics, East West Press, 2nd Edition, 1974.
Crouse, Automotive Mechanics, Mc Graw Hill, 6th Edition, 1970.
K.M. Gupta, Automobile Engineering, Umesh Publications. New Delhi, 2001.
Kirpal Singh, Automobile Engineering, Standard Pub, 8th Edition, 1999.
N.K. Giri, Automotive Mechanics, Khanna Pub. New Delhi, 2004.

ME419 PROPULSION (3-0-0) 3

Reaction principles, essential features of propulsive devices, momentum theory applied to propulsive devices, operating performance and equilibrium running conditions, augmentation of thrust, ramjet engine, rocket engines.

Zucrow N.J, Principles of Jet propulsion and gas turbine, John Wiley, New York, 1970.
Mathur M.L and Sharma R.P, Gas Turbines and Jet and Rocket Propulsions, Standard Publishers, New Delhi, 1988.

Nijaguna B.T, Thermal Science/Engineering Data and Book, 1st Edition, Allied Pub. Ltd. New Delhi, 1992.

ME420 MECHANICAL VIBRATION & ACOUSTICS (3-0-0) 3

Importance and scope, Single DOF systems, Free, damped, forced vibration, Two DOF system, Multi DOF systems, Eigen values and vectors, numerical solutions, Continuous systems, non linear systems. Theory of vibration measuring instruments, Vibration reduction methods, Fundamentals of acoustics, Plane wave, prorogation, radiation and scattering, effect of noise on human, acoustics measurement, Noise reduction methods.

W .T .Thomson, Theory of Vibration with application, 5th Edition, Prentice Hall, 2001.
Kinslr L. E & Fray A. R, Fundamentals of acoustics, 3rd Edition, Jon Wiley & Sons, 1982.
Philip M .Morse, Vibration and Sound, 2nd Edition, McGraw- Hill, 1948.
Lyon R. C, Machine Noise and Diagnostics, Butterworths, 1987.
Leo L Beranek, Noise and Vibration control, McGraw Hill Higher Education, 1971.

ME 421 THEORY OF PLASTICITY (3-0-0) 3

A brief review of elasticity, octahedral stress, spherical and deviatoric stress, representative stress, Engineering and natural strains, cubical dilation, finite strains coefficients Octahedral strain, strain rate, tensor, yield criteria for ductile metal, stress space, stress–strain relations, plastic stress-strain relations, yield locus, symmetry convexity, normality rule, upper and lower bound theorems and corollaries and slip line theory.

R.A.C.Slater, Engineering Plasticity: Theory and Application to Metal Forming Process, The McMillan Press Ltd, London, 1977.
Sadhu Singh, Theory of Plasticity and Metal forming Process, Khanna Publishers, New Delhi, 2008.
Chakraborty. J, Theory of plasticity, Mc-Graw Hill Book Company, New York, 1987.

ME422 HUMAN FACTORS IN ENGINEERING DESIGN (3-0-0) 3

Introduction, Information input, Human output and control, workspace and arrangement, Environment, Human factor applications in system design, Human error and work, Case studies.

Sanders and McCormick, Human factors in Engg Design, Mc Graw Hill Book Co, 5th edition, 1982.
Christopher D.Lackers, John D.Lee, Yili Lin, Sallie Gordon-Becker, Introduction to Human factors engineering, Prentice Hall, 2003.
Neville A. Stantaon, Paul M, Salmon, Guy H. Walker and Chris Baber, Human factor methods, A practical guide for Engineering and Design, Ashgate publishing, 2005.

ME423 NUCLEAR ENERGY (3-0-0) 3

Status and prospects: Fuel for Nuclear fission reaction, Energy from fission reaction, nuclear fission and chain reaction, nuclear fuel Cycle, Storage and transportation. Power reactor system: Reactor thermal design, power distribution in reactor core, fuel element temperature and heat fluxes, Reactor operations, Reactor kinetics, reactivity coefficients, Fission product poisoning, nuclear waste management.

Richard Stephenson, Introduction to Nuclear Engineering, McGraw Hill Edition, 1954.
Charles F. Bonilla, Nuclear Engineering, McGraw Hill Book Company, 1957.
K.S. Ram, Basic Nuclear Engineering, Wiley Eastern Ltd, 1977.
M.M. El Wakil, Power Plant Technology, McGraw Hill International Edition, 1984.

ME424 INDUSTRIAL TRIBOLOGY (3-0-0) 3

Introduction to the concept of tribo design, Basic principles of tribology, elements of contact mechanics, Friction, Lubrication and Wear in kinematics pairs, Tribological properties of solid materials, Fluid lubricated Thrust and Journal bearings, Lubrication of lightly loaded contacts, lubricating systems, Bearing selection, Tribology in metal working processes, Steel, Mining, paper and pulp, Glass fiber industries, Transportation sector.

T.A. Stolarski, Tribology in Machine Design, Industrial Press Inc. New York, 1990.

R.D. Arnell. P.B. Davies, J. Halling and T.L. Whomes, Tribology - Principles and Design applications, Springer- Verlag, New York, 1991.

ME425 ENGINEERING ACOUSTICS (3-0-0) 3

Fundamentals of wave propagation, propagation and radiation of sound, Elastic isolation, Sound absorber materials, fundamentals of Room Acoustics, silencers, sound refraction, Electro Acoustic transducer for Air borne sound.

Moser.M, Engineering Acoustics, Springer Ed-1, 2004.
Harris.C.M., (Ed) Handbook of Acoustic measurement and noise control, ASA New York, 1998.
Kutturuff. H, Room Acoustics, Elsevier Science Publication, 1991.
Kinsler .L. E & Fray. A. R, Fundamentals of Acoustics, John Wiley & Sons, New York, 1982.

ME426 APPLIED COMPUTATIONAL METHODS IN MECHANICAL SCIENCES (3-0-0) 3

Modeling, Computers, and Error Analysis, Roots of Equations, Statistical description of thermal data, Modeling of data, Boundary value and initial value problems of mechanical science, Numerical solution of partial differential equations of mechanical sciences, Eigen value problems.

William H Press, Saul A Teukolsky, William T Vellerling and Brain P Flannery, Numerical Recipes in C, 2nd Ed., Cambridge university press, 1992.
E.V. Krishnamurthy and S. K. Sen, Numerical Algorithms, 2nd Edition, Affiliated East-West Press Pvt Ltd, 1986.

ME427 COLLABORATIVE MANUFACTURING (3-0-0) 3

Evolution of modern manufacturing concept, virtual manufacturing, concurrent engineering, open architectural soft CNC systems with PLCS, CNC architecture design, real time OS for CNCS, process management, process synchronization, inter process communication, multi processing hard ware, OS configuration, CNC system architecture, open CNC system, object oriented data modeling, feature based modeling, agent based manufacturing, agent protocols, AI protocols, OSI communication network protocols, network configuration, STEP-NC systems, STEP-NC data models, intelligent STEP-CNC Systems, implementation of collaborative systems.

A.Dashchenko, Manufacturing technologies for machines of the future, Springer Publ, 2003
Suk-Hwan Suh & others, Theory and design of CNC systems, Springer, 2008
Cornelius T.Leondes, Intelligent systems Vol 5, Manufacturing, Industrial and management systems, CRC Press, 2003
Behrouz A Forouzan, Data Communications and networking, Mc Graw -Hill, 2006.

ME428 REFRIGERATION AND AIR AIR CONDITIONING TECHNOLOGY (3-0-0) 3

Psychrometry, Air-conditioning processes, use of Psychrometric chart, air conditioning processes, Cooling load calculations. types of air conditioning systems, winter and Summer air conditioning, Applications of air conditioning. (Use of Refrigeration data handbook permitted in examination)

Arora C. P, Refrigeration and Air Conditioning, Tata McGraw Hill Company Limited, New Delhi, 1981.
Manohar Prasad, Refrigeration and Air conditioning, Wiley Eastern Ltd, New Delhi, 1983.
Refrigeration/Thermodynamics/Heat transfer/Air conditioning data hand book.

ME 429: Analytical Mechanics (3 0 0) 3

Review of basic solid mechanics theory, Work, Energy and Variational Calculus, Energy principles in structural mechanics, Variational forms, Energy principles in mechanics, Principle of virtual work, Deformation of Bars and Beams, Plates, Problems in plane elasticity (Plane stress, plane strain, axisymmetric elasticity), Dynamical Systems, Hamilton's principle for particles, rigid bodies, continuum and constrained systems.

References:

Energy Principles and Variational Methods in Applied Mechanics by J. N. Reddy (John Wiley, New York, 2002)
Mechanical Systems, Classical Models, Analytical Mechanics, by P.P. Teodorescu, Springer, 2009
Analytical Dynamics, Theory and Applications, by Mark D Ardema, Kluwer Academic/Plenum Publishers, 2005
Methods of Analytical Dynamics, Leonardo Meirovitch, Dover Publications, 2010

ME 430 THEORY OF FATIGUE ANALYSIS (3-0-0) 3

Review of failure theories, fatigue design methods, fundamentals of LEFM and application to fatigue crack growth, Stress-life and strain-life approaches, notches and their effects, fatigue from variable amplitude loading, spectrum loading, cumulative damage theories, cycle counting methods, statistical aspects of fatigue.

Ralph I. Stephens, Ali Fatemi, Robert .R. Stephens and Henry O Fuchs, Metal Fatigue in engineering, John Wiley, New York, Second Edition, 2001.
Jack. A. Collins, Failure of Materials in Mechanical Design, Second Edition, John Wiley & Sons, New York, 1981.
Robert L. Norton, Machine Design- An Integrated Approach, Fourth Edition, Prentice Hall, 2010.
S. Suresh, Fatigue of Materials, Cambridge University Press, Second Edition, Cambridge, U.K., 1998.

ME431 CONTEMPORARY CONCEPTS IN PRODUCT DESIGN (3-0-0) 3

Pre-requisite: ME 324

Human-Product Interactions – Design for Aesthetics, Input-Output Human interface devices, Design thinking. Design for ease of use. Ergonomics and Human modeling-Definition and aspects in Product Design, Digital Human Modeling and Virtual Humans. Bio-inspired product design and biomechanics-Designs inspired by flora and fauna, fundamentals of biomechanics. Creative Design and Design research methodology- Definition of Novelty and creativity. Abstractize and Synthesize for creative design. Design for sustainability, twelve principles of green engineering.

M S Sanders and E J McCormick, Human Factors in Engineering and Design, McGraw-Hill Education (India)Pvt. Ltd., 7ed, 2013
Don Norman, The Design of Everyday things, Basic Books, 2013
W Lidwell, K Holden and J Butler, Universal Principles of Design, Rockport Publishers
Duane Knudson Fundamentals of Biomechanics, Springer, 2007 (Second Edition)
Lucienne T.M. Blessing, AmareshChakrabarti, DRM, a Design Research Methodology, Springer, 2009
Our common future – Brundtland Report

ME 432 DESIGN OF SOLAR ENERGY SYSTEMS (3-0-0) 3

Introduction, Solar geometry , Measurement of Solar Radiation, Solar collectors design - flat plate & focusing type, storage of solar energy, solar heating, cooling, passive and active systems, green buildings, applications of solar energy in various fields, water heating, air heating, drying, pumping etc, Economic viability of solar systems, Thermal modeling of solar devices – Case study based assignment.

Duffie J.A. and Beckman W.A., Solar Thermal Processes, John Wiley, New York, 1974.
Garg H.P, J. Prakash, Solar Energy, TMC, 1997.
Sukhatme S.P, Solar Energy Principles of Thermal Collection and Storage, 2nd Ed., Tata Mc Graw-Hill, New Delhi, 1996.
C. S. Solanki, Renewable Energy Technology, Prentice Hall, New Delhi, 2008.

ME270 THERMODYNAMICS AND FLUID MECHANICS (3-1-0) 4

Laws of thermodynamics, Concept of entropy, Air standard efficiencies and MEP representation on P-V and T-S diagrams, Compressor. Reciprocating, Use of compressors in Mining equipment, Fluids: Definition and properties, Ideal and real fluids, Pressure and its measurement for liquids. Dynamics of fluid flow, Flow in pipes, Centrifugal and reciprocating pumps.

Nag, P.K., Thermodynamics, Tata Mc Graw Hill, 2002.
Kumar, K.L, Engineering fluid mechanics, Eurasia, 3rd Edition, 1984.
Eastop and McConkey, Applied Engineering Thermodynamics, ELBS, 1995.

ME300 ENERGY ENGINEERING (3-0-0) 3

Conventional Energy Sources: Hydel, Steam, Gas turbine, Diesel and Nuclear Power Plant, Layout, function of different components and types, Power plant Economics, Non-conventional or Renewable energy sources: Solar energy, application of solar energy, Wind, Ocean, Geothermal, Biomass Energies, Energy Conversion Principles and types.

Houghton E.L., Carruthers, Aerodynaimcs for Engineers studentents, Butterworth-Hinemann Ltd., 2006
Sukathme S.P., Solar Energy Principles of Thermal Collection and Storage, 2nd Ed., TMC New Delhi,1984
M.M.El.Wakil, Power Plant Techniques, McGraw Hill, New York, 1985.
G.D. Rai, Non-Conventional Energy, Dhanpat Rai & Sons, New Delhi, 1998

ME301 DESIGN OF MECHANICAL DRIVES (3-1-0) 4

Belt, rope and chain drives, theory of gearing and forces on gears design of gears, design of industrial gear drives, Design standards, Optimization and reliability principles in Engineering Design, Human factors in Engineering design.

Shegley J.E. and Vicker J.J, Theory of Machines and Mechanisms, McGraw Hill, 1981.
Rajendra Karwa, A Text book of Machine Design, Laxmi Publications, 1989.
Sanders and McCormick, Human factors in Engineering Design, McGraw Hill book company, 7th Edition, 1993.

ME 302 MECHANICAL MEASUREMENTS AND INSTRUMENTATION (3-0-0) 3

Scope nad methods of measurements, generalized measuring system, sensors transducers detailed classification and principles, static characteristics, signal conditioning and input circuitry, read out devices, measurement uncertainties and error analysis, strain gauge theory, construction, installation, strain gauge for stress and strain analysis. measurement of force, pressure, torque by variety of principles. temperature measurement. heat flux, sensors, flow measurement. dynamic characteristics of instruments and transducer, mathematical representation and response analysis of zero , first and second order systems and time response specification. accelerometers and vibro meters, theory and characteristic of seismic type.

Ernest O. Doebelin, Measurement Systems – Application Design, McGraw Hill International Edition-1990.
TG Beckwith, NLBuck and RD Marangoni, Mechanical Measurements, Indian Student Edition, Narosa Publishing House, 3rd Ed., 1987.
D. V. S. Murty, Transducers & Instrumentation, Ist Ed., 2nd printing, Prentice Hall of India Pvt. Ltd, 1995.
JP Holman, Experimental methods for engineers, Mc Graw-Hill book, 6th Ed.1994.
RS Sirohi and HC Radha Krishna, Mechanical measurements, Wiley Easter Ltd., 2nd Ed., 1983, India
R Raman, Principles of Mechanical measurements Oxford and IBH Pub, 2nd Ed.,1997, India

ME303 METROLOGY AND CAD LAB (0-0-2) 1

Metrology Lab: Linear and angular measurement, measurement using slip gauges, Calibration, Screw thread and gear tooth parameter measurement, Tool makers microscope, surface measurement, comparators, acceptance test on lathe. CAD Lab: Graphics programming, drafting techniques, solid modeling practices.

I.C. Gupta, Engineering Metrology, Dhanpat Rai Publications, New Delhi, 1994.
Ibrahim Zeid, Mastering CAD/CAM, TMH publishing company ltd, New Delhi, 2007.

ME304 MECHANICAL LABORATORY-I (0-0-2) 1

Determination of Fuel properties, Calibration of pressure gauge, Performance of IC Engines.

Mathur and Sharma, Internal Combustion Engines, Dhanpath Rai and Sons. New Delhi, 8th Edition,1996.

ME310 MEASUREMENTS IN THERMAL SYSTEMS (3-0-0) 3

Measurement of specific heat, Viscosity, Thermal Conductivity, Thermal diffusivity, Heat flux, Calorific value, Thermal and solar radiation measurements, Gas composition analysis by Orsat apparatus, Gas Chromatograph, Infra-red analyzer, Mass Spectrometer, Turbulence measurements using hot wire anemometer, laser Doppler anemometer. Measurements in controlled environments, Mass transfer measurements, Shadowgraph, Schlieren and Interferometer, High speed Photography, Data acquisition and processing, Analysis of experimental data.

Landis, Lab experiment and demonstration in fluid mechanics and heat transfer. Dept of Mechanical Engg, school of Engg & science, New York University, 1964.
Sotoukhim and Afgan, Measurement techniques in heat and mass transfer-Hemisphere, New York, 1985.
Eckert and Goldstein, Measurements in heat transfer –hemisphere, Pub Corp, 2nd Edition, 1976.
Beckwith and Buck, Mechanical Measurements – Addison Wesley publishing company, 3rd Edition, 1982.
Doeblin, Measurement Systems Application and Design – Mc Graw Hill education, 5th Edition, 2003.

ME350 HEAT TRANSFER (3-1-0) 4

Introduction, Conduction Heat transfer, Insulation, Fin theory, Convection Heat transfer, Natural and Forced flow inside and outside tube, two phase heat transfer, Boiling and condensation, Heat exchangers, Radiation heat transfer (Non participating media), Introduction to mass transfer.

Nicati M. Ozisik, Heat Transfer a Basic Approach, McGraw Hill Publication,1985.
Holman J. P., Heat Transfer, McGraw Hill Publication, 8th Edition, 1996.
C. P. Arora, Engineering Heat Transfer, Khanna Publishers, India, 1996.
Frauk P Incropera, Fundamentals of Heat and Mass tranfer, John Wiley and sons, Fifth Edition, 2002.

ME351 MACHINE DYNAMICS AND VIBRATIONS (3-1-0) 4

Balancing of Machines, Whirling of shafts, Single Degree of freedom systems – Free, damped and forced vibrations, linear and torsional vibrations, Theories of Vibration measuring instruments, two degree of freedom systems, free, damped and forced vibration of multi degree freedom system.

W.T. Thomson, Theory of vibration with Application, 4th Edition, Prentice hall, Eagle wood cliffs, 1993.
V Ramamurti, Mechanical Vibration Practice with Basic Theory, Narosa 2010
M.K. Groover, Mechanical Vibration, PHI Publication, 1996.
J.E. Shigley and John Joseph Vicker, Theory of Machines and Mechanism, 3rd Ed. TMH, 1995.
Robert L. Norton, Design of Machinery, McGraw- Hill Inc, 3rd Editions, 2003.

ME352 MACHINE SHOP – I (0-0-3) 2

Study and Demonstration of different Lathes for various jobs, different cutting tools and different Lathe operations, Marking, Centre drilling, Facing, Taper turning, Grooving, knurling, Profile turning, Drilling, Boring, Thread cutting, Eccentric turning.

Hajara and Choudhary, Workshop Technology Vol.I &II, Median Promoters & publishers, Bombay.
Khanna O. P, Workshop Practice Vol.I, Dhanpat Rai & Co., 2000.

ME401 MECHANICAL LABORATORY- II (0-0-2) 1

Heat transfer experiments, Performance analysis of Compressors, Blowers, Boilers, Refrigerators and Air Conditioning equipments, Dynamics of Machinery experiments.

C. P. Arora, Engineering Heat Transfer, Khanna Publishers, India, 1996.
J.E. Shigley and John Joseph Vicker, Theory of Machines and Mechanism, 3rd Ed. TMH, 1995.
Manohar Prasad, Refrigeration and Air conditioning, Wiley Eastern Limited, New Delhi, 1983.

ME402 MACHINE SHOP - II (0-0-3) 2

Demonstration of Machine tools and Power tools, Practice on Shaper, Milling Machine, Cylindrical and Surface Grinding, Slotter, Drilling Machines, etc. Programming for CNC Machines,

Hajara and Choudhary, Workshop Technology vol.I &II, Median Promoters & publishers, Bombay.
Khanna O. P, Workshop Practice Vol.I, Dhanpat Rai & Co., 2000.

ME 433 ENERGY AUDIT AND MANAGEMENT (3-0-0) 3

Energy Sources, Energy management program, Energy auditing, Instruments used, case studies, Energy Economics, Thermodynamics of energy conservation, Energy conservation in boilers, furnaces, in steam and condensate system, Cogeneration Concepts, Heat Transfer Equipment, Waste heat recovery, Electrical energy conservation, Space Heating and cooling.

W .R. Murphy and G Murrey, Energy Management, Butterworth-Heinemann, 2007.
Larry C. Witte, Schmidt & Brown, Industrial energy management and utilization. Hemisphere publishing, Co. New York, 1988.
Wayne. C Turner, Energy management handbook, Wiley Inter-science publications. New York, 1982.
D. A. Reay, Industrial Energy Conservation – Pergamon Press, 1980.
T.L. Boten, Thermal energy recovery, Wiley, 1980.

ME434 EXPERIMENTAL STRESS ANALYSIS (3-0-0) 3

Review of Elementary Elasticity and Fracture Mechanics, Strain measurement methods and related instrumentation, Optical methods of stress analysis, Coating methods, Applications of statistics.

J.W. Dally and W.F. Riley, Experimental Stress Analysis, Mc Hill International Editions, New York, 1991.
L.S. Srinath et al., Experimental Stress Analysis, Tata Mc Hill, NewDelhi, 1984.
A.W. Hendry, Elememts of Experimental Stress Analysis, Pergamon Press, New York, 1977.
A. J. Durelli, Applied Stress Analysis, Prentice-Hall Inc., New Jersey, 1967.

ME435 MODELING AND SIMULATION OF ENGINEERING SYSTEMS (3-0-0) 3

Basic Component models, System model and its solution, State space equation and analysis of linear and non-linear systems, multidomain systems-mechanical, mechatronic and thermo fluidic systems, modeling and simulation of hybrid systems simulation tools.

Robert L. Woods, Kent L. Lawrence, Modeling and Simulation of Dynamic Systems, 1st Edition, , Prentice Hall, 1997.
Katsuhiko Ogata, System Dynamics, 4th Edition,Pearson Prentice Hall, 2004.
Karnopp D C, Margolis D L and Rosenberg R C, Modeling and Analysis of Mechatronic Systems, Wiley Interscience, 3rd Ed, 1999.
Doebelin E O, System Dynamics: Modeling, Analysis, Simulation and Design, Marcel Dekker 1998
Modeling, Identification and Simulation of Dynamical systems, by P.P.J. Van Den Bosch, A.C. Van Der Klauw, ISBN: 0849391814.
Dynamic Modeling and Control of Engineering Systems by J. L. Shearer, B. T., Kulakowski, and J. F. Gardner, Sec. Ed., Prentice Hall, 1997.

ME436 DATABASE MANAGEMENT SYSTEMS (3-0-0) 3

Introduction; E-R Models, Relational Models, Relational Algebra & Calculus, SQL Queries, programming and triggers, Data Storage, File Handling, Security, Parallel & distributed data, Internet database, Data Mining, Object Database systems, Real Time Database systems, Case studies in Mechanical Engineering.

R. Ramaksrishnan & Johannes G, Database Management System, 2nd Edition, WCB/ McGraw Hill Publishers, 2000.
J.D. Ullman , Principles of Database systems, 2nd Edition, Galgotia Publishers, 1999.
Stamper, D & Price, W, Database Design and Management- An Applied Approach, McGraw Hill, 1990.

ME 433 ENERGY AUDIT AND MANAGEMENT (3-0-0) 3

Energy Sources, Energy management program, Energy auditing, Instruments used, case studies, Energy Economics, Thermodynamics of energy conservation, Energy conservation in boilers, furnaces, in steam and condensate system, Cogeneration Concepts, Heat Transfer Equipment, Waste heat recovery, Electrical energy conservation, Space Heating and cooling.

W .R. Murphy and G Murrey, Energy Management, Butterworth-Heinemann, 2007.
Larry C. Witte, Schmidt & Brown, Industrial energy management and utilization. Hemisphere publishing, Co. New York, 1988.
Wayne. C Turner, Energy management handbook, Wiley Inter-science publications. New York, 1982.
D. A. Reay, Industrial Energy Conservation – Pergamon Press, 1980.
T.L. Boten, Thermal energy recovery, Wiley, 1980.

ME434 EXPERIMENTAL STRESS ANALYSIS (3-0-0) 3

Review of Elementary Elasticity and Fracture Mechanics, Strain measurement methods and related instrumentation, Optical methods of stress analysis, Coating methods, Applications of statistics.

J.W. Dally and W.F. Riley, Experimental Stress Analysis, Mc Hill International Editions, New York, 1991.
L.S. Srinath et al., Experimental Stress Analysis, Tata Mc Hill, NewDelhi, 1984.
A.W. Hendry, Elememts of Experimental Stress Analysis, Pergamon Press, New York, 1977.
A. J. Durelli, Applied Stress Analysis, Prentice-Hall Inc., New Jersey, 1967.

ME435 MODELING AND SIMULATION OF ENGINEERING SYSTEMS (3-0-0) 3

Basic Component models, System model and its solution, State space equation and analysis of linear and non-linear systems, multidomain systems-mechanical, mechatronic and thermo fluidic systems, modeling and simulation of hybrid systems simulation tools.

Robert L. Woods, Kent L. Lawrence, Modeling and Simulation of Dynamic Systems, 1st Edition, , Prentice Hall, 1997.
Katsuhiko Ogata, System Dynamics, 4th Edition,Pearson Prentice Hall, 2004.
Karnopp D C, Margolis D L and Rosenberg R C, Modeling and Analysis of Mechatronic Systems, Wiley Interscience, 3rd Ed, 1999.
Doebelin E O, System Dynamics: Modeling, Analysis, Simulation and Design, Marcel Dekker 1998
Modeling, Identification and Simulation of Dynamical systems, by P.P.J. Van Den Bosch, A.C. Van Der Klauw, ISBN: 0849391814.
Dynamic Modeling and Control of Engineering Systems by J. L. Shearer, B. T., Kulakowski, and J. F. Gardner, Sec. Ed., Prentice Hall, 1997.

ME436 DATABASE MANAGEMENT SYSTEMS (3-0-0) 3

Introduction; E-R Models, Relational Models, Relational Algebra & Calculus, SQL Queries, programming and triggers, Data Storage, File Handling, Security, Parallel & distributed data, Internet database, Data Mining, Object Database systems, Real Time Database systems, Case studies in Mechanical Engineering.

R. Ramaksrishnan & Johannes G, Database Management System, 2nd Edition, WCB/ McGraw Hill Publishers, 2000.
J.D. Ullman , Principles of Database systems, 2nd Edition, Galgotia Publishers, 1999.
Stamper, D & Price, W, Database Design and Management- An Applied Approach, McGraw Hill, 1990.

ME 437 : Nonlinear and Random Vibrations (3 0 0) 3

Nonlinear Vibration, Introduction, Examples of nonlinear vibration problems, exact methods, Approximate analytical methods, Sub harmonic and super harmonic oscillations, Graphical Methods, Stability of equilibrium states, Chaos.

Random Vibration, Introduction, Random variables and random processes, Probability Distribution, Mean Value and standard deviation, Probability distribution and Correlation functions, Stationary and Gaussian Random Process, Fourier Analysis, Power spectral density, Wide-band and Narrow Band process, Response of a single degree of freedom system. Response due to stationary random excitations,

References:

Mechanical Vibrations, by Singiresu S Rao, Pearson Education, 2011.
Mechanical Vibrations Theory and Applications, by S Graham Kelly, CengageLearning, 2012.
Theory of Vibration with Applications, by Willimam T Thomson, Marie Dillon Dahleh and ChandramouliPadmanabhan, Pearson Education, 2008.
Elements of Vibration Analysis by Leonard Meirovitch McGraw Hill (India) Education, 2014

ME438 POLYMER NANO COMPOSITES (3-0-0)3

Nanotechnology and nanomaterials, Basic Materials for Polymer Nanocomposites Technology, Preparation of polymer based nanomaterials, polymer Nanocomposites based on Carbon nanotubes and nanofibers, Polymer nanocomposites based on inkotian
organic nanoparticles, Application of polymer Nanocomposites.

Joseph Koo, Polymer Nanocomposites: Processing Characterization , and Applications, McGraw-Hill, USA, 2006
T.J Pinnavia and G.W Beall, Polymer –clay Nanocompostes, Wiley Series in Polymer Science, John Wiley , New York 2000
Rakesh K Gupta and Elliot Kennel, Polymer Nanocomposites, CRC Press USA, 2009
Vikas Mittal, Characterization Techiques for Polymer Nanocomposites, John Wiley & Sons,USA,2012

ME439 INTRODUCTION TO LASER PROCESSING OF MATERIALS (3-0-0) 3

Basics of Lasers – Laser Operation Mechanism, Properties of Laser Radiation, Types of Industrial Lasers, Fundamentals of Laser Material Interactions: Absorption of Laser Radiation, Thermal Effects, Materials science for laser processing, Transport phenomena for laser materials processing, Lasers in Manufacturing (Laser Cutting, Laser Drilling, Laser Machining, Laser Forming, Laser Welding, Laser Surface Alloying, Laser Cladding) Laser Additive Manufacturing – Classification, Processing Philosophy and Metallurgical Mechanisms, Modeling of Laser Material Processing.

Laser Material Processing, 4th Edition, W M Steen and J Mazumder, Springer, 2010.
Laser Processing of Materials - Fundamentals, Applications and Developments, Schaaf, Peter , Springer, 2010.
Physics of Laser Materials Processing: Theory and Experiment, Gennady G.Gladush and Igor Smurov, Springer, 2011.
The Mathematics of Thermal Modeling: An Introduction to the Theory of Laser Material Processing" John Michael Dowden, Chapman and Hall/CRC, 2001.
Principles of Laser Materials Processing, E Kannatey-Asibu, Wiley, 2009.
Laser Fabrication and Machining of Materials, N B Dahotre and S P Harimkar, Springer, 2008.
Laser Processing of Engineering Materials: Principles, Procedure and Industrial Applications, John C Ion, Elsevier, 2005.

ME440 PRACTICAL TRAINING 2

This course is a 2 credit course. A student may complete the training before the beginning of 7th semester (or as stipulated by DUGC) and register for it in 7th Semester. The duration and the details shall be decided by the faculty advisor, with approval from DUGC.

ME 441 NUCLEAR SCIENCE AND ENGINEERING (3-0-0) 3

Introduction to nuclear power systems, Reactors, Thermal-hydraulics, Physics of reactor design, Nuclear fuel cycle, Uranium supply, enrichment fuel fabrication, In-core physics and fuel management Reprocessing and waste disposal, Principles of fuel cycle economics, Nonproliferation aspects, disposal of excess weapons plutonium, and transmutation of actinides and selected fission products in spent fuel.

Todreas, Neil E., and Mujid S. Kazimi. Nuclear Systems: Thermal Hydraulic Fundamentals. Vol. 1. New York, Taylor & Francis Inc., 1989.
Henry, A. F. Nuclear Reactor Analysis. Cambridge, MA: MIT Press, 1975.
Lamarsh, John. Introduction to Nuclear Engineering. 3rd Ed. Englewood Cliffs, NJ: 2001.

K. S. Ram, Basic nuclear engineering, Wiley, 1977.
Cochran, R. G, and N. Tsoulfanidis. The Nuclear Fuel Cycle: Analysis and Management. 2nd Ed. LaGrange Park, IL: American Nuclear Society, 1993.
Raymond L. Murray Nuclear Energy, Butterworth and Heinemann, 2000.

ME 442 MICROSYSTEM TECHNOLOGY (3-0-0) 3

Introduction to micro system elements, sensor and actuator fundamentals, scaling issues and materials for micro systems, micromachining, design and analysis of micro systems, CAD approach, micro system packaging.

W. Menz, J. Mohr and O. Paul, Microsystem Technology, Wiley, 2001.
Stephen D. Senturia, Microsystem Design, Springer, 2001.
Mark J Madou, Fundamentals of Microfabrication, CRC Press, 2002.

ME443 PRODUCT DESIGN AND MANUFACTURING (3-0-0)3

Contents: Introduction, Product characteristics, Types of design, Product design practice and industry, DFX, Optimization in design, Role of computers in Product design, new techniques in product design, Steps in product development.

Chitale A. K and Gupta R. C, Product Design and Manufacture, PHI, 2007.
Karl Ulrich and Steven D Eppinger, Product Design and Development, Irwin Mc Graw Hill, 2nd Edition, 2000.
Kristin L. Wood, Kevin N. Otto, Product Design, Pearson, 2000.
Edward Magrab, Integrated product and process design and Development, CRC Press, 2009.

ME444 SOLAR ENERGY (3-0-0)3

Introduction, Solar geometry, Solar Radiation, Measurement, Solar collectors design, flat plate, storage of solar energy, solar heating and cooling systems, Applications of solar energy.

Duffie and Beckman, Solar Thermal Processes, McGraw- Hill, 2nd Edition, 1991.
Garg H.P & J. Prakash, Solar Energy, TMC, 1997.
Sukhatme S.P, Solar Energy Principles of Thermal Collection and Storage, 2nd Ed., Tata Mc Graw-Hill, New Delhi, 1996.
C. S. Solanki, Renewable Energy Technology, Prentice Hall, New Delhi 2008.

ME445 ENERGY MANAGEMENT (3-0-0) 3

General energy problems, Energy use patterns, Energy management program, Energy auditing, Instruments used, case studies, Types of energy audits, Financial approval methods, Thermodynamics of energy conservation, Energy conservation in boilers, furnaces, in steam and condensate system. Cogeneration concepts, Performance evaluation, Waste heat recovery, Electrical energy conservation: Industrial uses of electric power, analysis and improvement methods.

Larry. C. Witte, Schmidt & Brown, Industrial energy management and utilization. Hemisphere publishing Co. New York, 1988.
Wayne C Turner, Energy management handbook, Wiley Inter science publications, New York, 1982.
D. A. Reay, Industrial Energy Conservation, Pergamon Press, 1980.
T.L. Boten, Thermal energy recovery, Wiley, 1980.

ME446 THEORY OF GAS TURBINE AND JET PROPULSION (2-1-0)3

Analysis of the gas turbine cycles, Design point performance calculations, Intake and propelling nozzle efficiency, Turbofan, turbojet and turboprop engines, Reaction principles, Momentum theory applied to propulsive devices, Augmentation of thrust, Ramjet and Pulse jet engine, The concept of losses and efficiency, Types of combustion system, Combustion process, Detailed component studies on compressors and turbines, Compressibility effects, Vortex theory, Selection of blade profile, chord and pitch,

Estimation of stage performance, Limiting factors in design, Off-design performance, Equilibrium running conditions

Cohen, H., Rogers G.F.C., Saravanamuttoo, Gas Turbine Theory, 5th edition, Pearson Education 2001.
David Gordon Wilson, Theodosios Korakianitis, The design of high efficiency turbomachinery and gas turbines, Prentice Hall, 1998.
P. P. Walsh, Fletcher P., Gas Turbine Performance, 2nd edition, Blackwell Publishing Limited 2004.
Nicholas Cumpsty, Jet Propulsion: A Simple Guide to the Aerodynamic and Thermodynamic Design and Performance of Jet Engines, 2nd edition, Cambridge University Press 2003.
Erian A. Baskharone, Principles of Turbomachinery in Air-Breathing Engines, Cambridge University Press 2006.
M.J. Zucrow, Principles of Jet Propulsion and Gas Turbines, John Wiley, 1970.

ME447 MULTI BODY DYNAMICS AND APPLICATIONS (2-1-0)3

Kinematics of particles and rigid bodies, Euler angles, Generalized displacement, velocity and acceleration, Rigid body dynamics, D'Alembert's Principle, Virtual work application in dynamics and Lagrange's equation, Constraints formulation in Multi Body Systems, Formulation of joint constraints for various joints used in practice, Formulations of Constrained Dynamics Equations, Lagrange Multipliers, Multi Body Dynamics Solution, Numerical Integration, Computer simulation of the dynamic behavior of multi-body systems using software tools. Treatment of holonomic and non-holonomic constraints through various elimination and augmentation methods, Application to Vehicle Dynamics, Engine Dynamics, Power Train Dynamics. Tyre models in Vehicle dynamics. Stability Analysis. Deformable Multi Body Dynamic Simulation.

Ahmed A. Shabana, Dynamics of Multibody Systems, 3rd edition, Cambridge University Press, 2010.
Michael Blundell and Damian Harty., The Multibody Systems Approach to Vehicle Dynamics, Elsevier Limited, 2004
FaridAmirouche, Fundamentals of Multibody Dynamics: Theory and Applications, Birkhäuser, 2006
Ahmed A. Shabana, Computational Dynamics", Wiley InterScience, 2nd Edition. 2001

ME490 SEMINAR (0-0-2) 1

This course is a 1 credit course to be completed during 7th / 8th semester. The student will make presentations on topics of academic interest.

ME449 MAJOR PROJECT - I (0-1-3) 2
ME499 MAJOR PROJECT – II (0-1-9) 6

MT 210 MECHANICAL TESTING (2-0-0)2

Cohesion between atoms: bonds, potential energy Vs interatomic distance curves, prediction of physical properties based on these curves; crystal systems: fundamentals of crystal structure of metals; tension testing: tensile properties, strain aging, ductile and brittle materials; Erichson cupping test, directionality; torsion test: specimen behaviour under torsion; hardness test: Brinell, Rockwell and Vickers test, relation between hardness and tensile strength, microhardness testing; creep test: creep curve, stress rupture test; fatigue test: S-N curve, statistical nature, effect of mean stress; impact test: Charpy and Izod test, transition temperature; structures & properties of engineering materials.

V.S.R. Murthy, A.K. Sema, K.P. Gupta, G.S. Murthy, Structure & Properties of Engg Materials, Tata McGraw Hill, ND, 2003.

Dieter G.E. Mechanical Metallurgy, McGraw Hill 1988 (SI Metric).

MT 211 METALLURGICAL THERMODYNAMICS (3-1-0)4

Review of first and second laws of thermodynamics, Maxwell's relations; free energy concept and applications, general strategy of deriving thermodynamic relations; third law of thermodynamics; related problems from Dube & Upadhyaya. Solutions, partial molar properties, Gibbs-Duhem equation, fugacity, activity, equilibrium constant; regular solutions, integration of G-D equation, dilute solutions, interaction parameter; equilibrium in thermodynamic systems, structure of unary phase diagrams in (P,T) space, Clausius -Clapeyron equation, triple point, alternative representation of unary diagrams; Gibbs phase rule, Free energy-composition diagrams, Ellingham diagrams; activation energy, effect of activation energy on reaction rate, chemically controlled reactions (both ideal and non-ideal systems).

Robert T. DeHoff, Thermodynamics in Materials Science, McGraw Hill International, 1993

David R Gaskell, Introduction to Metallurgical Thermodynamics, McGraw Hill International, 1973

G.S.Upadhyaya and R.S.Dube, Problems in Metallurgical Thermodynamics and Kinetics, Pergamon, 1977

Ahindra Ghosh, Textbook of Materials & Metallurgical Thermodynamics, PHI, 2003.

Hem Shankar Roy, Kinetics of Metallurgical Reactions, Oxford, BH, 1993.

MT212 PHYSICAL METALLURGY (3-1-0) 4

Structure of metals, space lattice, unit cells, crystal systems, metallic crystal structures, packing efficiencies, planes and directions, voids, imperfections in crystalline solids, dislocations and plastic deformation, theoretical shear strength, concept of dislocations, types of dislocations, Burgers vector, strain field associated with dislocations, dissociation of dislocations, climb and cross slip, dislocation interactions, plastic deformation by twin, yield point phenomenon, strain ageing, work hardening in single and polycrystalline materials, effect of temperature, composition and grain size on strain hardening, recovery, recrystallisation and grain growth, high temperature deformation of crystalline materials, diffusion in solids, applications of diffusion concepts, solidification of metals, freezing of alloys, Scheil equation,dendritic freezing in alloys, freezing of ingots, segregation, homogenization, porosity, eutectic freezing, growth of single crystals.

yllebus E.Reed-Hill and R. Abbaschian, Physical Metallurgy Principles, PWS Publishing Co., 1994.

G. E. Dieter,Mechanical Metallurgy, McGraw-Hill Book Co., 1988.

W.G.Moffat, G.W.Pearsall & I.Wulff, The Structure & Properties of Materials, Vol. I Structure, Wiley Eastern, 1968.

G. W. Hayden, W.G.Moffat and I.Wulff, The Structure & Properties of Materials, Vol.III Mechanical Behaviour,Wiley Eastern Pvt. Ltd, 1968.

MT213 POLYMER SCIENCE AND TECHNOLOGY (3-0-0) 3

Polymer structure: polymer conformation and chain dimensions, thermodynamics of polymer solutions; phase equilibria, determination of the interaction parameter, predictions of solubilities, the amorphous state, glass transition, secondary relaxation; crystalline state, thermal transitions and properties;

mechanical properties & effect of temperature, fatigue, creep in polymers, mechanisms of deformation, basic processing operations, introduction to polymer rheology, constitutive equations, elastic properties of polymeric fluids, analysis of simple flows: introduction to modelling of polymer-processing operations, membrane applications of polymeric materials, mechanisms of transport, membrane preparation, biomedical applications, artificial organs, controlled drug delivery, hemodialysis and hemofiltration; applications in electronics.

Joel R. Fried, Polymer Science and Technology, Prentice-Hall of India Private Limited, New Delhi, 2002
Herman, Herman S. Kaufman and Joseph J. Falcetta, Introduction to Polymer Science and Technology, Wiley Interscience, 1977
Ghosh, P, Polymer Science and Technology of Plastics and Rubbers, TMH, New Delhi , 2004
Peter C. Powell, Engineering with Polymers, Chapman & Hall, 1983

MT214 MINERAL DRESSING (3-0-0) 3

General and Dynamic Geology, Crystallography, Minerology, Economic Geology. Scope of Mineral Dressing in Metallurgy. Crushing and grinding. Sampling and Particle size analysis. Gravity concentration methods. Forth Floatation. Magnetic and Electrical Separation. Cyclones, Filters, Solids conveyance and storage.

Parbin Singh, General and Engineering Geology, 4th Ed., Kaston Publishing House, 1987.
A. M. Gaudin, Principles of Mineral Dressing. TATA McGraw Hill 1974.

MT260 PROCESS ENGINEERING (3-1-0) 4

Units and dimensions, applications of transport phenomena, properties of fluids, laminar and turbulent fluid flow, Stoke's Law, flow past submerged bodies, flow through packed and fluidized beds, Bernoulli's Equation, dimensional analysis, flow of compressible fluids, Fourier's law, conduction in solids, liquids and gases, concept of heat transfer coefficient; introduction to solidification, heat transfer, heat transfer in packed and fluidized beds; diffusion in solids, liquids and gases, Knudsen's diffusion, solution to diffusion problems in microelectronics, diffusion processing and homogenization of alloys, unsteady state mass transfer, concept of mass transfer coefficient, diffusional operations, staged operations, similarity criteria, introduction to model and pilot plant studies.

D. R. Poirier and G. H. Geiger, Transport Phenomena in Materials Processing, TMS, Warrendale, 1994.
N.J. Themelis, Transport and Chemical Rate Phenomena, Gordon Breach, New York, 1995.
R.I.L. Guthrie, Engineering in Process Metallurgy, Oxford Science Publications 1989.

MT261 PHASE DIAGRAMS (3-1-0) 4

Introduction: types of solid solutions, Hume Rothery rules, intermediate phases, binary isomorphous system; phase rule and lever rule, miscibility gaps, eutectic systems, phase diagrams with intermetallic compounds; monotectics, syntetic, eutectoid, peritectic and peritectoid reactions in binary systems and solidification behaviour of typical alloys in these systems; ternary phase diagrams: isothermal sections and isopleths; ternary systems involving binary reactions, ternary reaction, experimental techniques of phase diagram determination: Fe-Fe_3C phase diagram, introduction to steels and cast irons, other commercially important binary systems.

F.N.Rhines, Phase Diagrams in Metallurgy, McGraw Hill, N.Y.1956.
A. Prince, Alloy Phase Equilibria, Elsevier, Amsterdam, 1966. .
D.R.F West, Ternay equilibrium diagrams, 2nd Edn., Chapman and Hall, London, 1982.
A.H. Cottrell, Theoretical Structural Metallurgy, ELBS & Edward Arnold Ltd., London, 1964.
S.H.Avner, Introduction to Physical Metallurgy, McGraw Hill Book Co., NY., 1974
V.Raghavan, Materials Science & Engineering, 4th Edition, Prentice Hall of India, New Delhi, 1998.

MT262 PRINCIPLES OF EXTRACTIVE METALLURGY (3-1-0) 4

Sources of metals, unit processes, pyrometallurgical processes, halides in extractive metallurgy, refining processes, stoichiometric calculations, hydrometallurgical processes, recovery of metal values from leach solution, electrometallurgical processes, electrorefining and electrowinning, nickel: sources, extraction

from sulphide ores, carboxyl and electrolytic refining of nickel, extraction of nickel from oxide ores; copper: sources of copper, extraction from sulphide ores, refining, newer processes for copper extraction, hydrometallurgy of copper; zinc: sources, pyrometallurgical extraction, hydrometallurgical extraction, recovery of byproducts (cadmium); Imperial Smelting Process (ISP); lead: sources, extraction of lead, lead blast furnace, refining, modern developments in lead smelting, aluminium and magnesium extraction.

Ray, Sridhar and Abraham - Extraction of nonferrous metals, EW.P., New Delhi 1985.
R.D.Pehlke - Unit Processes of extractive metallurgy,1975, American Elsevier, New York
Sevmkov N. - Nonferrous Metallurgy, 1975, Mir, Moscow

MT263 X-RAY AND ELECTRON METALLOGRAPHY (3-1-0) 4

Stereographic projections, generation, absorption and detection of X-rays; intensity of diffracted beam, - Scherrer formula; Laue, rotating, powder methods, Debye-Scherrer technique, focusing technique, pin hole technique, diffractometer, crystal structure, indexing cubic and non-cubic patterns, precise lattice parameter, single crystal orientation; order-disorder transformation, grain size, texture, solvus line, chemical analysis: qualitative, quantitative; TEM Vs optical microscope, electron - matter interaction, image formation, specimen preparation, reciprocal lattice, indexing SAD patterns; SEM: modes, magnification, contrast, EPMA, FIM, STM, EDAX.

B D.Cullity, Elements of X-Ray Diffraction, Addison Wesley, 1977
R. E. Smallman & K. M.B. Ashbee, Modern Metallography, 1966

MT264 ELECTRONIC PROPERTIES OF MATERIALS (3-0-0) 3

Free electron theory, Fermi-Dirac statistics; density of energy states, Fermi energy, electrons in a periodic field of a crystal, Kronig Penny model, Brilluoin zone theory, classical theory of specific heat, thermal conductivity, photon conductivity, phonon conductivity, thermal expansion of metals, polymers and ceramics, resistivity variation, intrinsic & extrinsic semiconductors, semiconducting compounds, production of transistors, integrated circuits, zone refining and single crystal growth, dielectric materials, ferroelectric materials, superconductors, magnetic materials, applications, ferrites, zone theory, opacity, luminescence, translucency, laser modulation and amplification, LED, optical storage and optical computer, optical fibres; Lasers.

W. Hume Rothery and B R Coles, Atomic Theory for Students of Metallurgy, Institute of Materials, London, 1988.
G.V. Raynor, An Introduction to Electron Theory of Metals, Institute of Materials,London, 1988. Rolf E Hummel, Electronic Properties of Materials, 2nd Edition, Narosha Publishing House, 1995. Manas Chanda, Science of Engineering Materials, Vol. 3, Engineering Properties, McMillan, 1980. S. O. Pillai, Solid State Physics, New Age International Pvt. Ltd., India 2002.
B. M. Srivatsava and C. Srinivasan, Science of Engineering Materials New Age International Pvt. Ltd. 1999.
John Wulff et al. Electronic Properties, Vol. IV John Wiley and Sons, 1964.

MT265 INSTRUMENTAL METHODS OF ANALYSIS (3-0-0) 3

Spectroanalytical methods:Introduction, Beers law, selction rules, IR spectroscopy, UV-visible spectroscopy, atomic absorption spectrometryThermal Analysis: Thermogravimetry, differential thermal analysis, differential scanning calorimetry, temperature modulated DSC, dynamic mechanical thermal analysis,hyphenated techniques.Surface Characterization: X-ray photoelectron spectroscopy,scanning tunneling microscopy, atomic force microscopy, comparison between electron microscopy and scanning probe microscopy, sample preparation techniques for electron microscopy.

J.W.Robinson, E.M.S Frame, and G.M Frame II, Undergraduate Instrumental Analysis, 6th Edn., Marcel Dekker, 2005
D.A.Skoog, F.J.Holler and T.A Nieman, Principles of Instrumental Analysis, 4th Edn. Harcourt, 2001
J.D Menczel, R.B Prime, Thermal Analysis of Polymers , Wiley, 2009
G.H Michler, Electron Microscopy of Polymers, 1st ed., Springer – Verlag, 2008

MT 266 MEASUREMENTS AND CONTROL (3-0-0)3

Characteristics of measurement system, Sensors for various signals, Data converters and acquisition systems, Transfer of signals, Display and recording units; Measurement systems for Temperature, displacement, velocity, pressure, vacuum, fluid head, density, specific gravity, viscosity; Flow metering of compressible and incompressible fluids, dry materials; Measurement of force, torque, strain and vibrations; Measurement of current and voltage of different scales; Controls, their action; Implementation of control action; Use of PC assisted measurement and control of industrial activity.

Instrumentation for engineering measurements: J W Dally, W.F. Riley, K.G. McConnel, John Wiley Publ., 1995.

Industrial instrumentation-Al Sutko, J.D. Faulk, Cengage Learning, 1996.

Principles of Industrial Instrumentation- D. Patranabis, McGraw Hill, 1996.

Industrial Instrumentation, D.P. Eckman, John Wiley, 1951.

CH263 MINERAL DRESSING LAB (0-0-3)2

Experiments based on Mineral Dressing Theory

MT289 TESTING OF MATERIALS LAB (0-0-2) 1

Mechanical testing: impact test, transition temperature, study of fractures, hardness test - Brinell, Rockwell, Poldi, rebound hardness, microhardness testing, Hounsefield tensometer - cylindrical specimen, wire and sheet specimen; hardness testing, Instron testing machine, non-destructive testing: dye penetrant, magnetic particle test, radiograph, ultrasonic flaw detection, spark test, creep test.

MT320 PRODUCTION OF IRON AND FERRO ALLOYS (3-0-0)-3

History of Iron Making, Traditional Iron Making, Evolution of Blast Furnace, Iron Making in India. Iron ores of the world: Distribution; Indian iron ores, limestones and coking coal deposits, problems associated with Indian raw materials. Iron ore beneficiation and agglomeration, theory and practice of sintering and pelletising, Testing of burden materials, Blast Furnace Reactions, Thermodynamics and Kinetics, Fundamental studies, Blast furnace design, other auxiliary units, plant layout, recent developments in the design & operation of blast furnace, irregularities in operation and their remedies, Blast furnace refractories and instrumentation; Blast furnace slag & gas: importance, formation and use. Direct reduction methods, Details of some commercial processes like Rotary Kiln, Electric Pig Iron Furnace, HYL, Midrex, Fluilised Bed, Corex Process, Pyrophoricity of DRI, Ferroalloy Furnaces, Production of FeSi, FeMn and FeCr, Nitrided Ferroalloys.

Making, Shopping and Treating of Steel, 10th Edition, Edited by United States Steel, 1985; or 11th Edition Edited by the Association of Iron and Steel Engineers, 1999

Ghosh and A. Chatterjee, Ironmaking and Steelmaking: Theory and Practice, PHI Learning (P) Ltd., New Delhi, 2008

A. K. Biswas, Principle of Blast Furnace iron making, SBA Publications, Calcutta, 1981

Kurt Meyer, Pelletizing of Iron Ores Springer Verlag, Berlin, Heidelberg, Newyork, 1980

Strasburger, Brown, Stephenson & Dancy, B.F. Theory and Practice, Vol. I & II, 1969, Gordon & Reach, New York.

K.K.Prasad & H.S. Ray, Advances in Rotary Kiln Sponge Iron Plant

Robert L. Stephenson, Direct reduced iron – Technology & Economics of production and use, 1980, Iron & Steel Society of AMIE.

C.K.Gupta and A.K.Suri, Ferroalloys Technology in India, C.K. 1982, Milind Pub., New Delhi.

MT321 HEAT TREATMENT (3-1-0) 4

Nucleation and growth of austenite, pearlitic transformation, TTT diagrams, formation of martensite, annealing, normalizing, hardening and tempering, hardenability, heat treatment furnaces, austempering, martempering, ausforming; thermomechanical treatments; surface hardening of steels; effect of alloying elements on Fe-C diagram, structure and properties of steels; carbon and alloy tool steels, stainless steels, HSLA steels, maraging steels, dual phase steels; cast irons and their heat treatment, alloy cast irons, aluminium and its alloys.

R.E. Reed Hill, Physical Metallurgy Principles, Van Nostrand, East West Press, Newyork, New Delhi, 1973.
S.H.Avner, Introduction to Physical Metallurgy, McGraw Hill, 1974
D.S.Clark & W.R Varney, Physical Metallurgy for engineers, East West Press, New Delhi, 1962
T.V.Rajan and G.P.Sharma, Heat treatment (Principles & Techniques), Prentice Hall of India, 1995

MT322 PHYSICAL METALLURGY LAB (0-0-3) 2

Temperature measurement: calibration of thermocouples, use of optical and radiation pyrometer, metallography, study of metallurgical microscope, specimen preparation for metallography, etching technique, image analyzer, quantitative metallography, phase diagram by cooling curve, phase transformation study by dilatometer, diffusion studies of solidification structure.

MT323 EXTRACTIVE METALLURGY LAB (0-0-3) 2

Study of temperature distribution in a tubular furnace, oxidation and reduction roasting, pelletisation and sintering of iron ore fines, leaching studies, flotation of sulphide ores, oxidation of metals and alloys, cementation of copper, reducibility of ores, proximate analysis of coal, calorific value of solid fuels and gaseous fuels, flash and fire point determination using Cleveland's open cup and Pensky Marten's closed cup testers, determination of viscosity of liquids using Redwood viscometer and Brookfield viscometer, Orsat apparatus for gas analysis.

MT324 FATIGUE, FRACTURE AND CREEP (3-0-0) 3

Fatigue test: S-N curve, statistical nature, effect of mean stress, Goodman diagram, effect of surface finish, size, residual stress and temperature; effect of metallurgical variables, suppression of fatigue, fracture mechanics: type of fracture in metals, theoretical cohesion strength, Griffith theory, dislocation theory of fracture, plane strain fracture toughness and its evaluation, instrumented impact testing, comparison of fracture toughness of various materials, embrittlement of steels, creep and stress rupture, creep curve, stress rupture test, determination of fracture at higher temperature, presentation of engineering creep data, prediction of long time practices, theories of creep, effect of metallurgical variables.

Dieter G.E., Mechanical Metallurgy, McGraw Hill 1988 (SI Metric)
Thomas H. Courtney, Mech. Behaviour of Metals, McGraw Hill 1990

MT325 FUELS, FURNACES AND REFRACTORIES (3-0-0) 3

Classification of fuels, properties and tests, coal origins, carbonization and gasification. Other solid fuels. Liquid fuels – Types, testing, properties, Gaseous fuels, Introduction to nuclear fuels, Indian fuel deposits. Principles of theory of combustion, Combustion calculations, Waste heat utilization. Classification of furnaces – various methods including Glinkov's. Thermal characteristics of furnace operation. Heat Balance , classification, production, characteristics and uses of silica, alumina, alumino-silicate, chrome-magnesite, carbon & insulating refractories.

O.P.Gupta, Elements of fuels, furnaces and refractories, 2011
J. D. Gilchrist, Fuels, Furnaces and Refractories, 1977
V. A. Krivandin, B. L. Markov, Metallurgical Furnaces, 1980
A.O Surendranthan, an introduction to ceramics and refractoies, CRC Press NY 2015

MT360 PRODUCTION OF STEEL (3-0-0) 3

History of steel making, major steel making processes, principles of steel making, physical chemistry of steel making, deoxidation, tapping and teeming, slags in steel making. Basic oxygen steelmaking processes, top and bottom blown processes, combined blowing/Hybrid processes, LD/BOF, Q-BOP/ OBM, LD-AC/OLP, Kaldo Rotor; Requirement of Metallic Coolant, Energy Optimizing furnace (EOF), Inputs required in oxygen steel making, yields from metallic inputs. Alloy and stainless steel making, continuous steel making, steelmaking in electric arc furnace, steel making in induction furnace, conarc process. Secondary steel making processes, steel degassing processes, casting pit practice, continuous

casting of steel, moulds used for continuous casting; use of casting powder, Electromagnetic stirring, defects in continuous cast product.

Making, Shaping and Treating of Steel, 10th Edition, Edited by United States Steel, 1985; or 11th Edition, Edited by the Association of Iron and Steel Engineers, 1999

A. Ghosh and A. Chatterjee, Ironmaking and Steelmaking: Theory and Practice, PHI Learning (P) Ltd., New Delhi, 2008

A.K. Chakravarty, Steelmaking, PHI (P) Ltd., New Delhi, 2007

R. H. Tupkary, Modern Steel Making, 1982, Khanna Pub, New Delhi, 2008

C. Bodsworth, Physical Chemistry of Iron and Steelmaking

T. Rosenqvist, Principles of Extractive Metallurgy

R.G. Ward, An Introduction to the Physical Chemistry of Iron and Steel making, ELBS, London

MT361 CERAMICS ENGINEERING (3-0-0) 3

Ionic bond, Madelung constant, Pauling's rules, rocksalt, zinc blende, CsCl, flourite & antifluorite, perovskite, spinel, ilmenite, rutile and alumina structures, structure of silicates, glasses, defects in ceramics, ceramic microstructures, production of ceramic powders, forming processes, thermal treatment, calcination, sintering, glazing, tensile and compressive strengths, thermal stresses, creep, fatigue and fracture, toughening mechanisms.

Michel Baersoum, Fundamentals of ceramics, McGraw Hill, 1997

W.D.Kingery, Introduction to Ceramics, Wiley Interscience, 1976

D.W.Richerson,Modern Ceramic Engg., Marcel Decker Inc. New York and Basel, 1984

A. R. Chesti, Refractories, Manufacture, properties& applications

refractories.

A.O Surendranthan, an introduction to ceramics and refractoies, CRC Press NY 2015

MT362 POWDER METALLURGY & JOINING OF METALS (3-0-0) 3

Historical development of Powder Metallurgy, reasons for using powder metallurgy. Metal powder manufacturing techniques and powder characterization, Powder conditioning, Compaction and shaping, Sintering, Sintering atmospheres and equipments Secondary operations, testing, standards and quality controls, Apllications. Classification of welding methods; electrodes, gas welding, MMAW, TIG, MIG, EBW, LBW, plasma welding, SAW, ESW, thermit welding, arc characteristics & metal transfer, equipment for welding, friction welding, ultrasonic welding, explosive welding, induction pressure welding, electrical resistance welding, production of tubes, diffusion bonding, welding of plain carbon steels, alloy steels, stainless steels and tool steels, cast iron and wrought iron, copper, aluminium, magnesium, titanium & super alloys, welding of dissimilar metals, underwater welding, welding in vacuum, welding at low temperature (cryogenic welding), welding in space robotic welding, flame cutting, powder cutting, plasma cutting, laser cutting, electron beam cutting, fluxes, filler materials, solidification, micro & macrostructure, weldability and hardenablity, residual stresses, inspection and testing of welds, design of weldments, numerical problems in welding, use of computers in welding. Brazing & Soldering.

An introduction to powder Metallurgy, F. Thummler and R. Oberacker, The Institute of Materials, 1993

ASM Handbook, powder Metallury Technologies and Applications, vol.7, ASM International, 1998.

N. K. Srinivasan, Welding Technology, Khanna Publishers, 1997 Richard Little, Welding & Welding Technology, Tata McGraw Hill, 1998.

A.C.Davies, Welding, Cambridge University Press 1996

MT363 METAL FORMING (3-0-0) 3

Elasticity and plasticity, yield criterion theories of metal forming, hot, warm and cold working, ring compression test, temperature rise in deformation zone, superplasticity and explosive forming, force-stroke diagrams in forming, friction and lubrication in metal working processes, forging, CAD & CAM in forging, extrusion, mannesmann mill, rolling, drawing of rods, wire and tubes, dies, optimum die angle, bulk forming and sheet metal forming, deep drawing, redrawing, limiting draw ratio, forming limit

diagram, role of texture defects in sheet metal working, bending, shearing, rubber pad forming, stretch forming, electro hydraulic forming, electromagnetic forming and high energy rate forming, numerical problems and design aspects in forming.

G. E. Dieter and David Bacon, Mechanical Metallurgy, McGraw-Hill, 1988, 3 Edition (SI Metric)
Kurt Lange, Handbook of Metal Forming McGraw-Hill 1985.
W. F. Harsford & R M Caddell, Metal Forming Mechanics & Metallurgy, Prentice Hall, USA, 1993, Second Edition
B. Avitzur, Handbook of Metal Forming Processes, John Wiley, New York, 1983
Metals Handbook Vol. 14, Forming and Forging, ASM Metals Park, Ohio, 1988
T Altan, Metal Forming-Fundamentals and Applications, ASM Metals Park, Ohio, 1983.

MT364 AEROSPACE MATERIALS (3-0-0) 3

Carbon-carbon composites, production, properties and applications, intermetallic matrix composites, ablative composites based on polymers, ceramic matrix, metal matrix composites based on aluminium, magnesium, titanium and nickel based composites for engines, superalloys, aluminum alloys, magnesium alloys and titanium alloys, materials for plasma engines, intermetallic aluminides, ceramics and polymeric materials.

H. Buhl, Advanced Aerospace Materials, Springer Verlag, Berlin 1992.
Balram Gupta et.al Aerospace Materials Vol 1, 2, 3 ARDB, S. Chand& Co. 1996.

MT370 PROFESSIONAL PRACTICE 1

This course is a 1 credit course during 5^{th} and 6^{th} semesters. It consists of atleast 4 special lectures spread over entire year, arranged or suggested by the hosting department and approved by DUGC.

MT377 METALLOGRAPHY LAB (0-0-3) 2

Microstructure of cast iron, plain carbon steel, brasses, bronze and babbits, aluminum silicon alloys, aluminum copper alloys, image analysis, inclusion studies, macro-microstructure of forged, rolled, cast and welded structures.

MT378 CERAMICS AND POLYMERS LAB (0-0-2) 1

Ceramics: thermal spalling resistance, tensile properties of ceramics, specific gravity of ceramics, coefficient of thermal conductivity, specific heat, porosity and bulk density, preparation of glazed tiles and their property determination, thermal conductivity measurement, polymers: molecular weight and identification using chromatography, melt flow index, viscosity using viscometer, glass transition temperature determination, molecular weight-viscometric/end group analysis method, softening point determination by Vicat softening point apparatus, water permeability, water absorption, density determination, refractive index of liquid polymer, estimation of free phenol and formaldehyde in phenol formaldehyde resin.

MT379 HEAT TREATMENT LAB (0-0-3) 2

Full annealing, normalizing, hardening and tempering of plain carbon steels, Jominy end quench test, pack carburizing, precipitation hardening, diffusion studies, recrystallisation and grain growth, heat treatment of high speed steel and stainless steels.

MT420 FOUNDRY TECHNOLOGY (3-0-0) 3

Patterns, sand moulds, moulding processes, special casting process, evaluation and characterization of moulding materials, cores and core materials, mould production, core production, sand compaction, foundry machines, moulding equipments, foundry layouts, mechanization & automation, different types of foundries, solidification, growth structures in pure metals, applications of constitutional super cooling to castings, cast structures, gases & inclusions in castings, segregation, defects related to solidification, design of risers, runner systems and design of runners, elements of casting designs, foundry metallurgy of cast irons, production of S.G. iron and malleable iron, classification of gray cast iron, inoculation practice,

ADI, steel foundry practice, melting practice, cupola, induction melting, melting of aluminum and copper alloys.

J. Campbell, Castings, Butterworth, 1991, London
Heine and Rosenthal, Principles of Metal Casting, 1955, McGraw Hill, NY.
W. C. Winegard, Solidification of Metals, Institute of Metals 1964.

MT421 CORROSION ENGINEERING (3-0-0) 3

Definition of corrosion, corrosion damage, classification of corrosion, electrochemical aspects, electrochemical reactions, mixed potential theory, polarisation, passivity, environmental effects, effect of oxygen and oxidisers, effect of temperature, effects of corrosive concentration, effect of galvanic coupling using mixed potential theory, corrosion testing, standard expressions for corrosion rate, galvanic corrosion, erosion corrosion, crevice corrosion, intergranular corrosion, pitting, stress corrosion. Tafel and linear polarisation, AC impedance, small-amplitude cyclic voltammetry. Paint tests, sea water tests. Interpretation of results, Corrosion prevention; materials selection, alteration of environment, design, cathodic and anodic protection, coatings, high-temperature corrosion and mechanisms and kinetics, high-temperature materials

Mars G. Fontana, Corrosion Engineering, McGraw-Hill Book Company, 1986
David Talbot and James Talbot, Corrosion Science and Technology, CRC Press, New York, 1998
Denny A. Jones, Principles and Prevention of Corrosion, Maxwell Matemillar 1992.

MT411 PHASE TRANSFORMATIONS (3-0-0) 3

Thermodynamic concepts, homogeneous and heterogeneous transformation, nucleation and growth, growth kinetics, Johnson-Mehl and Avrami models, precipitation hardening, modern theories of precipitation hardening, crystallography and morphology of precipitates, typical age hardening alloys, martensitic transformation, morphological features, crystallographic features, kinetic features, phenomenological theories of martensitic transformation, martensitic transformation in-Tl, Fe-Ni and Fe-C alloys, pearlitic transformation, order-disorder transformation, short range order, long range order, degree of order, experimental methods to study ordering, dependence of order parameter on temperature, change of property with ordering, recovery, recrystallisation and grain growth, secondary recrystallisation, anelasticity and internal friction, thermo-elastic effect, interstitial diffusion, Snoek effect, Kahn's torsion pendulum, relaxation time, measurement of damping capacity.

R.E.Reed-Hill and R. Abbaschian,Physical Metallurgy Principles, PWS Publishing Co., 1994.
V. Raghavan, Solid State Phase Transformations, Prentice Hall of India Pvt. Ltd, 1987.
D.A.Porter and KE.Easterling,Phase Transformation in Metals and Alloys, Chapman and Hall, 1992.

MT412 EXTRACTION OF NON-FERROUS METALS (3-0-0) 3

Silver: sources, extraction by cyanidation, refining; gold: sources, concentration methods, gold recovery, refining; chromium: occurrence, production; cadmium: sources, extraction, recovery from secondary sources; mercury: sources, extraction from cinnabar; uranium: ores, processing of uranium ores, solvent extraction, reduction, production in India; thorium - sources, extraction and its purification; beryllium: types of ore, production, zirconium: sources, extraction and its refining, separation of Zr and Hf, fabrication of zirconium, production of zirconium in India; titanium: sources, beneficiation methods of illmenite, production of titanium tetrachloride, the Kroll process; molybdenum: production of powder and ductile Mo; tungsten: ores, concentration methods, production of tungsten trioxide; production of tungsten powder and ductile tungsten; tin: types, smelting of tin concentrates, refining of tin.

H.S.Ray, A.Sridhar and K.P.Abraham, Extraction of Nonferrous Metals, 1985, EWP, New Delhi.
Sevryukov N., Nonferrous Metallurgy, 1975, Mir, Moscow.
W.H.Dennis - Metallurgy of the Non-Ferrous Metals, Ed.2, 1966, Pitman, London.

MT413 SECONDARY REFINING OF STEELS (3-0-0) 3

Introduction, unit processes in secondary steelmaking viz stirring, slag control, refractories and atmosphere control: ladle furnace method; ladle injection metallurgy, vacuum treatment of liquid steel:

prinicples, processes viz ladle, stream and circulation degassing methods, stainless steel making technology - VOD, AOD and CLII processes, remelting, refining processes - ESR and VAR processes.

R.H.Tupkary, Modern Steelmaking, Khanna Publishers, New Delhi, 1996
R.G.Ward, An Introduction to the Physical Chemistry of Iron and Steel making, ELBS, London, 1962
V.Kudrin, Steel Making, Mir Publication, Moscow, 1985

MT414 NON-DESTRUCTIVE TESTING (3-0-0) 3

Terms, definition, value of NDT, X -ray radiography: production of X -rays, absorption, scattering, X-ray film processing; industrial radiographic practice, micro-radiography, Gamma radiography: radioactivity, gamma ray sources; Industrial Computed Tomography: principles and applications; ultrasonics: types of waves, production of ultrasonic wave, techniques, thickness measurement, types of scanning, types of indication, welding inspection, tube inspection, test standards, determination of elastic constants; magnetic methods: magnetisation guides in application, limitation, standards; penetration methods: surface flaw detection, application.

McGonnangle, W.J., Nondestructive Testing, Gorden and Breach, New York, 2nd edn.
Baldev Raj, T. Jayakumar, M. Thavasimuthu, Nondestructive Testing, Narosa Publishing House, 1997

MT415 PROCESS PLANT MATERIALS (3-0-0) 3

Selection of process materials, fabrication, mechanical properties and strength of materials, effect of temperature on mechanical properties, testing and inspection of materials, properties and uses of ferrous metals, cast iron, plain carbon steels, thermal and electrical insulating materials, non ferrous metals and alloys, general properties and fields of application of non ferrous metals, plastics as materials of construction for chemical plant, corrosion resistance, uniform corrosion, galvanic corrosion, pitting, intergranular corrosion, effect of stress, erosion corrosion, high temperature oxidation, hydrogen embrittlement, selection for corrosion resistance, corrosion charts, design for corrosion resistance.

William F. Smith, Principles of Material Science and Engineering, McGraw Hill Book Co,1990
Vernon John, Engg Materials, 3rd Edition, Macmillan, 1992.
William D. Callister, Materials Science & Engg., 4th Edition, John Wiley, 1997.

MT416 ADVANCED ENGINEERING MATERIALS (3-0-0) 3

Metals for high temperature service, Ti and Zr alloys, Ni and Co based super alloys, rapid solidification, metallic glasses, production, properties and applications, liquid crystals: production, properties and applications, composite materials, mechanics of composite materials, dispersion strengthening, metal matrix composites, special steels, maraging steels, trip steels, patenting, interstitial free steels, smart materials, shape memory effect, principles, pseudoelasticity, applications, nano technology, nano materials.

R. E. Reed Hill & Reza Abbaschian, Physical Metallurgy Principles, 3rd Edition, 1994 PWS Publishers USA.
W. E. Smith Structure & Properties of Engineering Alloys McGraw Hill, 1993
F.L. Matthews & R. D. Rawlings, Composite Materials Engg. & Science, 1994 K.
K. Chawla, Composite Materials, 2nd Edition, Springer - Verlag 2001

MT418 NUCLEAR MATERIALS (3-0-0) 3

Structure of a nuclear power plant, requirements of reactor materials, fuel materials, plutonium uranium and thorium and their alloys & compounds, core materials: beryllium, graphite, control and shielding materials, magnesium & its alloys, aluminium & its alloys, zirconium & its alloys, austenitic stainless steel; materials for reactor vessel and other components, pearlitic steels, ferritic, chromium stainless steels, copper alloys, titanium and its alloys, coolants used in reactors: radiation embrittlement, corrosion of reactor materials, mechanical properties of materials.

V.Gerasimov & A. Monakhov, Nuclear Engineering Materials, Mir Publishers, Moskow, 1983.
D.S.Clark & W.R Varney, Physical Metallurgy for engineers, East West Press, New Delhi, 1987
C.M.Srivatsava & C.Srinivasan, Science of engineering Materials, 1997, New Age International.

MT419 FRACTURE OF ENGINEERING MATERIALS (3-0-0) 3

Failure and their causes - techniques of failure analysis, conventional design concepts, inadequacies of conventional design, mechanics of fracture, theoretical cohesive strength, Griffith theory of fracture, Irwin - Orowan modification, concepts of G and R, relation between G and rate of change of compliance, crack tip stress fields, stress intensity factors, relation between G and K, fracture toughness: determination of fracture toughness, ASTM standards; crack tip plasticity, plastic enclaves and their effect on energy release rate, concept of plastic zone criterion, R curve concept, J Integral, COD criterion, brittle and ductile fractures, fatigue crack growth and fracture mechanics, stress corrosion cracking, liquid metal embrittlement, hydrogen embrittlement, microscopic aspects of cleavage crack propagation, plastic relaxation at crack tip, nucleation of cleavage cracks by plastic deformation, crystallographic mechanism, initial growth and propagation, ductile - brittle transition; designing and testing for fracture resistance, principles of fracture safe design, testing procedure, designing steels for fracture resistance, improved toughness in ceramics, composites, case studies in failure analysis.

D. Broek,Elementary Engineering Fracture Mechanics, Marinus Nijhoff, Dordredet, 1986.

J.F.Knott, Fundamentals of Fracture Mechanics, Butterworths 1973.

S.Teteleman & A.J.McEvily, Fracture of Structural Materials, John Wiley and Sons, 1961.

MT423 METAL FINISHING LAB (0-0-3) 2

Cleaning base metal: (Steel specimens) buffing, brushing, polishing, degreasing, acid dip - water wash, common metal plating: Zn, Ni, Cd, Cr, Cu - acid baths, Zn, Cd, Cu - cyanide baths, post plating, drying, passivity, lacquering, phosphating, test on deposit: corrosion resistance test - by salt spray chamber, hardness, ductility by bending test, photo micrographs.

MT424 FOUNDRY TECHNOLOGY LAB (0-0-3) 2

Sand testing: moisture content, clay content, permeability, sieve analysis of base sand, strength properties of molding sand, shatter index, mold hardness; clay testing: gelling index, gelling time, pH measurement, acid demand value, design of casting: selection of parting line, design of patterns, full mold process, CO_2 molds, melting and pouring of aluminium alloy, defect analysis; computer aided designs.

MT449 MAJOR PROJECT - I (0-0-6) 3

MT471 COMPOSITE MATERIALS (3-0-0) 3

Reinforcements, whiskers, matrix materials, polymers, metals, ceramics, interfaces: wettability, crystallographic nature, interactions, types of bonding: processing, thermoset matrix composites, thermoplastic matrix composites, structure and properties, structural defects, mechanical properties applications, processing: liquid-state processes, solid state processes, properties, thermal characteristics, aging, fatigue and creep applications, electronic-grade MMCs, ceramic matrix composites: processing, infiltration, directed oxidation properties, toughness, thermal shock resistance, applications- cutting tool inserts, ceramic composite filters

Krishnan K. Chawla, Composite Materials, Springer, New York, 1998

Mallick, P.K, Composite Materials Technology: Process and Properties, Hanser, New York, 1990

D. Hull and T.W.Clyne, An Introduction to Composite Materials, Cambridge University Press, 1996

MT472 ADVANCED WELDING TECHNOLOGY (3-0-0) 3

Arc characteristics and metal transfer, arc temperature, coated electrodes, hardfacing electrodes, stainless steel, and cast iron electrodes, inconel electrode, special welding techniques: gas tungsten arc welding, developments in TIG welding, CO_2 welding, electroslag welding, plasma arc welding, electron beam welding, laser welding, ultrasonic welding, under water welding; weldability of steel, welding of low alloy steels, welding of stainless steel, welding of C.I., welding of dissimilar metals, weld test, solidification of weldments, heat treatment of welds, stresses in weldments, weld defects, design of weldments, fracture and failure of welds, welding equipments.

Richard L. Little, Welding and Welding Technology, Tata McGraw Hill, 2004

V. Tsegelsky, The Electric Welder, Mir Publishers, Moscow, 1968
J.F.Lancaster, Metallurgy of welding, Allen & Unwin, London, 1980

MT473 SURFACE ENGINEERING (3-0-0) 3

Current status of surface engineering, fundamentals of electrode position, electroless plating, metalliding, hard anodizing, carburizing, nitriding, carbonitriding, flame hardening, induction hardening, thermal evaporation, sputter coating, ion plating electron-beam surface treatments, electron-beam hardening, laser hardening, ion implantation, hardfacing processes: shielded metal arc welding, gas tungsten arc welding, gas metal arc welding, flux cored arc welding, submerged arc welding, plasma arc welding, oxyacetylene welding, furnace fusing, thermal spray processes.

Kenneth G.Budinsk, Surface.Engineering for Wear Resistance, Prentice Hall, New Jersey, 1988
P.K.Datta & lS.Gray, Surface Engineering, Vol. I, II, & III, Royal Society of Chemistry; 1993 J.S.Burnell-Grayand, P.K.Datta, Surface Engineering Casebook- Solutions to Corrosion and Wear- related Failures, Woodhead Pub., 1996

MT474 MODELLING AND SIMULATION IN MATERIALS PROCESSES (3-0-0) 3

Introduction to modeling, simulation models, Casting process: modeling of heat transfer, direct heat conduction modeling, one-dimensional and multidimensional inverse modeling, fluid flow and heat transfer model, thermodynamics of solidification, metal/mold interfacial heat transfer, deformation and stresses in castings, thermo-mechanical modeling in casting, determination of heat transfer coefficient and air gap width in permanent mould castings, continuous casting and DC casting process, Welding process: weld heat -source models, thermal analysis with-microstructure, transient fluid flow, residual stresses in welds, Heat treatment: metal quenchant, interfacial heat transfer, diffusion model, microstructure model, carburization model, quench crack simulation, creep simulation, Modeling of rolling, forming and extrusion processes, Artificial Neural Net works in materials processing, Phase-field modeling and Monte-Carlo simulations, introduction to commercially available softwares - Solid Cast, FIowCast, OptiCast,.Deform HT, ProCast, MagmaSoft, Design of experiments and factorial designs.

Modeling in Welding, Hot Powder Forming and Casting (Eds. L. Koarlsson), ASM, MaterialsPark,OH, 1997.
Szekely,J.,Evans, J.E.and Brimacombe, J.K., The Mathematical and Physical Modelling of Primary Metal processing Operations, Wiley, 1988.
Numerical Recipes: The Art of Scientific Computing, Cambridge Univ. Press, N.Y., 1988.
D.R. Poirier and G.H. Geiger: Transport Phenomena in Materials Processing, TMS, warrendale 1994.
R.I. L. Guthrie: Engineering in Process Metallurgy, Oxford Science Publications (1989)

MT475 SCIENCE & TECHNOLOGY OF NANOMATERIALS (3-0-0)3

Introduction: Difinitions, Classifiation, Fundamental principles, Fullerences, nanoparticles, nanoclusters, nanowires, nanotubes, nanolayers, nanopores, supramolecules.

Synthesis: Top-down and bottom-up approaches, Plasma arcing , Chemical vapor deposition, Electro-deposition, Sol-gel synthesis, High energy ball milling, Nanolithography , Self assembly , Langmuir-Blodgett films, Electrospinning.

Characterization: Particle size and surface area determination, IR and Raman Spectroscopy, X-ray photoelectron spectroscopy, scanning tunneling Microscopy, Atomic force microscopy

Properties : Size dependence of properties, such as Electrical, Physical, Optical, Chemical.

Applications:Nanomachines and nanodevices, nanocomposites, Impact of nanomaterials in the areas of materials manufacturing, health care, data storage, clean energy, etc .

Society and nanotechnology: Challenges and fears, Impact on health and environment.

D. L. Schodek, P. Ferreira and M. F. Ashby, Nanomaterials, Nanotechnologies and Design, Butterworth-Heinemann, Oxford, 2009.

M. Wilson, K. Kannangara, G. Smith, M. Simmons and B. Raguse, Nanotechnology: basic science and emerging technologies, CRC press, Boca Raton, 2002.

C. P. Poole, Jr., and F. J. Owens, Introduction to Nanotechnology, Wiley-Interscience, New Jersey, 2003.

MT 476 ADVANCED MICROSCOPIC TECHNIQUES (3-0-0) 3

SEM-Review of electron optics, Electron specimen interactions, image formation and interpretation, High resolution imaging, WDS and EDS, Quantitative x-ray analysis, compositional mapping, Sample preparation for inorganic, organic, hydrated and biological materials.

TEM-Review of electron optics, reciprocal space and electron diffraction, sample preparation, diffraction from crystals and small volumes, diffraction patterns and their indexing, Kikuchi diffraction, CBED, Amplitude contrast and phase contrast, Thickness and bending effects, defects and their visualisation, High resolution TEM, Quantitative analysis using TEM.Concept of EELS, STEM, XPS, Auger microscopy, SIMS, etc.

Scanning electron microscopy and X-ray analysis: J.I Goldstein et al. Plenum press, (Second or higher ed), 1992

Transmission electron microscopy: D.B. Williams & C B Carter, Springer, 2009

Electron microscopy- S. Amelincky et al. VCH publ., 1997.

MT477 SMART MATERIALS AND SENSORS (3-0-0) 3

Inorganic: solid electrolyte sensor, oxygen sensors, hydrogen sensors, sulfur and sulfur containing gas sensors, humidity sensors, gas sensitive resistors, surface acoustic wave sensors, catalytic gas detectors, semi conductor junction devices, organic: semi conductor gas sensors, surface Plasmon resonance sensors, mass-sensitive sensors optical chemical sensors, electro chemical sensors, future prospects, automotive sensors: ceramic sensors, silicon sensors, chemical sensors for hostile environments, Piezoelectric sensors, actuator materials, micromechanics, chiral materials, conducting and chiral polymers, electrochromic materials, liquid crystals, molecular level smart materials, bio materials, composites, ceramics processing and fabrication, interface science, optical fibers, optical mirrors, smart skins for drag and turbulence control, other applications in aerospace / hydrospace structures, transportation vehicles, manufacturing equipment.

J. of Smart, Materials and Structures, Back volumes, Institute of Physics, Polishing Bristol, U.K.

L.Dai, Intelligent Macromolecules for Smart Devices, Springer, 2002.

MT478 METAL PROCESSING LAB (0-0-2) 1

Powder Metallurgy: powder production, powder characterization, sieve analysis, optical microscopy, particle microstructure, flow rate, apparent density; powder compaction: determination of compressibility curve, porosity determination, specimen preparation for tensile test, sintering of green compacts, tests for sintered properties: shrinkage/growth, sintered density, porosity, tensile strength, hardness using Hounsefleld tensometer, microstructure; welding: welded specimens by shielded metal arc welding, oxy fuel gas welding, TIG welding and MIG welding, testing and examination of welded specimens - Rockewell hardness, tensile strength (transverse and reduced section), yield strength (transverse and reduced section), nickbreak test, microstructures of weld zone, heat affected zone and parent metal, deposition efficiency in shielded metal arc welding, welder qualification tests.

MT499 MAJOR PROJECT - II (0-0-9) 5

MT422 PRACTICAL TRAINING 2

This course is a 2 credit course. A student may complete the training before the beginning of 7^{th} semester (or as stipulated by DUGC) and register for it in 7^{th} Semester. The duration and the details shall be decided by the faculty advisor, with approval from DUGC.

MT480 SEMINAR (0-0-2) 1

This course is a 1 credit course to be completed during 7^{th} / 8^{th} semester. The student will make presentations on topics of academic interest.

Department of Chemistry

CY110 CHEMISTRY (3-0-0) 3

Electrochemical Cells: Nernst equation, electrochemical series, types of electrodes, Polarization, Decomposition potential, Overvoltage, factors effecting electroplating, Electroless plating – PCB preparation. Corrosion: Types, Theory and factors affecting, Corrosion control, Galvanic series, Measurement of corrosion rate. Water Technology: Hardness of water, Boiler troubles, Internal and external treatments, Desalination. Energy: Fuels, Classification, Calorific value and its determination, Coal and its analysis, Petroleum, Catalytic cracking, Diesel and petrol knocking, Reforming of gasoline, Synthetic petrol, Power alcohol, Biodiesel, Hydrogen as a source of energy.High Polymers: Addition, Condensation and Coordination polymerization, Copolymerisation, Molecular weights and their determinations, Methods of polymerization, T_g & T_m and factors affecting them, Teflon, PMMA, UF; Elastomers - Compounding, SBR and Silicone rubbers, Conducting, biodegradable, Liquid crystal polymers. Semiconductor Chemistry: Preparation of pure semiconductors, Doping techniques. Chemistry of Nano-materials - Nano-carbons, ZnO, TiO_2.

B. R. Puri, Sharma, L. R. and Madan S Pathania, Principles of Physical Chemistry, Vishal Publishing Co., 41st Edn. 2004.

Jain, P. C. and Monika Jain, Engineering Chemistry, Dhanpat Rai & Sons, Delhi, Revised 14th Edn. 2004.

Kuriacose, J. C. and Rajaram, J., Engineering Chemistry, Volume I/II, Tata McGraw-Hill Publishing Co. Ltd. New Delhi, 2000.

Gowariker et al., Polymer Science and Technology, Prentice Hall of India Pvt. Ltd., New Delhi, 2004.

Rao, C. N. R., Chemistry of Nanomaterials, Volume I and II, Wiley Publication, 2004.

CY111 CHEMISTRY LABORATORY (0-0-3) 2

Volumetric estimations involving metal-ion, redox, self and precipitation type indicators - analysis of water (hardness and chlorides), ores (haematite and pyrolusite); Instrumental methods of analysis - potentiometry, colorimetry, conductometry, refractometry and viscometry; Analysis of polymers, metals, alloys, and related engineering materials.

Engineering Chemistry Lab Manual, written by Faculty, Dept of Chemistry, NITK, Surathkal.

Furnis et al (ed.), Pearson, Vogel's Text book of 'Quantitative Chemical Analysis', Pearson, 2006

CY201 PRINCIPLES OF ORGANIC SYNTHESIS (3–0–0) 3

Formation of C-C bonds: Organometallic reagents. Formation of aliphatic C-C bonds, base/acid catalyzed. Formation of aliphatic C-N bonds. Pericyclic reactions. Electrophilic aromatic substitution. Nucleophilic aromatic substitution reactions. Molecular rearrangements: Rearrangement to electron-deficient carbon, nitrogen and oxygen. Aromatic rearrangements. Photochemical reactions. Free radical reactions. Oxidation & reduction reactons.

J. March, Advanced Organic Chemistry, 4th edition, McGraw Hill, New York, 1994.

R. O. C. Norman and J. M. Coxon, Principles of Organic Synthesis, Blackie Academic and Professional, Glasgow, NewYork, 1993.

CY202 UNIT PROCESSES IN ORGANIC SYNTHESIS (3-0- 0) 3

Bond breaking, bond forming, synchronous bond breakage and formation, intramolecular migration, electron transfer, types of reactions. Electrophilic addition. Nucleophilic addition. Radical addition. Elimination. Substitution reactions. Intramolecular rearrangements and intermolecular rearrangements. Oxidation and reduction reactions.

P. H. Gorggins, Unit Processes in Organic Synthesis, 5th edition, McGraw-Hill, 1958.

J. March, Advanced Organic Chemistry, 3rd edition, McGraw Hill, New York, 1985.

CY205 ORGANIC CHEMISTRY (3-0- 0) 3

Strengths of organic acids and bases. Reagents of synthetic importance. Active methylene compounds. Named organic reactions. Stereochemistry: Optical activity, asymmetric carbon, enantiomers, diastereomers, configurations and conformations. Carbohydrate chemistry: Monosaccharides, disaccharides and polysaccharides. Benzene: Structure, aromaticity, Huckel's rule, electrophilic substitution and orientation effect. Heterocyclic compounds – five and six membered. Dyes: Colour and constitution, applications, some important dyes of different types.

I. L. Finar, Organic Chemistry, Volume 1: The Fundamental Principles, VI edition, ELBS, 1989.
M. K. Jain and S. C. Sharma, Organic Chemistry, Shoban Lal Chand. & Co., 2000.

CY206 INSTRUMENTAL ANALYSIS LAB. (0–0–4) 2

Potentiometry. Conductometry. Colorimetry. Refractometry. Gravimetric estimations. Demonstration of UV and IR spectrophotometer.

A. I.Vogel, A Text Book of Quantitative Inorganic Analysis Including Elementary Instrumental Analysis, ELBS, Longman Group, UK, III Edition, 1962.
J. Basset, R. C. Denny, CH Jaffery and J. Mendhan, Vogel's Text Book of Quantitative Inorganic Analysis, including elementary analysis, ELBS, London, 5th Edition, 1989.

CY251 POLYMER SCIENCE AND TECHNOLOGY (3–0–0) 3

Basic concepts, configuration and conformation. Thermoplastic and thermosetting polymers. Condensation, addition, coordination, ring opening, metathesis polymerization. Copolymerization. Chemical reactions of polymers and polymer degradation. Analysis and testing of polymers. Rheology and mechanical properties: Kinetic theory of rubber elasticity, glassy state and glass transition, mechanical properties, crystalline melting point, property requirements and polymer utilization. Polymer processing: Molding, extrusion, calendaring, casting, coating, thermoforming, foaming. Multipolymer systems and composites. Additives and Compounding. Fibre and elastomer technology.

F. W. Billmeyer, Textbook of Polymer Science, Wiley Interscience Publication, 1984.
Joel R. Fried, Polymer Science and Technology, Prentice Hall, NJ, 1995.

CY252 INDUSTRIAL CHEMISTRY (3–0–0) 3

Synthetic Organic Chemical Industries: Petrochemicals – Chemicals from C_1, C_2, C_3, C_4 compounds. Chemicals from aromatics. Phenols and alkyl phenols. Isomerization, Dehydrogenation. Oxidation of paraffins. Pesticides and Pharmaceutical Industries. Polymer Industries: PE, PVC, Teflon, SBR, NBR, Neoprene, Silicone rubber, Nylon, Dacron. Starch and cellulose derivatives. Natural product industries: Oils. Soaps. Detergents. Essential oils. Paints and Varnishes. Food industries. Fermentation industries. Explosives and propellants.

E. Riegel, Industrial Chemistry, 6th ed,, J. A. End, Reinhold Publishing Corp., 1962.
R. N. Shreve, Chemical Process Industries, 3rd ed., McGraw-Hill Book, 1967.

CY300 INSTRUMENTAL METHODS OF ANALYSIS (3–0–0) 3

Electroanalytical methods: Conductometric and potentiometric titrations. Polarography - theory and applications. Amperometric titrations. Spectroanalytical methods: Molecular spectra. Beer-Lambert's law and its deviations. IR, UV-visible spectroscopy – theory, instrumentation and applications. Atomic absorption spectroscopy: Thermal methods of analysis: TGA, DTA, DTG, instrumentation and applications. Solvent extraction: Principle, distribution coefficient, separation factor and efficiency, applications. Chromatography: Paper chromatography, TLC, GC,
HPLC – theory, instrumentation, experimental techniques and applications.

Willard, Merritt, Dean & Settle, Instrumental methods of analysis, 6th Ed., CBS Publishers & Distributors, Delhi, 1986.

G. Chatwal and S. Anand, Instrumental Methods of Chemical Analysis, S. D. Himalaya Publishing House, 2000.

CY301 ADVANCED ELECTRO CHEMISTRY (3–0–0) 3

Introduction. Theory of electrolytic conductance: Debye-Huckel theory, transport numbers, Faradays laws and ionic velocities, Hittorff's methods of determination. Ion-solvent interaction: Born model and expression for free energy of ion-solvent interaction, Fick's law of diffusion. Polarography: DME, Ilkovic equation, half-wave potential, theory and applications. Special polarographic techniques: Chronopotentiometry, Chronoamperometry, Linear sweep voltammetry, like Cyclic voltammetry, Oscillographic polarography, Amperometry.

Samuel Glasstone, An Introduction to Electrochemsitry, Affiliated East West Press, New Delhi.

J. O. M. Bockris and A. K. N. Reddy, Modern Electrochemistry, Plenum Press, 1970.

CY302 BIOCHEMISTRY (3–0– 0) 3

Chemistry of biomolecules: Basic aspects of carbohydrates, lipids, amino acids, proteins, nucleic acids and biological membranes. Enzymes: structure, functions, mechanism of action, specificity, kinetic considerations, multi enzyme systems and immobilized enzymes. Bioenergetics: ETS, ATP. Biochemistry of nutrition and digestion: Metabolism of carbohydrates, lipids, and amino acids. Interrelation. Flow of genetic information: Genetic code, replication of DNA, transcription and translation. Biosynthesis of proteins.

Albert L. Lehninger, David L. Nelson, Michael M. Cox, Principles of Biochemistry, CBS Publishers and Distributors, Indian Edition, 1993.

Eric E. Conn. Paul K. Stumpf, George Breening & H. Roy Doi, Outlines of Biochemistry, 5th Edition, John Wiley and Sons, 1987.

CY305 INORGANIC AND PHYSICAL CHEMISTRY (3–0– 0) 3

Chemistry of d-block elements: Periodic properties. Coordination compounds: Theory of complexes, VBT, CFT, LFT and MOT for complexes, optical and magnetic properties, factors affecting stability and isomerism. Surface Chemistry: Adsorption -Freundlich and Langmuir's adsorption isotherms, applications. Catalysis – Types, mechanism, kinetics of surface reactions, autocatalysis. Solutions: Raoult's law, ideal and nonideal solutions, Gibb's-Dichem Margules equation, thermodynamics of ideal solution, binary solutions, fractional distillation, Henry's law.

J.E. Huhey, Inorganic Chemistry – Principles of structure and reactivity, Harper & Row Publishers, Singapore.

B. R. Puri, L. R. Sharma and M. S. Pathania, Principles of Physical Chemistry, S. N. Chand & Co., Jalandhar, 31st edition, 1990.

CY350 ENVIRONMENTAL CHEMISTRY (3–0– 0) 3

Introduction, Environmental segments, Natural cycles of the environment. Atmosphere: Composition, structure, evolution. Chemical and photochemical reactions. Green house effect, Ozone hole, E1-Ninophenomena. Water resources: Complexation in natural waste water. Microbially mediated acquatic chemical reactions. Composition of Lithosphere, water, air, and inorganic components in soil. Nitrogen pathways. Wastes and pollutants in soils. Toxic chemicals in the environment. Air and water pollution, causes, bad effects and control.

C. N. Sawyer, P. L. McCarty and G. F. Parkin, Chemistry for Environmental Engineering, McGraw-Hill, 1990.

A. K. De, Environmental Chemistry, New Age Intl. (Pvt)Ltd., 1998.

CY351 PHYSICAL CHEMISTRY OF POLYMERS (3-0- 0) 3

Kinetics of free radical, ionic, coordination and step polymerization, copolymerization. Phase transitions: Kinetics and mechanism of polymer crystallization.Amorphous polymers. Thermodynamics and theory of

polymer solutions, Flory Huggins theory, UCST and LCST. Determination of molecular weights of polymers –osmometry, viscometry, light scattering methods. Rheological properties of solutions and polymer melt. Liquid crystalline state. Electrical properties of polymers. Elastomers – theory of elasticity.

A. Tager, Physical Chemistry of Polymers, MIR Publishers, 1972.

Anil Kumar and Santhosh K Gupta, Fundamental of Polymer Science and Engineering, Tata Mcgraw-Hill Publishing Co. Ltd. India, New Delhi, 1970.

CY352 PHARMACEUTICAL CHEMISTRY (3–0–0) 3

Introduction, classification and nomenclature of drugs. Theories of drug action and factors affecting. Assay of drugs and their metabolism. Sedatives. Analgesics. Antihistamins. Antiinflammetory, Antimalarial. Antifungal, Antiviral agents. Steroids. Sulphonamides and Antibiotics. Organic pharmaceutical aids. Chemical models and mimics for enzymes, receptors, carbohydrate and other bioactive molecules, catalytic antibodies. Molecular modeling, conformational analysis, qualitative and quantitative structure and activity relationships.

Ed. Manfred E. Wulf, Burger's Medicinal Chemistry and Drug Discovery, Vol. 1-6, John Wiley, New York, 1995.

G. R. Chatwal, Pharmaceutical Chemistry, Vol. I and II, Himalaya Publishing House, Delhi, 2nd edition, 1997.

CY353 FOOD CHEMISTRY (3–0–0) 3

Components of food: Carbohydrates, Fats and oils, Proteins, Vitamins, Minerals. Food Microbiology: Interaction between microorganism and food, mechanism of spoilage, food borne illness and fermentation. Cryogenic food preservation. Water activity and storage stability. Drying techniques. Food and food by-products processing industries. Food preservatives, Fragrances. Flavours. Food additives. Interesterification of oils. Food packing, materials, and methods. Analysis of food proteins, fats, carbohydrates, vitamins, etc.

T. P. Coultate, Food – The Chemistry of Components, RSC, 2002; C. W. Hall, Encyclopedia of Food Engineering, AVI publishing, 1971. M. Karel and D. B. Lund, Principles of Food Science, M. Decker, New York, 1975.

CY355 TECHNICAL ANALYSIS LAB. (0–0–3) 2

Experiments involving electrochemistry, kinetics, chromatography, spectroscopy, thermo-chemistry – Potentiometry, Conductometry, Refractometry, Polarimetry, Viscometry, Polarography and Chromatography

D.P.Shoemaker & C. W .Garland, Experiments in Physical Chemistry, McGrawHill 1962

F. Daniels, J. W. Williams, P. Bender, R. A. Alberty and C. D. Cornwell, Experimental Physical Chemistry, McGraw-Hill, New York, 1962.

CY356 CERAMIC AND POLYMER LAB. (0–0–3) 2

Experiments involving evaluation of thermal, electrical, mechanical, optical, and miscellaneous properties of polymeric materials and ceramics. Chemical analysis of polymers and ceramics. Molecular weights, MFI, Strength, hardness, Specific gravity, Particle size distribution, T_g and Softening point, Refractive index, Haze, Water permeability, Spalling resistance, Refractoriness, Chemical characterization, Identification of plastics.

Cyus Klings, Physics & Chemistry of Ceramics & Refractories, Ed. Breach Science,1963

Vishu Shah, Hand Book of Plastic Testing Technology, Wiley-Interscience Publication, New York, 1984.

CY400 BIO-INORGANIC CHEMISTRY (3–0–0) 3

Introduction. Transport and storage of metal ions. Elements of Biology and Medicine. Energy of biological systems. Hydrogen Biochemistry. The functional value of the chemical elements in Biological systems. Sodium, Potassium, Chlorine, Magnesium, Cadmium, Zinc, Iron, Manganese, Copper, Cobalt,

Molybdenum, Vanadium, Tungsten, Phosphorus, Sulphur, Sele-nium, Halogen. Metal based drugs. Environmental application and toxic effects of metal ions.

M. Satake & Y. Mido, Bioinorganic Chemistry, Discovery Publ House, New Delhi, 2001.

H. Siegel & T. G. Spiro, Metalions of Biological Systems, Mercel-Dekker,1980 to present.

CY401 CHEMISTRY OF DYES AND PIGMENTS (3–0–0) 3

Dyes – Color and constitution, chromophores and auxochromes, insulating groups, Classification based on chemical constitution and applications. Preparation, properties and uses of dye intermediates and dyes. Photochemistry –Principles, photo induced reactions, oxidation, reduction, isomerization, addition reactions. Woodward Hoffmann's rule. Inks – composition, pigments, vehicles, ink additives, Ink manufacture, printing methods and screen printing. Inorganic pigments.

The chemistry of synthetic dyes and pigments, American Chemical Society Monograph Series, Hagger Pub. Co., 1970.

K. Venkataraman, The chemistry of synthetic dyes, Academic Press Inc. 1980.

D. E. Bissett, Printing Ink Technology, Northwood, 1978.

CY402 SURFACE MODIFICATIONS (3–0–0) 3

Introduction. Plating and Coating Processes: Basic principles and methods. Hardfacing. Anodising. PVD. CVD. Thermal spraying. Electrodeposition. Electroless deposition. Hot dipping. Composite coating. Surface alloying. Alloy plating. Thermal processes: Laser -hardening, glazing, surface alloying, cladding. Electron beam hardening. Implantation and special processes: Ion implantation. CMM coating. Applications and recent developments.

T. S. Sudarshan (Ed), Surface Modification Technologies, Marcel Dekker, 1989.

V. Vasantasree and P. S. Sidky, Metallic and Ceramic Coatings, Longman Scientific and Technical, UK, 1989.

CY403 WATER AND SOIL CHEMISTRY (3–0–0) 3

Water resources. Physical chemistry of sea water. Complexation in natural water and waste water. Microbialy mediated redox reactions. Ion-water interactions. Water Pollution: Water pollutants, waste water treatment, trace elements in water, water quality parameters and standards, sampling, preservation and monitoring techniques. Soil-ion interactions and chemical cycles. Solute-solute interactions. Weathering and soil development processes. Soil organic matter. Soil and microorganism. Cation, anion and molecular interactions in soils. Acid soils and salt affected soils. Soil pollution. Radiation effect.

K. H. Tan, Principles of Soil Chemistry, Dekker, New York, 1982.

R. A. Home, Chemistry of our Environment, Plennum, New York, 1975.

CY450 ADVANCED INSTRUMENTAL METHODS OF ANALYSIS (3–0–0) 3

Magnetic Resonance Spectroscopy: NMR. FTNMR. ESR. NQR. X-ray methods: Absorption, Fluorescence, Diffraction. Radiochemical methods. Electron and Ion Spectroscopy. XPS. UPS. EIS. AES. ISS. Photoacoustic Spectroscopy. Basic principles and applications.

G. W. Ewing, Instrumental Methods of Analysis, McGraw-Hill, New Delhi, 1990.

Willard, Merritt, Dean & Settle, Instrumental methods of analysis, 6th Ed., CBS Publishers & Distributors, Delhi, 1986.

CY451 CHEMISTRY OF NATURAL PRODUCTS (3–0–0) 3

Alkaloids: Introduction, occurrence, functions, nomenclature, classification, isolation, properties, determination of molecular structure. Terpenoids: occurrence, isolation, classification, general characteristics, structural features, isoprene rule. Steroids and hormones. Natural Pigments. Biosynthesis of some natural products: Biosynthesis of carbohydrates and photosynthesis, biosynthesis of terpenoids and steroids.

I. L. Finar, Organic Chemistry, Volume 1: The Fundamental Principles, and Volume 2, Stereochemistry and Chemistry of Natural Products, VI Edition, ELBS, 1989.
O..P. Agarwal, Chemistry of organic natural products, (volumes 1 & 2), Goel Publishing house, Meerut, 1993.

CY452 BIO-PHYSICAL CHEMISTRY (3–0–0) 3

Molecular species in solution. Energy and equilibria. Enzyme and Enzymatic catalysis – Kinetics and mechanism of enzymatic reactions and their specificity. Bioenergetics – Notions of TD, application to chemical reactions in living organisms. ATP energetics.

C. R. Canter and P. R. Sehimmell, Biophysical Chemistry, Freeman, Sanfransisco.
G. M. Barrow, Physical Chemistry of Life Sciences, McGraw-Hill, New Delhi.

CY453 POLYMERS FOR ELECTRONICS AND OPTOELECTRONICS (3-0-0) 3

Conducting polymers. Electrodepositable resists: Electrodepositable resins formulation. Thermotropic liquid crystal polymers: fundamentals, processing. Photoconductive polymers: charge-carrier generation, charge injection, charge transport and charge trapping; electron-transporting and bipolar polymers. Polymers for optical data storage: Principles of optical storage, polymers in recording layer. Nonlinear materials: NLO properties, NLO effects, wave guide devices and through-plane modulators.

A. B. Kaiser (Eds. H. Kuzmany, M. Mehring and S. Roth), Electronic properties of conjugated polymers – basic models and applications, Springer-Verlag, Berlin, 1989.
Ed. J. A. Chilton & M. T. Goosy, Special polymers for electronics and optoelectronics, Chapman & Hall, 1995.

Department of Physics

PH110 PHYSICS (3-1-0) 4

Special theory of relativity. Elements of Quantum Mechanics: Particle properties of waves : Photoelectric effect and Compton effect. Wavelike properties of particles : de Broglie hypothesis, Davisson-Germer experiment, Wave packets, phase and group velocities, uncertainty principle. Schrodinger equations – time dependent and independent and application of Schrodinger's equation to case of free particle, particle in an infinite potential well, particle in a finite potential well, tunneling with examples (only qualitative treatment). Physics of Solids : Ohms' law, Classical free electron theory. Statistical Physics: MB, FD and BE Distribution functions Semiconductors. Electrical conductivity in intrinsic and extrinsic semiconductors, effect of temperature on electrical conductivity, Hall effect, experimental determination of carrier concentration. PN junction. Dielectric Materials : Electrical polarization mechanisms, expression for dielectric constant of monatomic gases, qualitative ideas for dielectric constant of polyatomic molecules, internal fields in solids, dielectric constant of elemental solids (Claussius Mosotti equation only). Ferroelectric and Piezoelectric materials, Piezoelectric effect.

Arthur Beiser, Concepts of Modern Physics (Sixth Edition) Tata Mc Graw – Hill Publication, 1998
Kenneth.S. Krane, Modern Physics (Second Edition) Wiley International Edition,1998
A. J. Dekkar, Electrical Engineering Materials, Prentice Hall of India Ltd., 1990.
B.G Streetman, Solid State Electronic Devices, Prentice Hall of India Ltd.,1981.

PH111 PHYSICS LABORATORY (0-0-2) 1

Experiments on Zener Diode Characteristics, Series Resonance, Helmhotz Resonator, Photoelectric effect, Transistor Characteristics, Hall Effect. Air-Wedge/Newton's Ring Experiment.

Arthur Beiser, Concepts of Modern Physics (Sixth Edition) Tata McGraw Hill publication, New Delhi (1998)
Kenneth.S. Krane, Modern Physics (Second Edition) Wiley International Edition (1998).
Practical Work book for I/II sem B.Tech Students
Chauhan & Singh, A Text book of Advanced Practical Physics

PH201 QUANTUM MECHANICS FOR ENGINEERS (3-0-0) 3

Basic principles of quantum mechanics. Probabilities and probability amplitudes. Linear vector spaces. Bra and ket vectors. Completeness, orthonormality, basis sets. Change of basis. Eigenstates and eigenvalues. Position and momentum representations. Wavefunctions, probability densities, probability current. Schrodinger equation. Expectation values. Generalized uncertainty relation. One dimensional potential problems Particle in a box. Potential barriers. Tunnelling. Linear harmonic oscillator: wavefunction approach and operator approach. Motion in three dimensions. Central potential problem. Orbital angular momentum operators. Spherical harmonics. Eigenvalues of orbital angular momentum operators. The hydrogen atom and its energy eigenvalues. Charged particle in a uniform constant magnetic field, energy eigenvalues and eigenfunctions. Schrodinger and Heisenberg pictures Heisenberg equation of motion. Interaction picture.

V.K. Thankappan, Quantum Mechanics. Wiley Eastern (1985)
A.K Ghatak, S.Lokanathan Quantum Mechanics Theory and applications, Macmillan India Ltd (1984)

PH202 BASIC NUCLEAR PHYSICS (3-0-0) 3

Atomic structure-Bohr atom model, energy levels and atomic spectra, correspondence principle.
Nuclear structure- Composition and properties of nucleus, stability and binding energy, liquid drop model and shell model, meson theory of nuclear forces. Nuclear transformations-Radioactivity, α, β and γ decay, nuclear reactions, fission and fusion, nuclear reactors. Elementary particles-interaction of charged particles, Leptons, Hadrons, Quarks, fundamental interactions.

Concepts of Modern Physics – Arthur Beiser (Ch. 4, 11, 12 and 13), Tata McGraw Hill Pub.

PH203 CLASSICAL MECHANICS (3-0-0) 3

Review of Newton's Laws of motion; Conservation principles; Harmonic oscillator; Two particle systems; Time dependent forces; Variational Principle; Lagrange's equation of motion; Charged particles in EM fields; Planetry motion; Rutherford scattering; Small Oscillations; CO_2 Molecule; Beads on a stretched string; Euler's equation for rotating bodies; Hamilton's equations of motion; Charged particle dynamics; Virial theorem; Hamilton – Jacobi equations; Action angle variables; Poisson Brackets; Integral invariants; Stretched elastic string; Energy momentum relations.

PH251 ELECTRICAL PROPERTIES OF MATERIALS (3-0-0) 3

Conductivity of metals-classical free electron theory and quantum free electron theory, Semiconductors - pure and impure semiconductors, band model, conductivity and its temperature dependence, Hall effect, Direct and indirect bandgap semiconductors, p-n junction and diode equation, Dielectric properties of insulators-dielectric behaviour in static and alternating fields, dipolar relaxation and dielectric loss, ferroelectric and piezoelectric materials.

Electrical Engineering Materials – A.J.Dekkar, Prentice Hall India Publ.
Solid state Electronic Devices – B.G. Streetman, Prentice Hall India Publ.

PH252 ELECTROMAGNETIC THEORY (3-0-0) 3

Electrostatics: electrostatic field, Divergence and Curl of electric field, Electric potential. Laplace's equation in three dimetians. Separation of variables. Electrosatic field in Matter Electric displacement. Magnetostatic , Lorentz force law, Biot-Savarts law, Divergence and Curl of Magnetic field, Ampere's law. Electromotive force Faraday's law, Maxwell's Equations plane wave solutions of Maxwell's equations, Poynting vector, wave propagation through a boundary, reflection, refraction, absorption and skin depth.

D. Griffiths, Introduction to Electrodynamics, 2nd ed., Prentice Hall, 1989.
William H. Hayt . Engineering Electromagnetics, 5th ed. Tata Mc Graw Hill Publishing Company Ltd.

PH301 SEMICONDUCTOR PHYSICS (3-0-0) 3

Review of atomic structure and statistical mechanics : Schrodinger wave equation- Particle in a periodic potential well. Crystalline and amorphous; inorganic and organic; elemental and compound semiconductors. Band models. Impurities and Defects. Bulk and thin film techniques. E-k diagrams, effective mass and mobility. Temperature dependence. Degenerate and non-degenerate semiconductors. Fermi level and impurity levels, Equilibrium and non-equilibrium characteristics. Carrier transport phenomena, Electrical conductivity, Temperature dependence, Conductivity in a magnetic field, Hall effect. Thermal Conductivity, Thermoelectric power. Optical and dielectric properties. Refractive index, Transmission and reflection, Debye length, photoconductivity and photovoltaic effect. Oxidation methods, Diffusion, Ion implantation, Metallization and Etching processes. Measurement techniques: Resistivity, energy gap, thermal conductivity, film thickness and carrier mobility.

Donald A Neamen, Semiconductor Physics and Devices-Basic Principles.
Helmut F Wolf, Semiconductors.
M.S. Thyagi, Semiconductor Materials and Devices.
S Mahajan and K S Sree Harsha, Principles of Growth and Processing of Semiconductors.
S.M. Sze, Physics of Semiconductor Devices.
David H Ferray, Electronic materials and Devices.
Jasprit Singh, Semiconductor Optoelectronics and Technology

PH302 X-RAYS AND CRYSTALLOGRAPHY (3-0-0) 3

Crystal structure- crystal systems, Bravais lattices, Miller indices, inter planar spacing, atomic packing factor, structure of NaCI, CsCI, ZnS and diamond. Symmetry considerations- rotational and translational symmetries, angle between planes and directions, reciprocal lattice and its relation to diffraction patterns.

X-rays- production, continuous and characteristic x-rays, properties, diffraction of x-rays, Bragg's law, Bragg's spectrometer, Laue diffraction technique and Debye-Scherrer method of structure analysis.
Elements of x-ray crystallography – L. V. Azaroff, McGraw Hill publ.

PH351 PHYSICS OF SEMICONDUCTOR DEVICES (3-0-0) 3

The PN Junction Diode, basic device technology, current-voltage characteristics, Transient behaviour and noise. Heterojunction. Bipolar transistor- static characteristics. Microwave and power transistor and related devices. Metal-semiconductor contacts. Energy band relation, transport processes, barrier height JFET and MESFET basic device characteristics. Microwave performance. MOSFET-Device structure and characteristics, Nonvolatile memory devices Tunnel Diode, IMPATT and related transit-time diodes. Transferred-electron devices- Gunn effect. Principles of photonic devices: LEDs, semiconductor lasers; photodetectors – photodiodes and APDs. Solar Cells.
S.M. Sze, Physics of Semiconductor Devices.
Donald A Neamen, Semiconductor Physics and Devices-Basic Principles
M.S. Thyagi, Semiconductor Materials and Devices.
David H Ferray, Electronic materials and Devices
Jasprit Singh, Semiconductor Optoelectronics and Technology.

PH352 VACUUM TECHNOLOGY AND THIN FILMS (3-0-0) 3

Production of vacuum – mechanical pumps, sorption pumps and cryogenic pumps. Measurement of vacuum – thermal conductivity gauges and ionization gauges. Behaviour of gases at low pressure. Thin films – methods of preparation – vacuum evaporation, sputtering, electro-deposition, chemical deposition. Properties of thin films. Measurement of film thickness, Applications of thin films.
Handbook of thin film technology – L. I. Maissel and R. Glang, McGraw Hill publ.

PH401 OPTOELECTRONICS (3-0-0) 3

Light Propagation in material media. Maxwell's equations, Wave equations for dielectrics, Polarization., reflection and refraction of light from dielectric interfaces, total internal reflection, light propagation in uniaxial crystals. Nonlinear polarizability of material media, second harmonic generation of light, optical rectification, frequency conversion by 3-wave mixing, parametric oscillators. Optical wave guides- Types of optical wave guides, guided modes in planar wave guides, guided modes in step-index optical fibers. Attenuation and dispersion. Directional couplers, prism couplers. Mach-Zehnder interferometer, Optical sources and detectors - light absorption and emission in semiconductors, structure, working and operating characteristics of heterojunction LED's laser diodes, photodiodse and APDs. Noise in photodiodse, Electro-optic effect, longitudinal and transeverse electro-optic modulators. Acousto-optic effect, Bragg diffraction. Photonic switching and optical bistability.
B E Saleh & M.C. Teich, Fundamentals of Photonics.
J Wilson & J F B Hawkes, Optoelectronics - an Introduction
Jasprit Singh, Optoelectronics: An introduction to Materials & Devices
P. Bhattacharya, Semiconductor Optoelectronics.

PH402 EXPERIMENTAL TECHNIQUES FOR CHARACTERISATION OF MATERIALS (3-0-0) 3

Metallographic Techniques – Optical Microscopy, Image Analysis. Diffraction Method. Crystallographic Texture, Measurement and Analysis, X-ray diffraction residual stress techniques, Neutron Diffraction. Resonance Methods. Electron Optical Methods, Spectroscopy and Other Methods, Atomic Absorption, X-ray, Infrared, Raman Spectroscopy, Atom Probe Micro-analysis.
Edington J.W., Practical Electron Microscopy, Vol-01.
A. Goldstein, Introduction to Scanning Electron Microscopy
B.D. Cullity, Metals Handbook, Vol. 10.Elements of X-ray diffraction.

Department of Mathematical and Computational Sciences

MA110 ENGINEERING MATHEMATICS - I (3-0-0) 3

Sequences, Infinite Series and various tests, Power Series, Extreme value, Mean value theorem etc, Taylor and Maclaurin series, functions of several variables, Partial differentiation, Taylors Theorem for a function of two variables, Extreme values of functions of two variables.

Thomas and Finney : Calculus and analytical Geometry, Pearson 2010(9 or 11 edition)
Courant and John :introduction to calculus and analysis Vol. I & II
Piskunov : Differential and Integral calculus, Vol 1& 2
Erwin Kreyszig : Advanced Engineering mathematics, Wiley Eastern, 2011

MA111 ENGINEERING MATHEMATICS - II (3-0-0) 3

Areas between curves, volumes by slicing, volumes of solids-disks and washers, cylindrical shells, areas of surface of revolution. Multiple integrals- evaluation by change of order of integration and change of variables-Jacobians-polar, spherical and cylindrical co-ordinates application to areas and volumes. Directional derivates, gradient. Line, Surface and volume integrals, Green's theorem (with proof), Divergence and Stokes' theorems(Statements only), ordinary differential equations.

Thomas and Finney : Calculus and analytical Geometry, Pearson 2010(9 or 11 edition)
Courant and John :introduction to calculus and analysis Vol. I & II
Piskunov : Differential and Integral calculus, Vol 1& 2
Erwin Kreyszig : Advanced Engineering mathematics, Wiley Eastern, 2011

MA200 Mathematical Foundations of Information Technology (4-0-0) 4

Graph Theory: Undirected and Directed Graphs, Bipartite Graphs, Connectivity, Traversability, Trees, Spanning Trees, Rooted and Binary Trees, Algorithms – Kruskal's and Prim's Minimal Spanning Tree, Dijkstra's Algorithm, Max-flow Min-cut theorem. Algorithms for computing maximum s-t flows in graphs.

Probability Theory: Non-deterministic models, Finite Probability Space and related concepts, Conditional Probability, Independent and mutually exclusive events, Bayes' Theorem, Random Variables – One and Two dimensional, Mathematical Expectation, Variance, Correlation, Distributions – Binomial, Poisson, Normal, Gamma, Chi-Square

Sampling Theory: Purpose and nature of sampling, its uses and applications, Mean, Median, Mode, Variance, Standard Deviation.

Hypothesis Testing: Formulation of hypotheses – null and alternate hypothesis, Parametric and non-parametric tests and their applicability, Criteria for acceptance of hypothesis, Level of Significance, t-test, z-test and Chi-Square Tests with simple applications.

D. B. West, Introduction to Graph Theory, Pearson Education, ISBN 0-13-014400-2
R. Diestel, Graph Theory, Electronic Edition 2000, Springer Verlag, NY.
P. L. Meyer, Introductory Probability and Statistical Applications, Oxford & IBH Pub. Co.
S. M. Ross, Introduction to Probability and Statistics for Engineers and Scientists, John Wiley.
R. V. Hogg and A. T. Craig, Introduction to Mathematical Statistics, Macmillan NY, 4th Edition.

MA201 CONCRETE MATHEMATICS (3-0-0) 3 PREREQ: *Exposure to* MA110

Sums and Recurrences, General methods. Finite and infinite calculus. Floors and ceilings. Applications. Number Theory, Congruences, Chinese Remainder Theorem. Generating functions. Solving recurrences. Special generating functions, Convolutions and Exponential generating functions.

Graham, Knuth, and Patashnik, Concrete Mathematics: A foundation for Computer Science, Pearson , 2000.

MA202 DISCRETE MATHEMATICAL STRUCTURES

(3-0-0) 3 PREREQ: *Exposure to* MA110

Propositional and Predicate Calculus, Normal forms, Applications to Artificial Intelligence, Lattice Theory and Boolean Algebra, Introduction to Graph Theory – Trees, Planarity, Connectivity, Traversability, Shortest Path and Spanning Tree Algorithms. Groups: Cosets, Normal Subgroups, Permutation groups, Burnside's Theorem and simple applications.

J.P.Tremblay & R. Manohar, Discrete Math. Structures with app. to Comp.Sc., McGraw Hill.
C.L.Liu, Elements of Discrete Mathematics, McGraw Hill.
Kenneth Rosen, Discrete Mathematics and its applications, TMH

MA203 GRAPH THEORY (3-0-0) 3 PREREQ: *Exposure to* MA110

Graphs: Introduction to Graphs, Digraphs, Bigraphs, Connectivity, Trees, Traversability, Coverings and Independence, Planarity, Coloring, Representation of Graphs, Enumeration of graphs.

F. Harary, Graph Theory, Narosa Pub.
Narsingh Deo, Graph Theory with app. to Engg. & Comp.Sc., PHI
D.B.West, Introduction to Graph Theory, PHI.

MA204 LINEAR ALGEBRA AND MATRICES (3-0-0) 3 PREREQ: *Exposure to* MA110

Linear dependence, Basis, vector spaces and subspaces. Expansion by Co-factors, Inverse by Partitioning, Linear Transformations, Rank and echelon matrices. Homogeneous linear equations, Basic solutions, similarity, symmetric matrices, diagonalization, Quadratic forms, Rotation of Co-ordinates, Orthogonal transformations.

G. Hadley, Linear Algebra, Narosa 2000.
G. Strang, Linear Algebra and its applications, Thomson Learning, 2003.

MA205 MODERN COMPUTER ALGEBRA (3-0-0) 3 PREREQ: *Exposure to* MA110

Fundamental algorithms. Extended Euclidean algorithm and applications. Modular inverses, repeated squaring continued fractions and Diophantine approximation. Modular algorithms and interpolation Chinese Remainder Algorithm. Resultant and GCD computation. Applications to decoding BCH codes.

Joachim Von Zur Gathen and Jurgen Gerhard,Modern Computer Algebra, Cambridge University Press, 1999.

MA206 NUMBER THEORY AND CRYPTOGRAPHY (3-0-0) 3 PREREQ: *Exposure to* MA110

Elementary Number Theory. Congruences, applications to Factoring. Finite fields, Quadratic residues and reciprocity. Simple cryptosystems, public key cryptography, RSA, Discrete logs. Primality and Factoring, the rho method, Fermat factorization, continued fraction and Quadratic Sieve methods.

N. Kobltiz, A course in Number Theory and Cryptography, Springer, 1994.

MA207 NUMERICAL METHODS (3-0-0) 3 PREREQ: *Exposure to* MA110

Approximations and errors in computations. Interpolation and inverse interpolation. Numerical differentiation and numerical integration. Numerical solution of initial value problems in ordinary differential equations. Numerical solution of algebraic and transcendental equations. Solution of systems of equations by iterative methods. Eigen values and Eigen vectors. Difference equations. Linear and quadratic curve fitting using least square principle.

S. S. Sastry : Introductory methods for numerical analysis, Prentice Hall.
M. K. Jain, S. R. K. Iyengar and R. K. Jain : Numerical methods for Scientific and Engg. computations. Wiley Eastern.

MA208 PROBABILITY THEORY AND APPLICATIONS

(3-0-0) 3 PREREQ: *Exposure to* MA110

Introduction to probability, Sample space, Definitions of probability, Conditional probability, Bayes'

theorem, Random variables, pmf, pdf, cdf, Marginal and Conditional Distributions, Mean and Variance, Covariance and Correlation, Probability distributions: Bernoulli, binomial, Poisson, uniform, exponential, normal, Gamma and use of statistical tables.

P.L. Meyer, Introductory Probability and Statistical Applications, Oxford & IBH Publishing Co.
S.M. Ross, Introduction to Probability and Statistics for Engineers and Scientists, John Wiley.

MA209 THEORY OF COMPLEX VARIABLES (3-0-0) 3 PREREQ: *Exposure to* MA110.

Functions of complex variables. Cauchy Riemann equations. Properties of analytic functions. Conformal mapping. Line integrals in complex plane. Cauchy's theorems. Power series. Residues. Evaluation of standard real integrals using contour integration.

Erwin Kreyszig : Advanced Engg. Mathematics, Wiley Eastern.
Lars V. Ahlfors : Complex Analysis , Mc Graw Hill Book Co.

MA301 ADVANCED GRAPH THEORY (3-0-0) 3 PREREQ: *Exposure to* MA203

Representations of Graphs, Trees, Enumeration, Spanning Trees, Planar and Dual Graphs, Detection of planarity, Geometric and Combinatorial Duals, Covering and Independence, Coloring, Structure of k-chromatic graphs, Perfect graphs, properties.

D.B.West, Introduction to Graph Theory, PHI

MA302 DATA ANALYSIS, TIME SERIES ANALYSIS *AND* NON-PARAMETRIC METHODS (3-0-0) 3 PREREQ: *Exposure to* MA208

Data analysis: Correlation and Regression of data, simple linear regression, Time series analysis: definitions, characteristic movements, measurement of trend, secular trend, seasonal movements, cyclical movements. Non – parametric methods, Wald – Wolfowitz test, sign test, Mann – Whitney U test, signed rank test, Kolmogorov – Smirnov tests, Kruskal – Wallis test.

W.W. Hines and D.C. Montgomery, Probability and Statistics in Engineering and Management Science, John Wiley.
J. Medhi, Statistical Methods, Wiley Eastern.

MA303 INTEGRAL TRANSFORMS & APPLICATIONS (3–0–0) 3 PREREQ: *Exposure to* MA110

Laplace Transforms: solutions of boundary value problem using Laplace transforms, Applications of Laplace Transforms to the solutions of partial differential equations.

Fourier Transforms: Fourier sine and cosine transforms, Applications of Fourier Transforms to the solutions of ordinary differential equations and partial differential equations.

Hankel and Mellin and z – Transforms: solution of difference equations using z – transforms.
I.N. Sneddon; Integral Transforms.
P.P. Gupta; Integral Transforms, 1989, 2nd Edition, Meerut Publishers.

MA304 LINEAR PROGRAMMING AND APPLICATIONS (3–0–0) 3 PREREQ: *Exposure to* MA204

Linear programming theory of simplex method, Duality, Dual sensitivity analysis.

Integer linear programming, Transportation problem, assignment problem, solution by the Hungarian method, transshipment model. Game theory – 2 persons zero sum game

G. Hadley, Linear Programming, Narosa Publish, 1987.
Hamdy A.Taha, Opertions Research, Fifth edition, Mc Millan Publishing company, 1992.
Kanti Swarup, Gupta and Manmohan, Operations Research, Sultan Chand Publications, 1995,.

MA305 NETWORK OPTIMIZATION (3–0–0) 3 PREREQ: *Exposure to* MA203

Network Models, Minimal Spanning Tree, Shortest Route Problem (viewed as transshipment model), Matching and Covering Problems. Max-Flow Min-Cut Theorem, Capacitated Network Model and

Network Simplex Method. PERT and CPM, Resource analysis in Network Scheduling: LP formulation, Precedence Planning Updating, Resource Allocation and Scheduling.

C.H. Papadimitriou and K. Steiglitz, Combinatorial Optimization: Algorithms & Complexity, PHI
Hamdy Taha, Operations Research, McMillan

MA306 OPERATIONS RESEARCH (3–0–0) 3 PREREQ: *Exposure to* MA204

Introduction, Linear Programming, Duality Theory, Transportation and Assignment problem., Integer Programming: Branch and bound method for IPP, Dynamic Programming: Introduction to Non- linear programming.

G. Hadley, Linear Programming, Narosa Publishers, 1987.
Hamdy A. Taha, Operations Research, Fifth Edition Mc. Millan publishing company, 1992.
Fredericks Hiller and G.J. Leibermann, Operations Research, Holden Day Inc., 1974.

MA307 OPTIMIZATION TECHNIQUES AND STATISTICAL METHODS

(3-0-0) 3 PREREQ: *Exposure to* MA 208

Linear programming, simplex method, duality, transportation and assignment problems, Reliability, definitions, concept of hazard, bath-tub curve, system reliability for various configurations, data analysis: correlation and regression of data, simple linear regression, time series analysis: definitions, characteristic movements, measurement of trend, secular trend, seasonal movements, cyclical movements.

H.A. Taha, Operations Research, Prentice Hall India
J. Medhi, Statistical Methods, Wiley Eastern.

MA308 STATISTICAL ANALYSIS AND APPLICATIONS

(3–0–0) 3 PREREQ: *Exposure to* MA208

Sampling theory: random samples, statistic, sampling distribution, x^2 t and F distributions, central limit theorem, statistical inference, point estimation, unbiasedness, MLEs, interval estimation of mean and variances, hypothesis testing, types of errors, one – sided, two – sided tests, tests concerning means and variances, goodness of fit tests, data analysis: correlation and regression of data, simple linear regression.

P.L. Meyer, Introductory Probability and Statistical Applications, Oxford & IBH Publishing Co.
S.M. Ross, Introduction to Probability and Statistics for Engineers and Scientists, John Wiley.

MA401 COMPUTATIONL FLUID DYNAMICS (3–0–0) 3 PREREQ: *Exposure to* MA207

CFD applications in Engineering, Overview of CFD, Governing equations of fluid dynamics, Introduction to finite differences, Explicit and implicit approaches, Advances in CFD, Upwind schemes, High – resolution schemes.

Hanif Chaudhry, Open – channel Flow.
J.D. Anderson, Computational Fluid Dynamics.

MA402 FINITE ELEMENT METHODS (3–0–0) 3 PREREQ: *Exposure to* MA207

Introduction to calculus of variations, Approximate methods, Finite Elements, nodes classifications, approximate functions, Solution of Boundary value problems of second order differential equations, Finite element equations for the heat conduction equation, vibration equation, elliptic problems using Galerkine and Ritz methods.

M.K. Jain, Numerical Solution of Differential Equations, PHI Ltd.
A.R. Mitchell and R. Wait, Finite Element methods in partial Differential Equations, Edn. John Wiley, 1977.

MA403 MATHEMATICAL MODELING (3–0–0) 3 PREREQ: *Exposure to* MA110/ MA111

Introduction: Mathematical modeling through ordinary differential equations and systems of ordinary differential equations of first order, Mathematical modeling through difference equations, Modeling using partial differential equations, Mathematical modeling through graphs

J.N. Kapoor Mathematical Modeling, 1988, Wiley Eastern.
R. Aris, Mathematical Modeling Techniques 1978, Pitman.

MA404 NON – LINEAR OPTIMIZATION (3–0–0) 3 PREREQ: *Exposure to* MA304

Classical optimization techniques: Unconstrained optimization –constrained optimization, Quadratic Programming, Construction of Kuhn- Tucker conditions, Wolfe's method and Beale's method; separable programming, Geometric Programming: unconstrained and constrained geometric programming problems Dynamic Programming: Deterministic dynamic programming, probabilistic dynamic programming

Hamdy A.Taha, Operations Research, fifth edition, 1992, Mc Millan.
Fedrick S. Hillier, Gerald J. Libermann, Operations Research, 1974, Holden Day Inc.
Kanti Swarup, Gupta and Manmohan, Operations Research, 1995, Sultan Chand Publications.

MA405 RELIABILITY THEORY AND APPLICATIONS

(3-0-0) 3 PREREQ: *Exposure to* MA208

Reliability, concepts and definitions, causes of failure, concept of hazard, failure models, bath tub curve, MTTF, MTBF, system reliability for various configurations, reliability improvement, redundancy, reliability-cost trade – off, maintainability and availability concepts, system safety analysis, FTA, FMEA.

E.E. Lewis, Introduction to Reliability Engineering, John Wiley.
K S. Trivedi, Probability and Statistics with Reliability, Queuing and Computer Science Applications, PHI.

MA406 STATISTICAL DESIGN AND ANALYSIS OF EXPERIMENTS

(3-0-0) 3 PREREQ: *Exposure to* MA208

Sampling theory: random samples, statistics, sampling distributions, central limit theorem, statistical inference: point estimation, unbiased ness, interval estimation of means and variance, hypothesis testing, types of errors, one – sided, two – sided tests, tests concerning means and variances, goodness of fit tests, Analysis of variance of one – way, two – way classified data, experimental designs: CRD, RBD, LSD, factorial experiments

D.C. Montgomery, Design and Analysis of Experiments, John Wiley.
R.V. Hogg and A.T. Craig, Introduction to Mathematical Statistics, McMillan.

MA407 STASTICAL QUALITY CONTROL (3-0-0) 3 PREREQ: *Exposure to* MA208

Sampling theory: random samples, statistic sampling distributions, central limit theorem, concept of Quality, types of variations, process control and product control, control charts for variables and attributes, concept of acceptance sampling, by attributes, O.C., AQL, LTPD, AOQL, ATI etc, types of sampling plans, Reliability, definitions, concept of hazard, bath-tub curve, system reliability for various configurations.

E.L. Grant, Statistical Quality Control, Mc Graw Hill.
D C Montgomery, Introduction to Statistical Quality Control, John Wiley.

MA408 STOCHASTIC ANALYSIS AND APPLICATIONS

(3-0-0) 3 PREREQ: *Exposure to* MA208

Stochastic processes, basic concepts, classifications, Markov chains, C– K equations, ergodic chains, steady state behaviour, Poisson process, derivations, birth and death process. Queuing systems, basic concepts, M|M|1 and M|M|s queues, Reliability, definitions, concept of hazard, bath- tub curve, system reliability for various configurations.

J. Medhi, Stochastic Processes, New Age International Publishers.
K S. Trivedi, Probability and Statistics with Reliability, Queuing and Computer Science Applications, PHI.

Department of School of Management

HU110 PROFESSIONAL COMMUNICATION (3-0-0) 3

Organization Communication : Attempts to acquaint students with the process and requirements of Communication in organization. It includes the Objectives of Communcation, Channels of Communication, Barriers in Communication, Cross Cultural Communication.

Written Communication : Focuses on improving the Writing Skills. A Review of Grammar, Tranformation of Sentences; Reading Comprehension; Precis Writing; Skills to Express ideas through various kinds of Essays; Business Letters, Application Letters, Email and Internet; Report Writing, CVs/Resumes.

Oral Communication : Aims at improving the Oral Communication Skills, Public Speaking Skills, Features of Effctive Speech-Verbal and Non-Verbal, Presentation Skills, Audio and Visual Aids; Group Discussion, Mock Interviews and Meetings.

Meenakshi Raman and Sangeeta Sharma, Technical Communication; Principles and Practice, Oxford University Press, 2011.

Mattukutty M. Monippally, Business Comunication Strategies, Tata Mcgraw-Hill Publishing Co. Ltd, 2001.

Shirley Taylor, Model Businees Letters, E-Mails and other Business Docuements (VI Edition), Pearson Education /Prentice Hall, 2012.

Michael Swan, Practical English Usage, Oxford University Press, 2005.

HU111 PROFESSIONAL ETHICS AND HUMAN VALUES (1-0-0) 1

Professional Ethics:Engineering as a Profession, Aim of Engineering, Responsibilities of Engineers, Rights of Engineers, Impediments to Responsibilties , Honesty, Integrity, Reliablity, Risk, Safety and Liability, Global Issues.

Personal Ethics: Value of Self, others and Society, Compliance with Law, Social Norms, Service to Community, Engineer's Responsibilities to Economically Deprived Peoples and Environment, Corruption, Indian and Western Culture, Simple Living and High Thinking, Science and Spirituality.

Charles E. Harris et al., Engineering Ethics,Cengage Learning, 2009

Govindarajan M, Engineering Ethics:PHI 2004.

Fleddermann, Charles D. Engineering Ethics:Pearson Education 2004

Baura Gail D. Engineering Ethics:Academic Press 2006

HU300 ENGINEERING ECONOMICS (3-0-0) 3

Basic economic concepts and problems –Theories of demand, supply and Market equilibrium. Elasticity, demand forecasting, cost terminology. Methods of economic analysis in Engineering– Bases for Comparison of alternatives. Selection among alternatives, replacement analysis - Evaluating public activities - depreciation accounting - Estimating economic elements.

Samuelson P.A. and Nordhans W.D., Economics, 15th ed., McGraw Hill, New York, 1995.

Thuesen G.J. and Fabrycky W.J.Engineering Economy, 9th ed., Prentice Hall of India, New Delhi 2002.

Sullivan W.G., Bontadelli J.A. and Wicks E.M., Engineering Economy, 11th ed., Pearson Education Asia, New Delhi 2001

Leland Blank P.E and Anthony Tarquin P.E.,Engineering Economy, 4th ed., McGraw Hill, Singapore, 1998.

HU302 PRINCIPLES OF MANAGEMENT (3-0-0) 3

Management: science, Theory and Practice. Management and Society: External Environment, Social Responsibility and Ethics. Global, Comparative and Quality Management. Planning: Principles, Process, MBO, Strategies, Policies, Planning Premises, Strategic Management, Decision Making. Organizing: Nature, Entrepreneuring, Reengineering, Organisation Structure, Departmentation, Line Staff Authority, Power, Empowerment, Decentralisation, Effective Organizing and Organization Culture, Staffing: Human

Resource Management, Recruitment and Selection, Performance Appraisal. Career Strategy, Managing Change and Organization Development, Leading: Human Factors and Motivation, Leadership, Committees, Teams, Group Decision Making and Communication. Controlling: System and Process of Controlling, Controlled Techniques, Productivity, Operations Management and Total Quality Management.

Harold Koontz and Heinz Weihrich, Essentials of Management, Tata Mc Graw Hill, 2012.
Heinz Weihrich, Mark V, Cannice and Harold Koontz, Management, Tata Mc Graw Hill, 2012.
Evans, Pucik, Barsoux, The Global Challenge, Tata Mc Graw Hill, 2010

HU400 MANAGERIAL ECONOMICS (3-0-0) 3

Introduction, Business Objectives and business decisions, Entrepreneurship Demand Analysis and forecasting, Market Structure, Perfect and imperfect competition, Production Theory, Pricing and Profit Management, Decision techniques and capital budgeting, National Income, Money System, Case Studies.

Mote V.L. Paul Samuel and Gupta G.S., Managerial Economics, McGraw-Hill,
Craig Petersen H. and Cris Lewis W., Managerial Economics Prentice-Hall of India, 2000.
Dwivedy D. N., Managerial economics, Vikas Publishing House, 1995.

HU401 MARKETING MANAGEMENT (3-0-0) 3

Concept of Market, Marketing Management Process, Marketing Environment, Organisational Market and Buyer behaviour, Market Segmentation, targeting and positioning, Planning marketing tactics, Product, price distribution and promotion decisions, Concepts of Market Research, Product Development and Re-Engineering- E-commerce, Marketing Information System and Research, Customer Relations Management (CRM), Business Process Outsourcing (BPO), Case Studies.

P. Kotler: Marketing Management, Prentice Hall of India, 1984.
D.J. Dalrymple and L.J. Parsons, Marketing Management, John Wiley, 1982.
R. W. Haas: Industrial Marketing Management, Petrocelli / Charter, 1974.

HU402 MANAGEMENT INFORMATION SYSTEM (3-0-0) 3

Functions of Management, Organization Environment, Organization Structure, System Concepts, Stakeholders Analysis, Framework for Information Systems (IS), Decision making process, Problem solving Process, Definition of Management Information System (MIS), EIS, DSS, Artificial Intelligence, Expert Systems, Computer hardware, Hardware standards, Computer Software File and Database Management, Communication Systems, Common Network components, Distributed systems, Design of MIS, Applications of MIS to business, Case studies.

Kenneth C. Laudon and Jane Price Laudon, Management Information Systems, Managing the Digital firm, Pearson Education, Asia, 2002.
GordonB.Davis, Management Information System:Conceptual Foundations, Structure &Development, McGrawHill, 1974.
Joyce J Elam, Case series for Management Information Systems', Simon and Schuster Custom Publishing, 1996.

HU403 HUMAN RESOURCE MANAGEMENT (3-0-0) 3

HRM functions, role each plays in the overall HRM process. HRM integration into strategic planning of the organizations - Key issues facing global HRM today and their impact on its successful practice in the 21st Century, including the critical issues of technology, workplace stability, workforce diversity or pluralism, globalization and ethics - Job analysis, job design, and job description in relation to job evaluation, job enrichment, and job enlargement. Effective recruiting plan and selection process for hiring qualified employees. Design of training program focused on needs assessment and evaluation of the effectiveness of training in relation to job performance – Development of practical system for evaluating employee performance and managing performance on a continuous basis - Analysis and evaluation of various approaches to compensation and benefit programs designed to meet the needs of the organizations and its employees - Integrating the human resource and organizations development aspects of the overall

HRM responsibility. Evaluation of relationship between labour unions and management in relation to collective bargaining and contract negotiation. Approaches to respecting employees rights and protecting the health and safety of workers. Concept of planned, managed organizational change through proven organization development techniques.

Drucker, Peter F. (1992). Managing for the Future: The 1990s and Beyond. Truman Talley Books/Dutton. New York.Gary Dessler, Human Resource Management.

HU450 FINANCIAL MANAGEMENT (3-0-0) 3

Financial Management, Accounting concepts. Financial statement analysis. Financial Investment Analysis. Financial Decisions.Managing Components of Working Capital. Capital Investment & Financing Decisions .

Pandey I.M., Financial Management, Vikas Publishing House, 1999.

Prasanna Chandra, Financial Management, Tata McGraw Hill Publication, 1998.

Kuchhal S.C., Financial Management an Analytical & Conceptual Approach, Chaitanya Publ. house, Allahabad 15th Ed, 2001.

HU451 ENTREPRENEURS' DEVELOPMENT AND MANAGEMENT (3-0-0) 3

Introduction to entrepreneurship. Target markets, identifying business opportunities, and consumer behavior. Pricing strategy. Promotional strategies and advertising - Creativity, inventions, and prototype development - Risk management - Record keeping and budgeting. Developing a business plan, business borrowing, banking, legal issues and taxes. Selling and customer service - Business ethics and financial management - Business etiquette and personal image - Presentation skills, Case Studies.

Mariotti, Steve. The Young Entrepreneur's Guide to Starting and Running a Business., New York NY: Random House, Inc.2000.

Entrepreneurship Development and Management – EDI Ahmedabad.

Vasant Desai, Dynamics of Entrepreneurial Development and Management, Himalaya Publishing House. 2000.

HU452 INTELLECTUAL PROPERTY RIGHTS (3-0-0) 3

Introduction to intellectual property. Copyright. Related Rights. Trademarks. Geographical indications(GI). Industrial Design. Patents. International Registration Systems. Unfair Competition. Protecting New Varieties Plants. Overall Summary. Glossary

WIPO handbook/ notes

Wadehra B.L, Law Relating to Patents, Trademarks,Copyright Designs & Geographical Indications, Universal Law Pub., 2000.

Sullivan & Patrick H.,Profiting from Intellectual Capital: extracting value from Innovation, John Wily, 1998.

Correa, Carlos M., Intellectual Property Rights, the WTO and Developing Countries: the TRIPS Agreement and Policy Options, Zed books, New York, 2000.

HU453 YOGA SUTRAS OF PATANJALI (3-0-0) 3

Bases and relevance of yoga. Elements of Sankhya philosophy. Some ancient texts on yoga. Sri Krishna and Gita. Patanjali and his Yoga Darshana. Commentaries (Bhashyas) and notes (Teekas) to Yoga aphorisms. The nature of asthanga yoga or raja yoga. A brief introduction to Patanjala Yoga Sutras on contemplation, yogic practices, attainments and the nature of freedom and realization.

Maharsi Patanjali,Yoga Sutram (shattikopetham) Edited with notes by Nyayacharya, Kavyathirtha Pandit Dhundhiraj Sastri, Chaukhamba Sanskrit Sansthan, Varanasi.

Bangali Baba, The Yogasutra of Patanjali with the commentary of Vyasa.

Swami Vivekananda, Raja Yoga.

HU454 INTRODUCTION TO INDIAN CLASSICAL MUSIC (3-0-0) 3

A brief history of Indian classical music and musical culture – Specificities of Indian classical music- Hindustani and Carnatic traditions of music – Musical notes in Indian classical music – Raga and Tala – Difference between Indian and Western musical traditions – vocal and instrumental music – Classification of Indian musical instruments – Some doyens of Indian music and their music – Classical and non-classical music – folk and film music – Dialectical relation between the classical and the non-
classical music – Music criticism – certain key terms – Indian classical music in print media – Indian classical music I (India) English literature – Some novels

Raghava R Menon, Indian Classical Music: An Initiation, New Delhi: Vision Books, 1996
Ram Avtar Vir, Theory of Indian Music, New Delhi: Pankaj Publications, 1999
Sumati Mutatkar, Aspects of Indian Music, New Delhi: Sangit Natak Academy, 2006

NATIONAL INSTITUTE OF TECHNOLOGY KARNATAKA, SURATHKAL

STUDENT DECLARATION ON THE *NITK HONOUR CODE*

I do hereby undertake that as a student at NITK-Surathkal, I shall be bound by the NITK Academic Regulations & Curriculum, and all the applicable Rules governing the academic programmes; and also specifically that :

(1) I will not give or receive aid in examinations; that I will not give or receive un-permitted aid in class work, in preparation of reports, or in any other work that is to be used by the instructor as the basis of evaluation/grading; and

(2) I will do my share and take an active part in seeing to it that others as well as myself uphold the spirit and letter of the *NITK Honour Code*.

I realize that some examples of misconduct which are regarded as being in violation of the *Honour Code* include (but is not limited to) what is listed here below:

- Copying in examination, from another's paper or from any other source;
- Allowing another to copy from one's own examination paper;
- Un-permitted collaboration in any form whatsoever;
- Plagiarism of any form or extent;
- Revising and resubmitting a marked quiz or examination paper for re-grading without the instructor's knowledge and consent;
- Giving or receiving un-permitted aid on take-home examinations, etc.;
- Representing as one's own work the work of another, including information available on the Internet, etc.;
- Giving or receiving aid on an academic assignment under circumstances in which a reasonable person should have known that such aid was not permitted;
- Committing a cyber offence, such as, breaking passwords and accounts, sharing passwords, electronic copying, planting viruses, etc.;
- Engaging in any act of indiscipline whatsoever, directly or indirectly, whether in the Institute premises or in the Hostels/Campus/etc, or even outside the Institute, that would reflect or project an undesirable image on the Institute;

I understand and accept that any act of mine that can be considered to be a violation of the NITK *Honour Code* will invite disciplinary action as decided by the Institute Authorities.

Student's Full Signature : _____

FULL NAME IN BLOCK LETTERS : _____

_____

Semester Fee Payment Receipt Number & Date : _____

Student Register Number :

Admission Number (if assigned)						Roll Number (if assigned)						

Date : _____

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to be duly filled-in by the student, and *signed in presence of the Faculty-Advisor or the HOD.*

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- Plagiarism of any form or extent;
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- Giving or receiving un-permitted aid on take-home examinations, etc.;
- Representing as one's own work the work of another, including information available on the Internet, etc.;
- Giving or receiving aid on an academic assignment under circumstances in which a reasonable person should have known that such aid was not permitted;
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Admission Number (if assigned)						Roll Number (if assigned)						

Date : _____

- copy to be retained by the student, as a *Reference* -

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- Plagiarism of any form or extent;
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- Giving or receiving un-permitted aid on take-home examinations, etc.;
- Representing as one's own work the work of another, including information available on the Internet, etc.;
- Giving or receiving aid on an academic assignment under circumstances in which a reasonable person should have known that such aid was not permitted;
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Admission Number (if assigned)						Roll Number (if assigned)						

Date : _____

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