Computerization of Students' Records at BITS for Educational Administration, Management and Monitoring

THESIS

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by

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Under the Supervision
of

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CERTIFICATE

This is to certify that the thesis entitled "*Computerization of Students' Records at BITS for Educational Administration, Management and Monitoring*" and submitted by Ravi Kant Mittal, ID. No. 76E85001 for the award of Ph.D. degree of the Institute, embodies original work done by him under my supervision.

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RAVI KANT MITTAL

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ACRONYMES AND ABBREVIATIONS

1.	ACB	Academic Counselling Board, ref. AR[1] Clause 5.01
2.	AO	Admissions Officer, ref. AR Clause 1.08
3.	AR	Academic Regulations
4.	ARCD	Academic Registration & Counselling Division
5.	APU	Admissions and Placement Unit
6.	BITS	Birla Institute of Technology & Science
7.	BL	Backlog, ref. AR Clause 3.25I(a)
8.	BOG	Board of Governors, BITS
9.	CDC	Compulsory Discipline Course, ref. AR Clause 2.11
10.	CGPA	Cumulative Grade Point Average, ref. AR Clause 1.13
11.	DARC	Dean, Academic Registration & Counselling, ref. AR Clause 1.08
12.	DCOC	Discipline Courses Other than Compulsory, ref. AR Clause 2.11
13.	DED	Dean, Educational Development, ref. AR Clause 1.08
14.	DID	Dean, Instruction, ref. AR Clause 1.08
15.	DPS	Dean, Practice School, ref. AR Clause 1.08
16.	DRCD	Dean, Research & Consultancy, ref. AR Clause 1.08
17.	EC	Examination Committee
18.	EDD	Educational Development Division
19.	EL	Elective, ref. AR Clause 2.05
20.	ES	Eligibility Sheet, ref. AR Clause 3.21
21.	GC	Grade Card (Same as Grade Sheet)
22.	GS	Grade Sheet, ref. AR Clause 1.12
23.	HL	Higher Level Course, ref. AR Clause 3.21
24.	IC	Instructor-In-charge, ref. AR Clause 4.02
25.	ID	Instruction Division
26.	L	Lecture Hours per Week
27.	LU	Library Unit
28.	OBL	Operative Backlog, ref. AR Clause 3.25 I(c)
29.	OE	Optional Elective, ref. AR Clause 2.09
30.	OPSC	Operative PSC, ref. AR Clause 3.25 I(c)

31.	P	Practical Hours per Week
32.	PS	Practice School, ref. AR Clause 2.12
33.	PSC	Prescribed Semester Courses, ref. AR Clause 3.21
34.	PSD	Practice School Division
35.	PSI	Practice School I, ref. AR Clause 6.02
36.	PSII	Practice School II, ref. AR Clause 6.02
37.	RA	Registration Advisor, ref. AR Clause 3.03
38.	RB	Research Board
39.	RCD	Research and Consultancy Division
40.	SAIPS	Students' Academic Information Processing System
41.	SRO	Students' Records, ref. AR Clause 4.10
42.	SWD	Students' Welfare Division
43.	TS	Thesis-Seminar, ref. AR Clause 2.12
44.	U	Units associated with a Course, ref. AR Clause 1.05

GRADE AND REPORT CODES

SNo	Code	Meaning
1	A	Excellent - 10 points (a letter grade)
2	B	Good - 8 points (a letter grade)
3	C	Average - 6 points (a letter grade)
4	D	Poor - 4 points (a letter grade)
5	DP	Discontinued from Programme, ref. AR Clause 4.18
6	E	Exposed - 2 points (a letter grade)
7	GA	Grade Awaited (a report), ref. AR Clause 4.15
8	I	Incomplete (a report), ref. AR Clause 4.13
9	NC	Not Cleared (a report), ref. AR Clause 4.19
10	RC	Registration Canceled (a report), ref. AR Clause 4.18
11	RRA	Required to Register Again (a report), ref. AR Clause 4.18
12	W	Withdrawn (a report), ref. AR Clause 4.17

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1. Academic Regulations (AR) [3].

CHAPTER ONE

INTRODUCTION

1.1 POSER OF THE PROBLEM - COMPUTERIZATION IN EDUCATIONAL ADMINISTRATION

The academic planning and execution of new ideas in educational systems poses unusual problems of information organization and management and academic monitoring for systems success. If the design of an educational system itself is constantly in the making, the designers cannot offer apriori complete systems model. They can only choose as much innovation as is acceptable by the system in the named operators of the system, create a network and make a beginning. In such an adaptive design there is a continuous requirement of feed-back, not only from the engineering design point of view but also from the educationist's point of view, and from the impressionist's point of human beings.

For such a dynamic, innovative and complex educational system, the system's failure or success will totally depend upon the flaw-less and timely execution of the decisions and completion of procedures. This can be only achieved by using computers for information organization, processing and systems monitoring.

The computerization for a system that is in the making has the advantage to begin with a completely new design and let the technique take over, but at the same time, computer system's men have to wait upon the designers of educational system to proceed. It may be argued that computerization of an existing, well-established and tested, on-going system is much easier than to start from scratch for a new system, but this is true only if the system's model is well defined and static. When the system itself is in the making, one has no choice but to follow the design. Many a times the available hardware resources and software tools pose heavy restrictions on the computer system's men to implement the designer's ideas. In such situations the computer system's men have to enlighten the designers on computers and their capabilities, as most often the designers are not necessarily literate on computers and have to suggest to the designers' alternatives possible. The very nature of the adaptive system provides the flexibility to the designer to alter the design in-order to cater for resource's limitations.

The dynamic and innovative nature of the educational system would demand from the computer based information system to provide for circumstances that may fortuitously intervene and force periodic pauses to review and redesign the computer file. Therefore, unless the computer system's men and the educational system designers and implementors work hand-in-hand, the educational system that continuously wants to ameliorate and grow, cannot be a success.

It is the interface between the educational planners, the designers, the implementors and the computer technologists that would lead to define broad boundaries of the system. It would be perceived, therefore, that an innovative educational unfolding also demands an innovative and open-ended software response and support and waiting for it.

This is a report of the background, delineation of a particular thread of educational system for which software design and development were ultimately derived for the furtherance of the educational task. The objective is to design a computerized integrated information system based on institutional academic and other related information needs, which maximizes the reliability, accuracy, consistency, and timeliness of information. Such a broad-based information system combined with on-line capability will not only increase the integrity and utility of information but will also provide for quick, efficient and personalized service to both management and clientele.

1.2 THE BITS EXAMPLE

The success story of a novel educational system backed by an all-out computerization of academic records and monitoring processes at **Birla Institute of Technology and Science, Pilani (BITS)** is the live and vibrant example of this. With the inception in 1964, BITS chose to adopt an educational system that continuously discovers new techniques of action by assimilating new concepts and situations.

It has been already stated that the educational design was not static. Similarly, the rules of operation have been developed with the passage of time. For the purpose of this Thesis, the most complex, the current, will be picked up as an example. The less complex system will be separately described when the contrast is to be emphasized. Similarly, the future projection would be described and demand delineated.

The growth of computerization in organization, monitoring and processing of academic information is highlighted in the next section.

1.2.1 Computerization at BITS

BITS adopted a basic structure of semester system with internal, continuous evaluation, coursewise teaching, evaluation and progress instead of a conventional "yearly system" with class or branch-wise teaching and evaluation and year-wise progress. The scenario of students' academic records processing in the beginning years of BITS was not encouraging because first, the manual system was not geared-up to cope with all these structural changes and, second, the tasks grew enormously in size and complexity such that humanly it became impossible to manage them flawlessly, reliably and timely, even with a large manpower.

The planners and visionaries of BITS educational system visualized the need and importance of computers in administration in the early years of its formation. In "A Forward Plan of The Institute" [1] they wrote under "A View on Academic Administration":

> "The Institute computer must be fully used in order to modernize many administrative procedures . . ."

The first successful use of computer was made in 1970-71 to perform the critical, confidential and tedious task of preparation of semester results and to print grade sheets for all students. In the conventional set-up of 'Examination Cell' under the registrar's office, with huge clerical force, this task alone used to take almost one man-year and there was always accumulated backlog. With computer it was done in a matter of days and without any errors.

This success added a new dimension to the utilization of the computers at BITS. Today, not only all tasks pertaining to educational administration have been computerized but use of computers has seeped into all walks of life at BITS and computers provide full decision support and processing for all housekeeping activities required by a university administration, [7], [62], [63].

The beginning made in 1970-71 was single in its kind. Even today, no documented records are available on use of computers in educational administration and monitoring of such a kind. The first national orientation-cum-appreciation program for educational administrators on "Computers in Educational Administration and Management" was organized by Association of Indian Universities (AIU) in 1989 [21]. Even to-date, therefore, the use of computers in organization and monitoring of academic records for educational administration remains unique for which no parallel exists.

1.2.2 Growth in Computerization of Students' Records at BITS - A Historical Prospective

The use of computers in educational administration was set in motion in response to educational, administrative and intellectual challenges. Today, it has become a tool for educational reforms, reliable management of information and meeting deadlines (timeliness).

The growth of computerization is summarized in terms of the following land-marks where the information base and associated software, as well as the operations and operating environments, have gone through major reviews and redesigns. These were prompted by hardware changes, ever increasing ambitions of the educational system and its administrators and changes in the rules governing the operations. A chronology of educational reforms and its impact on computerization progress is presented in Figure 1.1, in detail.

Phase I - The Nascent System

The computer's task was to take massive data of coursewise grades, compute CGPA and print enough copies of student wise grade sheets with CGPA, on a semester by semester basis.

The IBM-1130 configuration had only 1 Mb (Mega-byte) secondary storage (one disk drive) capacity that provided space for only 2050 students' information for a semester. The computer software persons were self-taught with no external guidance or previous experience of this kind.

Phase II - Augmentation of IBM-1130

The experience gained and the pressing educational systems' and its administrator's demands lead to enhancement of IBM-1130 configuration with an additional two-disk drive in 1973-74, thereby providing 3 Mb on-line secondary storage capacity.

The work on organizing the academic performance records of all students for their entire stay was started with the feasibility study carried out by Sethi [67]. The software development and testing was done and finally the system was implemented by Gupta [30] in 1979-80. It was called a "Three-Disc Model" as all the three drives were simultaneously used. The change was clubbed together with major changes brought in the

Milestones of Educational Reforms		Milestones of Computerization
*BITS Formed and Adopted: -Semester System, Continuous Internal Evaluation, Coursewise Passing, Grading System	1964	
*Academic Regulation Implemented	1968	
*Semester Registration Introduced	1969	*IBM-1130 Computer Commissioned
*Qualitative Letter Grading Introduced *Advanced Standing Admissions Introduced	1970	*Computerization of Student's Result at the End of Semester - First Success - GGPA Computation - Grade Card Preperation and Printing
*Flexibilities of Transfer, Marginal Deficiency Admissions	1971	
*Admissions in IInd Semester, Unassigned *Coursewise Time-Table Introduced	1972	*Admissions Process Computerized on IBM-1130
*Practice School Programme for First Degree Introduced	1973	*Computerized Allotment of Random Token Numbers for Registration *IBM-1130 Enhanced
*New grade to replace old in CGPA	1974	*Enhancement of Students' Records Software continued
*Academic Regulations Amended -'F' Grade Abolished and 'E' grade introduced -Academic Councelling Board (ACB) constituted -Optional Free Elective Introduced	1975	
*Functional Approach to Educational Administration Integrating Academic and Administrative Responsibilities at all levels	1976	*Computer help in Registration Process: -Stubs replaced with Pre-Punched Cards -Section/Course Lists, Partial Dean's List, List of Not Registered Students,Examination Committee Output, Hostel Lists etc. *Computer Aid in Time-Table
*Dual degree oferred as a special dispensation *Returt to Assigned Admissions	1978	*Student's Academic Records Software using all three disks implemented providing access to entire academic record of all the students, not just for one semester *Admissions Software for Assigned Admission
*Changes in Semesterwise Patterns due to 10+2 System of School Education	1979	*"Three-Disk" Model Student's Records Software Successfully Tested and made operational *PS II Profiles Computerized
*Four year integrated programmes	1981	*Work Started on the Software for Student's Academic Performance Monitoring
	1982	*Software for PS I and PS II Allotment and Analysis developed
*New discipline in Group C programme	1983	*Overall Computerization Task Started -Staff Data Base for Administrative Monitoring -Payrolls and Budget Preperations *"Three-Disk" Model Enhanced for: -increased number of on-rolls students -semesterwise program chart for all students and Update Sheets *Work began on Registration and Time-Table Validations through computer
*New Courses	1984	*Pay Rolls and Budget Preperations Computerized *Mess Bills and Students' Accounts Computerization work started
*M.Phil (Applied) Introduced	1985	*Students Academic records loaded on HP-1000 and software development started afresh in the new environment due to non-availability of IBM-1130
	1986	*HP-1000 enhanced
*Ph.D. Aspirants Scheme *Distance Learning Programmes Started	1987	*Students Academic, Personal, and Financial records fully computerized
*Computer Assisted Housekeeping Unit Created *BS/MS degrees revived	1988	*Students' Railway Concessions Computerized
*Programmes in collaboration with CSIR, NPL, MRF, etc. Started	1989	*Students Academic Information Processing networked to provide complete monitoring from Admissions to Graduation
	1990	*Transcript Computerized
	1991	*Provisional Certificate Computerised

Figure 1.1 - Chronology of Educational Reforms and Growth of Computerization at BITS.

academic structure and rules governing the operations in 1979 and administrative restructuring done in 1976.

Meanwhile, in the semester based processing system, developments and advancements continued. Printing grade sheets with students and parent's address for mailing conveniences using a window envelop, keypunching registration data and getting it verified before loading grades, providing coursewise course lists and grade lists to the faculty, using coursewise pre-punched (by computer) cards for keypunching grades, double keypunching and machine matching and verification of grades and other data to substitute for manual verification and generate clean data for processing in the shortest time, etc. were some of the significant developments. Reports in addition to one's mentioned above, like coursewise registration totals, address list, hostel wise lists, etc. were also continuously added for the convenience of the administrators.

The computer file and the software always kept pace with ever changing, innovative educational system and increasing students' population. The new system was capable of handling information of 2544 students for their entire stay at the Institute.

Phase III - Enhancement of Three-Disk Model

Need to augment the capabilities of the three-disk model was continuously felt so as to:

(a) allow for increased students strength,

(b) store program chart for all students and update the same at the end of each semester, and

(c) perform various kinds of eligibility and validation checks built around the program charts.

This extension lead to a "Four-disk" model and restructuring of database files. Consequently the software had to change. This became operational for the minimal tasks of "three-disk" model during 1983-84. The packages for the validations and eligibility checks, time-table checks, etc. were in the process of being developed, tested and implemented.

Phase IV - Machine Change

In late 1984, IBM-1130 came to a grinding halt due to non-availability of spares. The problem was that a living system cannot be frozen for even a second. Thus, the information on IBM-1130 had to be transferred to HP-1000, the only alternate computer available on the spot, in a metaphor of transferring a passenger from one running train to another running train. The handicap was that there was no immediate possibility of a hardware link between the two machines. The man-machine ingenuity used to achieve this transfer in a short time of 15 days is detailed in Mathur & Mittal [47]. The software tools and file handling systems on the two machines were also incompatible. Thus, the files underwent a redesign while the software was developed denovo. The software development, testing and implementation process was running side-by-side to keep pace with the progressing semester while clearing the accumulated backlog.

The processing on IBM-1130 was completely batch oriented. Data and commands were input to computer via keypunched cards, the amount of editing was minimal, cross checking of data across different input was not easy, and manual verification of keypunched data was carried out. There was a large time lag between the time data first entered the system and the time it ultimately became clean for processing.

The HP-1000 brought a sea change in the information processing environment. There were no keypunches, keypunched cards and card readers. The communication between the operator and the computer is through the keyboard and the terminal. The operator is able to see whatever is keyboarded, data or commands, and read the computers responses and error messages on the screen in front of him. The processing is no more a batch operation and more than one user is able to use the computer simultaneously without interfering with others work. Rubin [65] gives standards for comparison of batch and on-line systems while a critical analysis of the students' records processing on two machines was done by Mathur [48].

In addition HP-1000's available configuration offered much more capacity in terms of memory, primary as well as secondary, speed of processing, multiple users - upto eight, and time shared processing as compared to IBM-1130. The only resource in which HP-1000 lacked IBM-1130 was the slow, only 300 cps, printer as compared to 600 lpm printer with IBM-1130. Soon, need was felt to enhance the capabilities of HP-1000 in terms of faster printer and other resources.

Phase V - The Present - The Most Complex

Students' records processing was done on IBM-1130 for more than 14 years and had to be transferred to HP-1000 due to non-availability of IBM-1130. The users, operators, and administrators obviously had doubts about the capabilities of HP-1000, and about the security of academic records on it and reliability of its operations. With the processing of academic records for two semesters and through thorough verifications and re-verifications, all doubts were removed and simultaneously it was visualized that HP-1000 can offer better services, faster processing, higher reliability, greater ease of operations and greater security for maintaining, organizing and processing of students academic records. Administrators and computer systems men started longing for exploiting the full potential of computer for academic records processing and achieving the most complex in terms of providing information and decision support for academic monitoring of students' throughout their stay at BITS. It was at this stage the work of this Thesis began.

This dissertation is a record of the design process, difficulties faced and the solutions achieved, to implement a computerized academic information processing and monitoring system for a university environment with BITS as an example.

For the purpose of this Thesis, the computerized academic information processing and monitoring system will be called

"Students Academic Information Processing System (SAIPS)." In the Thesis focus is made on the design, development and operation of whatever system is proposed and this is more important, the various innovative solutions evolved, applied and adopted to overcome the resource limitations for completion of various fragments of operation. It is not for this Thesis to dwell on the merit or otherwise of the educational system. It would be established that without this nexus, the new educational system would not have succeeded. The Thesis proposes to highlight the importance of innovative ways of handling information, minimizing data entry problems, establishing a correct network for information supply and updating, and finally, present the information to the decision makers in time to act upon. Thesis will establish how this factor became crucial for the educational system just as information factor is crucial to any modern system.

At BITS the students' academic information processing system has grown into a fully integrated network providing information and decision support for monitoring the students from the day of admission to the day of their delivery as graduates and award of diploma to them.

1.3 THE STUDENTS ACADEMIC INFORMATION PROCESSING SYSTEM (SAIPS)

The Students' Academic Information Processing System (SAIPS) for organization and computerization of students' academic records for educational administration, management and academic monitoring is a management information system that performs processing for all applications, provides information for decision support system and acts under the educational structure and the defined rules governing the operations. Figure 1.2 gives a model that depicts the over-all organization, objective and operation of the SAIPS and the information flow in the overall context. The major events in the educational monitoring along with key decision steps, as spelt out by the educational structure and rules governing the operation, from the admission to graduation is detailed in Figure 1.3. This Figure also

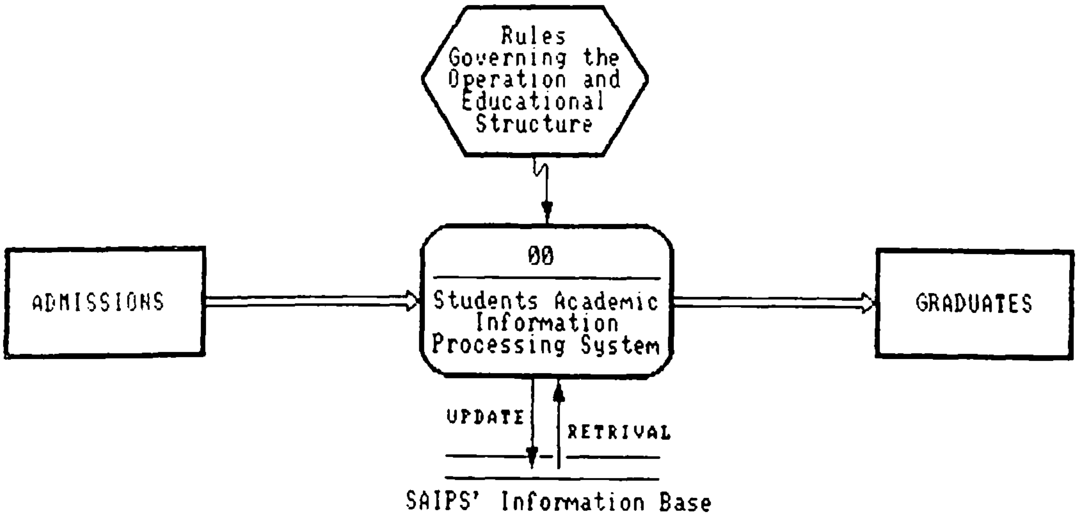

Figure 1.2 - The Simplified SAIPS Model (Level 00 IFD).

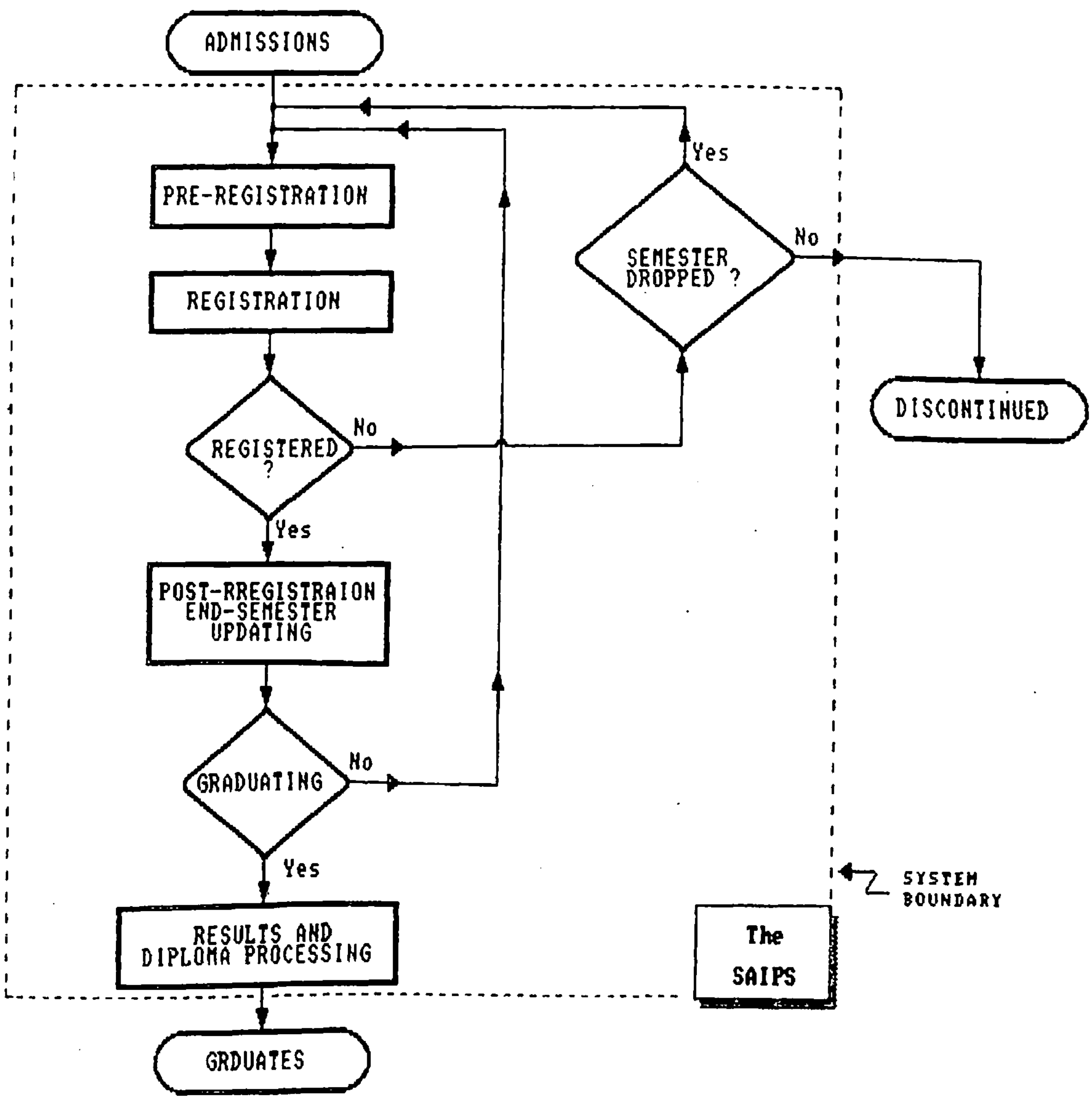

Figure 1.3 - Major Events of the Educational Administration and Monitoring Process in a Semester System.

highlights the cyclic and the acyclic nature of the processing and monitoring that need be performed.

The SAIPS has been built in response to the needs of the educational system, the administrators, the implementors, and the rules of operation for providing accurate, reliable timely, meaningful information while maintaining the confidentiality and security, in order to plan, analyze, control and monitor students' academic performances and records.

The SAIPS provides information to various counters following the well defined principle of 5 W's and 1 H, that is:

* What information is needed?
* When is it needed?
* Who needs it?
* Where is it needed?
* Why is it needed?
* How much does it cost?

In order to arrive at an answer to these questions, the administrative structure and hierarchy of the organization must be fully understood. Figure 1.4 gives the current administrative structure of BITS which has functionally motivated divisions, service oriented units and discipline oriented peer groups. Block diagram in Figure 1.5 shows the various counters served by the timely information from SAIPS and who update the information in SAIPS, for the BITS example.

1.4 OVERVIEW OF CHAPTERS

This dissertation examines various aspects of academic information, from source to preparation and processing for utilization in the very human enterprise of education. An educational institution's (The BITS) approach to academic information processing for educational administration, management and monitoring, is used as the example for designing the computerized system. The gist of Chapters of this Thesis is given in the following paragraphs. The Thesis is divided into seven

BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE
ADMINISTRATIVE STRUCTURE

DIRECTOR

- ADMINISTRATIVE DEANS (I & II)
- DEPUTY DIRECTORS (TWO)
- EDUCATIONAL CONSULTANCY DEANS (TWO)

DEAN	DEAN	DEAN	DEAN	DEAN	DEAN	DEAN	DEAN	DEAN	DEAN
FACULTY DIVISION I	FACULTY DIVISION II	FACULTY DIVISION III	INSTRUCTION DIVISION	PRACTICE SCHOOL DIVISION	RESEARCH & CONSULTANCY DIVISION	ACAD REGISTRATION & COUNSELLING DIVISION	STUDENT WELFARE DIVISION	EDUCATIONAL DEVELOPMENT DIVISION	EDUCATIONAL HARDWARE DIVISION
NUCLEUS ALL GROUP LEADERS	NUCLEUS ALL GROUP LEADERS	NUCLEUS ALL GROUP LEADERS	NUCLEUS OF THE DIVISION	NUCLEUS OF THE DIVISION	NUCLEUS OF THE DIVISION	NUCLEUS OF THE DIVISION	NUCLEUS OF THE DIVISION	NUCLEUS OF THE DIVISION	NUCLEUS OF THE DIVISION
BLOCK ADMINISTRATION HOUSEKEEPING & PHYSICAL FACILITIES LAB. CLASSROOM & OFFICE MAINTENANCE			TIME TABLE TEACHING ALLOCATION IMPLEMENTATION FEEDBACK & MONITORING GROUPS & GROUP LEADERS	ESTABLISHMENT OF STATIONS FACULTY ALLOCATION FEEDBACK & MONITORING STUDENT NEEDS STATION OPERATION STUDENT ASSIGNMENTS & EVALUATION GROUPS & GROUP LEADERS	IDEATION ADMINISTRATION ORGNISATION INTERFACING WITH OUTSIDE AGENCIES SEEKING OUT CONSULTATION GROUPS & GROUP LEADERS	REGISTRATION PLANNING & OPERATION ACADEMIC RECORDS OF STUDENTS ELIGIBILITY COUNSELLING ACADEMIC COUNSELLING BOARD GROUPS & GROUP LEADERS	HOSTELS, NSS, NCC, NIS, GAMES & ATHELETICS STUDENTS ACTIVITIES RAILWAY CONCESSIONS SCHOLARSHIPS & AIDS, SFC STUDENTS PERSONAL FILES & TESTIMONIALS DISCIPLINE GROUPS & GROUP LEADERS	COURSE & LAB DEVELOPMENT COURSE IMPROVEMENT TEACHING W/S INSTITUTIONAL & EDUCATIONAL RESEARCH EDUCATIONAL TECHNOLOGY TEACHING AIDS IDEATION FEEDBACK GROUPS & GROUP LEADERS	CENTRAL PURCHASE BASIC EQUIPMENT MAINTENANCE GROUPS & GROUP LEADERS
GROUPS & GROUP LEADERS CHEM.ENGG. CIVIL ENGG. ECONOMICS ENGG.TECH. HUMANISTIC STUDIES LANGUAGES MANAGEMENT	GROUPS & GROUP LEADERS EEE MECH.ENGG.	GROUPS & GROUP LEADERS BIO.SCI. CHEMISTRY MATHEMATICS MUSEUM STUDIES PHARMACY PHYSICS SCIENCE & TECHNOLOGY DEVELOPMENT							

UNITS
CHIEF, GENERAL ADMINISTRATION
CHIEF, MAINTENANCE (MAINTENANCE OFFICER)
CHIEF, ADMISSIONS & PLACEMENT (ADMISSIONS & PLACEMENT OFFICER)
CHIEF, ACCOUNTS & FINANCE (BUDGET OFFICER
CHIEF. DISTANCE LEARNING PROGRAMMES

UNITS
CHIEF, LIBRARY
CHIEF, INFORMATION PROCESSING CENTRE
CHIFF, WORKSHOP
CHIEF, INSTRUMENTATION CENTRE
CHIEF, COMMUNITY WELFARE
CHIEF, COMPUTER ASSISTED HOUSE KEEPING

Figure 1.4 - Functional Administrative Structure of BITS [16].

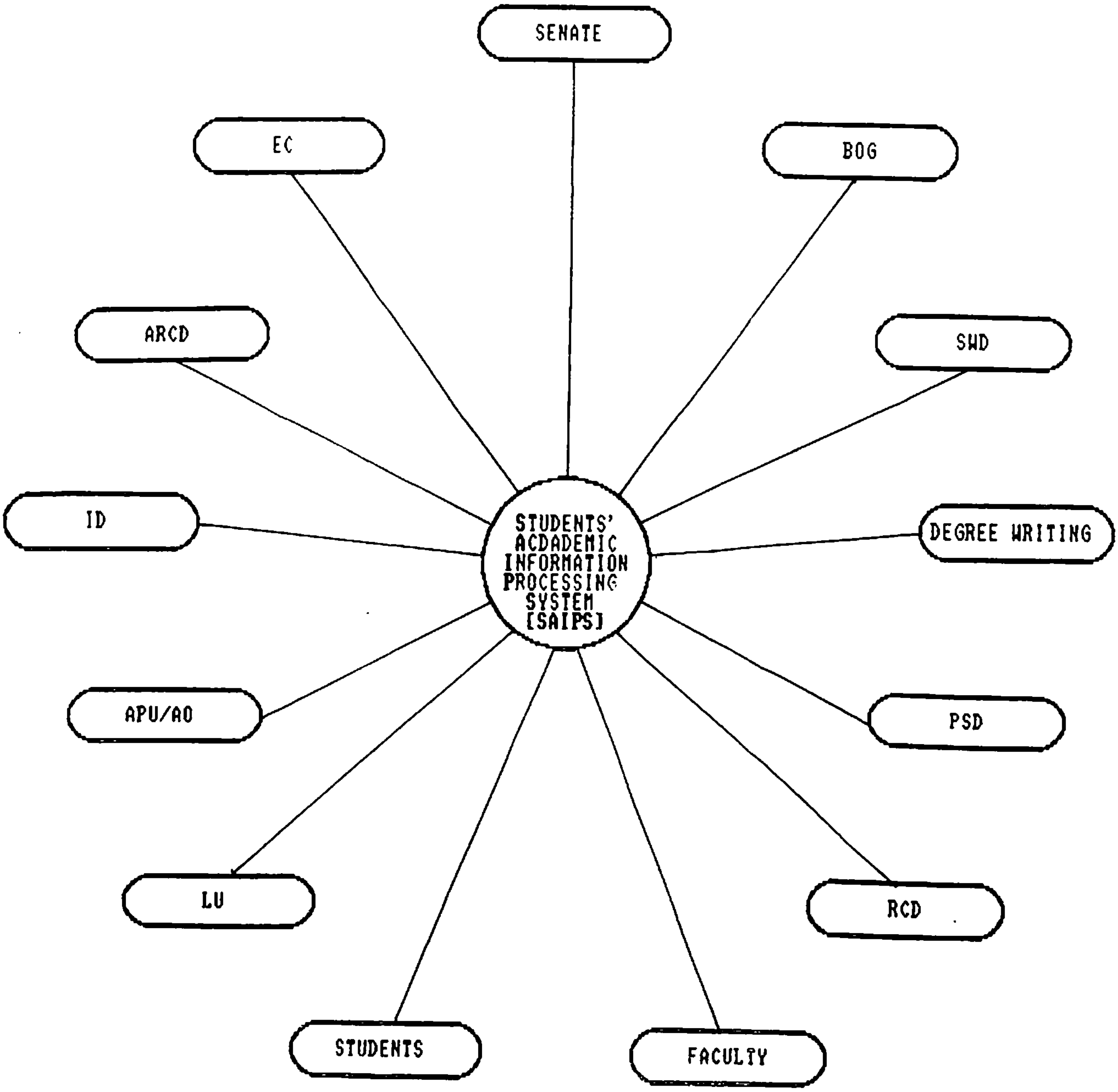

Figure 1.5 - Counters Served by SAIPS.
(for acronyms refer page xi or Bulletin [16])

Chapters and two Appendices. Figure 1.6 gives the overall organization of this dissertation.

Chapter Two briefly describes the prime characteristics of the BITS educational system, its administration and monitoring procedures and highlights the role played by the computerization and the computer system's men in the system's success. The computerized monitoring and administration of academic records of students' from admissions to graduation is explained there. The chronology of processes carried out and parallel processing situations are described in the chapter, highlighting the criticallity of each process and its repurcursions on entire system are also discussed.

The itemization of a variety of needs at a variety of levels is the first task in the software design and software tasks allocation to develop design specifications for the software. The establishment of software design specifications for the SAIPS is discussed in Chapter Three. The details of the software modularity and architecture are also described there.

Identifying the information needed to support the system's requirements and meet the software specifications of the identified software tasks is done next. The design of the information content and data systems to fulfill the system's requirements is presented in Chapter Four. The details of file structures designed and developed to support the long-range plan of information needs is also discussed.

Chapter Five deals with the design aspects and design details of the information collection and entry software to achieve the error-free, fast and reliable input. It also highlights the verification methods adopted and possible to meet the criticallity of the requirements like accurate records, consistent information in all files, etc.

Details of algorithms and data structures used in the SAIPS for maintaining the information base and carrying out processing and retrieval of information tasks is presented in Chapter Six.

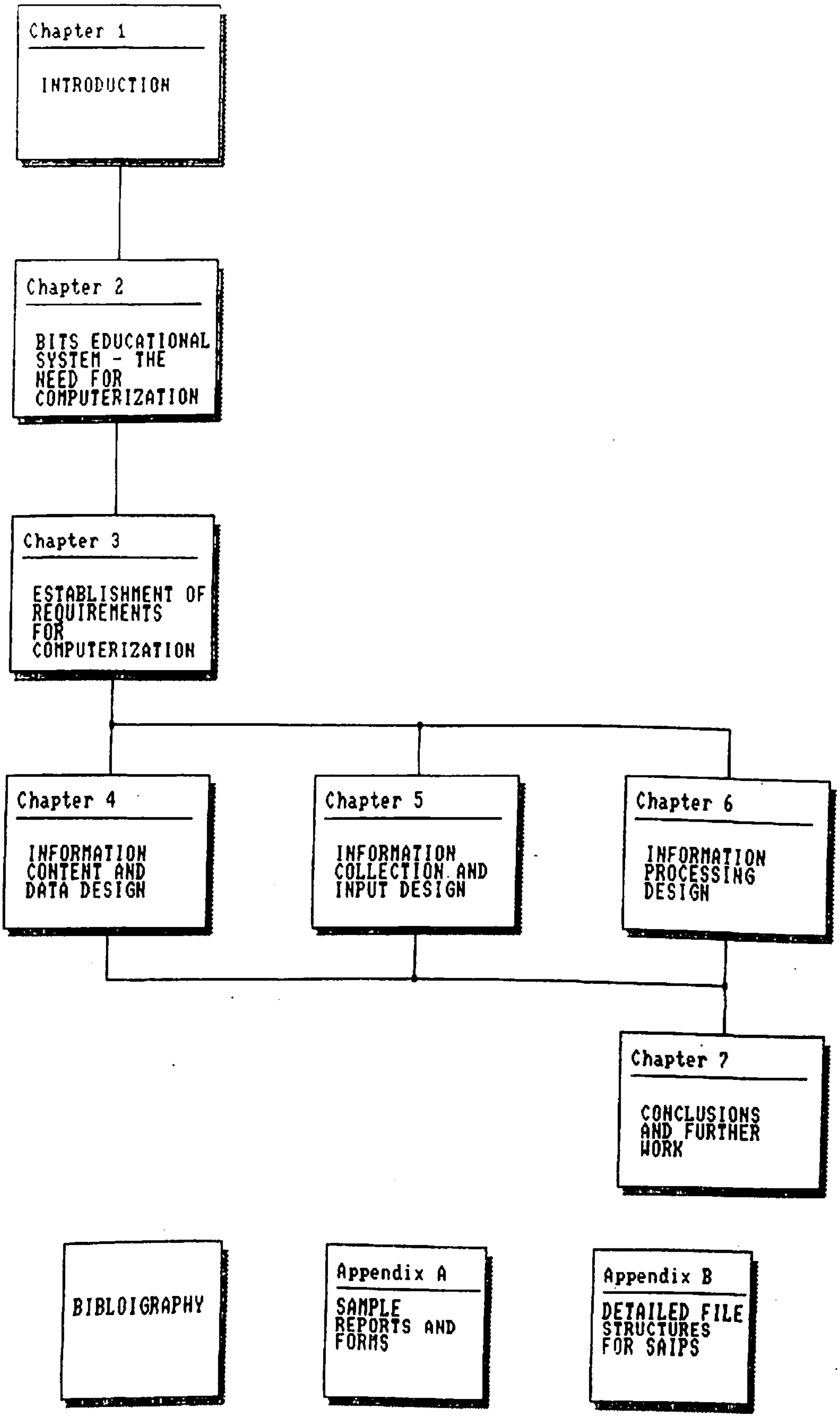

Figure 1.6 - Organization of Chapters and Appendices for this Dissertation.

Software design for the screen formats, proforma for information collection, input or update of same and formats of the reports required for academic monitoring is also described in the Chapter.

Chapter Seven dwells on the possibilities of enhancements and further research in the academic monitoring of students' academic information in order to improve the system performance and provide for more features. It also summarizes the process to be used for implementing a computerized system for educational administration, academic monitoring and management in an educational institution. Description of variety of other tasks that give service to clientele in an educational institution, can be undertaken in a similar manner, where computerized systems can be developed for helping the administrator, is also given.

1.5 SUMMARY

In a dynamic, innovative and complex educational system, the system's failure or success will totally depend upon the flawless and timely execution of the decisions and completion of procedures. This can only be achieved by using computers for information organization, processing and systems monitoring.

At BITS use of computers, in performing tasks of educational administration, began way back in 1970-71 and, today, it has become a tool for educational reforms, reliable management of information and meeting deadlines.

This dissertation is a record of the design process, difficulties faced and the solutions achieved, to implement a computerized academic information processing and monitoring system for a university environment with BITS as an example.

CHAPTER TWO

BITS EDUCATIONAL SYSTEM - THE NEED FOR COMPUTERIZATION

2.1 INTRODUCTION

BITS was formed in 1964 with an unusual combination of factors. Three traditional collages of (i) Arts, (ii) Science, Commerce and Pharmacy, and (iii) Engineering, affiliated to a large, conventional state university, were amalgamated and carried forward as the foundation for a modern university. Expertise and collaborative input from Ford Foundation and Massachusetts Institute of Technology (MIT) was injected in terms of funding and educational consultancy. A plethora of degrees, programs, marginally different courses, a traditional approach in curricula and examinations were its endowments.

Thus, the very beginning had to contend with what was thrust on the new system and what was possible. The input of American concept of education and strong urge to modernize propelled the Senate, the apex educational body of the Institute, to adopt "Semester System" and "Continuous Internal Evaluation System" right from the beginning. These were epoch making decisions of a nascent senate. Simultaneously, a letter grading system was introduced where marks were converted to letter grades based on a mechanical formula.

Since then, many other educational reforms have been introduced. Modular courses, commonalty of courses across the discipline-bound students, a certain degree of flexibility in admissions, programs and courses, and many other unusual reforms, not tried before by any Indian University, were introduced and have been perfected.

The peculiar legacy, the resource crunch, the passion to modernize and the dominant consensus of the faculty propelled the Institute to choose the most difficult task of building an educational system that continuously discovers new techniques of action by assimilating new concepts and situations while simultaneously maintaining fidelity with the strength of the past.

In this chapter, first the educational system and its characteristics are described in order to establish the specifications for computerization of the management and monitoring process. Then the role of computerization in organizing, maintaining and processing of academic records for successfully ploughing through the system is described.

2.2 FEATURES OF BITS EDUCATIONAL SYSTEM

The structure of programs at BITS is based on the semester system, internal evaluation, course by course passing and letter grading adopted at its inception. The structure offers remarkable academic flexibilities and simultaneously provides strict and precise monitoring for each student. It also takes care of overall national and social needs and provides for the linkages with the professional world through Practice School Program.

2.2.1 The Semester System

The academic year at BITS is divided into two semesters, each of approximately eighteen weeks duration and a summer term of eight weeks duration. A semester is the period of main activity while summer term is used for restricted course offerings for critical needs and for Practice School. The educational activity is quantaised in terms of a semester/term. The end of a semester/term is for consolidating, monitoring, reviewing, planning and marks the beginning of the work for next semester/term.

The academic program for a degree is thus segmented into semesters (and summer terms, where necessary), each containing a prescribed set of courses. The task of educational administration is, therefore, cyclic in nature as explained in Figure 1.3, Chapter One.

2.2.2 Internal Evaluation on Continuous Basis

The performance and progress of a student in a course is continuously measured from the beginning of the course in terms of periodic tests, quizzes, assignments, laboratory work, projects, seminars etc. and a comprehensive examination at the end of the semester. The entire evaluation is responsibility of the faculty who directly teach the course. The system's credibility and reliability is ensured by various internal checks and by making the system sufficiently open.

2.2.3 Course by Course Progress

The student is required to clear the courses prescribed for the degree program on an individual basis and their sum total contributes to the degree eligibility requirements, subjected to certain prerequisite requirements for individual or set of courses. The student's progress is, therefore, not dependent on semester-wise or year-wise passing.

2.2.4 Educational Structure

The structure for higher education is modularized in to three tiers with integrated first degree programs at the foundation, followed by one/two year higher degree programs in the middle and the doctoral programs at the top. The structure provides for campus-based and off-campus-based degree programs, and formal (classroom system) and Non-Formal (Person Centered Distance Education System) at different tiers. Figure 2.1 illustrates the three-tiers of current educational structure at BITS.

2.2.5 The Practice School

The educational structure provides for various kinds of university-industry linkages as evident from Figure 2.1. Practice School courses at the first degree level provide an option to the students to practice in the real world and involves them in solving real life problems before graduation, and bridges the gap between the professional world and academic world. These courses are run at designated stations, known as PS Stations, where the

BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI
THREE TIER STRUCTURE OF EDUCATION

PH.D. DEGREE

HIGHER DEGREES	
M.E. (COLLABORATIVE)	M.E.
M.PHIL. (APPLIED)	M.PHARM.
	M.PHIL.
	M.S.
	M.PHIL. VOCATIONAL STUDIES

FOUR-YEAR INTEGRATED FIRST DEGREES							
FORMAL WITH PRACTICE SCHOOL OR WITHOUT			FORMAL DIVIDE	NONFORMAL UNDER UNIVERSITY-INDUSTRY LINKAGE WITH WORK EXPERIENCE WITH PRACTICE SCHOOL OR WITHOUT (VOCATIONAL)		(NONVOCATIONAL)
GROUP A PROGRAMMES	GROUP B PROGRAMMES	GROUP DIVIDE	GROUP C PROGRAMMES	FORMAL DIVIDE	GROUP D PROGRAMMES	GROUP DIVIDE	GROUP E PROGRAMMES
B.E. (HONS) :CHEMICAL :CIVIL :ELECT & ELECTRONICS :MECHANICAL B.PHARM. (HONS) M.M.S. M.SC. (TECH.) :COMPUTER SCIENCE :INSTRUMENTATION	M.SC. (HONS) :BIO SCIENCES :CHEMISTRY :ECONOMICS :MATHEMATICS :PHYSICS		M.A. (HONS) :ENGLISH :GENERAL STUDIES M.SC. (TECH) :MUSEUM STUDIES :SCIENCE& TECHN. DEVELOPMENT :ENGINEERING TECHNOLOGY :INFORMATION SYSTEMS		M.V.S :INFORMATION MANAGEMENT :COMPUTER OPERATIONS AND APPLICATION :HUMAN POTENTIAL :RURAL DEVELOPMENT :PARAMEDICAL SERVICES		B.S. :IN SELECTED FORMAL DEGREES IN GROUPS A,B AND C :TECHNOLOGICAL OPERATIONS :PHARMACY OPERATIONS :INDUSTRIAL MANAGEMENT

FOR ADMISSION

INTEGRATED FIRST DEGREE
NORMAL INPUT: TWELVE-YEAR PRODUCT OF THE 10+2 SCHOOL SYSTEMS FROM THE CENTRAL BOARD OR ITS EQUIVALENT WITH PHYSICS, CHEMISTRY, MATHEMATICS AND ADEQUATE PROFICIENCY IN ENGLISH

HIGHER DEGREE:
NORMAL INPUT : FIRST DEGREE OF BITS OR ITS EQUIVALENT

PH.D. DEGREE:
PREFERRED INPUT: HIGHER DEGREE OR BITS OR ITS EQUIVALENT

NON-FORMAL : SEE ELSEWHERE
OTHER INPUT: SEE ELSEWHERE

Figure 2.1 - Three-tier Educational Structure of BITS.

classrooms are replicated and entire evaluation is done by BITS faculty resident at the stations.

Every single degree student at the first degree level has the option to choose or withdraw from PS stream. The first component of the Practice School program, Practice School I, is of approximately two months duration and is conducted during a summer term, while the other component, Practice School II, is of approximately six months duration and is conducted throughout the year. Students have the option to choose either first semester or second semester for the same.

Those single degree students, who do not choose PS option, are required to take Thesis and Seminar (TS) courses in their final semester.

2.3 ACADEMIC MONITORING SYSTEM

The innovative, open and flexible educational system will invariably fail in the absence of meticulous, stringent and fool-proof monitoring system. The academic monitoring system at BITS provides this monitoring at various levels beginning with the monitoring of the entire educational system ending in monitoring of each individual student.

2.3.1 The Senate

The Senate is the apex academic body of the Institute and can be visualized as the designer, planner, implementor, and administrator of the educational system. It creates, reviews and redesigns the rules governing the operations, degree programs, program structures, courses, course contents, teaching and evaluation methods, committees on academic issues and all other academic tasks.

Actions of all statutory and non-statutory committees on academic matters are reported to the Senate. All actions and decisions of the senate are either reported to or approved by the Board of Governors (BOG) of the Institute.

2.3.2 Examination Committee (EC)

Examination Committee is a high powered standing committee vested with the day to day monitoring of the educational system. In particular, it monitors the process of teaching and evaluation and maintains the credibility and integrity of the system. No grades or results are valid unless they are approved by the Examination Committee. Such a committee cannot perform its task meticulously unless it is equipped with a wealth of information.

2.3.3 Academic Regulations (AR)

Academic Regulations are the nerve center of the academic monitoring of the educational system and the students. These are the rules governing the operations and are framed and amended by the Senate. The current regulations came in force from the academic year 1981-82. The task of monitoring, management and processing of academic records is the task of implementing the Academic Regulations, manually or through a computerized process.

The processes and procedures, of monitoring and decision making, are completely described in these regulations at the individual students' and course's level. It spells-out duties and powers of various academic administrators of the academic monitoring process.

2.3.4 The Bulletin

The Institute Bulletin is another important document in the monitoring process. The Bulletin is published for every academic year and describes the current educational structure, various degree programs offered, course requirements, semester-wise patterns, courses and course descriptions. It also provides certain rules governing the current operations and course prerequisites and restrictions.

2.3.5 Academic Counseling

In the flexible educational system, continuous monitoring of student's academic performance and progress assumes importance. Academic Regulations prescribe a minimum academic standard of overall cumulative performance from each student, in order to maintain an academic standard at the institutional level. The Senate appoints a high level body of students and faculty, called Academic Counseling Board (ACB), to watch, counsel and monitor those students who fail to maintain these expected minimum requirements. Students falling short of stipulated minimum requirements are referred to as "under the purview of ACB" and all actions of such students are prescribed by ACB, while ACB is charged with the responsibility to steer them out of its purview.

2.4 SOME DEFINITIONS

To comprehend the BITS educational system, an understanding of the terminology will be helpful. The terms that will be frequently referred to are described below.

(a) Degree Program - The set of prescribed courses sequentially distributed over the required number of semesters/terms that must be studied and cleared for a degree.

(b) Semester/Term - Every academic year is divided into two regular semesters, each of approximately 18 weeks duration and a summer term of normally eight weeks duration. Semester is the basic unit of reckoning for management of educational system.

(c) Unit - A convenient metrics for the effort required for a course in terms of number of hours per week. Each course has specific units attached to it and a minimum number of units are prescribed for each degree program in the Academic Regulations.

(d) Semesterwise Program - It consists of the prescribed set of courses of a degree program described in the Bulletin [16], adding to a certain total number of units in each semester for an anticipated normal progress through the program. The courses are distributed over the semesters taking care of prerequisites, prior preparations, offerings and academic growth of the student. This is also called "semesterwise pattern." Figure 2.2 shows a typical semesterwise pattern for a four-year first degree.

(e) Normal Load - The prescribed courses/units for a semester in the semesterwise program are called normal load.

(f) Prerequisite - If a course (say A) requires prior knowledge of another course (say B), course B is a prerequisite of course A. Often a set of courses are linked in a complex manner and the prior knowledge may be specified varying from a minimum level of performance to a concurrent registration. Prerequisites provide local points of monitoring for individual courses.

(g) Prior Preparation - In order to cross from a lower level to a higher level, if a set of courses must be cleared, the set of courses are called prior preparation. This is also, sometimes, called "platform prerequisite." Prior preparation provides monitoring for a group of courses and progress from one level to another.

(h) Grades and Reports - In the process of continuous evaluation, the performance in all components of evaluation is aggregated at the end of the semester and based on the relative performance of all the students registered for the course, the instructor-in-charge awards grades or reports to all students.

There are two kind of grades, (i) letter grades and (ii) non-letter grades. Letter grades are denoted by letters "A" to "E" and have grade points and a qualitative meaning associated with them in a quantified hierarchy, Table 2.1 gives the details of letter grades. Non-letter grades have only a qualitative meaning and hierarchy and are applicable to specific categories of courses.

A report is used to record, by a suitable word or letter(s), certain events/facts that prohibit the

BITS , PILANI   BASE CHART FOR 8816 Onwords   29 DEC , 1991

CHART CODE A6PS   SEM: 1   PATTERN NO. 1806

YEAR	CODE COURSE NO		COURSE TITLE (I SEM)	UNITS		CODE COURSE NO		COURSE TITLE (II SEM)	UNITS	
I	618 MATH	D131	CALCULUS	2		469 BIO	C111	GENERAL BIOLOGY	3	
	912 SCI	E141	PHYSICAL SCIENCE	2		471 CHEM	C112	INORGANIC CHEMISTRY	3	
	483 CHEM	C111	ORGANIC CHEMISTRY	3		527 PHY	C112	ELECTRICITY & MAGNETISM	3	
	489 PHY	C111	MODERN PHYSICS	3		525 MATH	C112	HIGHER CALCULUS	3	
	485 MATH	C111	LINEAR ALGEBRA	5		897 TA	C132	WORKSHOP PRACTICE	4	
	494 TA	C111	ENGINEERING GRAPHICS	4		515 AAOC	C111	PROB & STAT	3	
II	476 ES	C112	THERMODYNAMICS	3		575 AAOC	C212	SOCIAL ENGINEERING II	3	
	528 PHY	C211	OPTICS & WAVE MOTION	3		531 TA	C122	COMPUTATION TECHNIQUES	3	
	589 MATH	C211	COMPLEX VARIABLES	3		566 MATH	C212	DIFF EQN & FOURIER SER	3	
	573 TA	C211	MEASUREMENT TECHNIQUES I	2		902 TA	C222	MEASUREMENT TECH II	4	
	529 ES	C211	CIRCUIT THEORY I	3		560 ES	C212	ELECTRONICS I	3	
	581 AAOC	C211	SOCIAL ENGINEERING I	3		563 ES	C242	STRUC & PROP OF MAT	3	
	491 PSY	C211	INTRODUCTORY PSYCHOLOGY	3		599 AAOC	C222	OPTIMISATION	3	
SUMMER	600 BITS	C221	PRACTICE SCHOOL I	5						
III	114 MGTS	C341	ECON ENVIR OF BUSINESS	3	CDC1	117 MGTS	C352	PERSONNEL MANAGEMENT	3	CDC1
	115 MGTS	C351	ORG BEHAVIOUR	3	CDC1	112 MGTS	C327	MARKETING	3	CDC1
	121 MGTS	C361	ACCOUNTING AND FINANCE	3	CDC1	116 MGTS	C337	GOVERNMENT & BUSINESS	3	CDC1
	595 TA	C311	REPORT WRITING	3		119 MGTS	C342	PRODUCTION MANAGEMENT	3	CDC1
	516 AAOC	C311	DATA PROCESSING	3		597 AAOC	C312	OPERATIONS RESEARCH	3	
	....		....		EL	598 AAOC	C322	SYSTEMS	3	
IV	....		....		EL	554 BITS	C412	PRACTICE SCHOOL II	20	
	....		....		EL					
	....		....		EL					
	....		....		EL					
	....		....		EL					
	....		....		EL					

Figure 2.2 - A Typical Semesterwise Pattern for First Degree.

instructor-in-charge from awarding a grade. Table 2.2 give the details of various reports and situations under which they arise.

(j) Cumulative Grade Point Average (CGPA) - The metrics for the overall performance of a student in all courses in which letter grades have been awarded, since one's entry into the Institute is called "Cumulative Grade Point Average" or CGPA. It is the weighted average of the grade points of all the letter grades received by a student and is computed as follows:

$$CGPA = \frac{u_1 g_1 + u_2 g_2 + u_3 g_3 + \ldots}{u_1 + u_2 + u_3 + \ldots}$$

where u_1, u_2, u_3, . . . denote the units associated with courses and g_1, g_2, g_3, . . . are the grade points of letter grades (Table 2.1) obtained in the respective courses by the student.

If a course is repeated, the previous performance is replaced by the grade points of the new performance in calculation of CGPA.

(k) Grade Sheet - At the end of each semester every student gets a "Grade Sheet" (GS), which reflects the academic performance in terms of grades and reports for all the courses registered for the semester and the CGPA. For mailing conveniences student's address is also printed on the grade sheet.

(m) Transcript - Chronologically organized grade sheet(s) with necessary explanation sheet(s) constitute the "Transcript", which is issued at the time of leaving the Institute, after or without completing the program, to every student.

(l) Eligibility Sheet - The prescribed semester wise pattern and additional requirements, if any for each student, which is continuously updated at the end of each semester by the

TABLE 2.1

LETTER GRADES AND GRADE POINTS

Letter	Qualitative meaning	Grade Point attached
A	Excellent	10
B	Good	8
C	Average	6
D	Poor	4
E	Exposed	2

(Source AR [3], p.22)

TABLE 2.2

POSSIBLE REPORTS FOR A REGISTERED COURSE

Report	Letter	Situation Under which Arise
Incomplete	I*	When some requirements not fulfilled by the deadline but is likely to be fulfilled soon by the student.
Grade Awaited	GA*	When operational and practical difficulties are the cause of delay in communication of a grade.
Withdrawn	W	When student is not able to continue in a course and using the flexibilities, with permission with in stipulated period, drops the course.
Registration Canceled	RC	When registration in a course is canceled due to administrative academic reasons.
Discontinued from the Program	DP	When student leaves the Institute in the middle of a semester or is required to discontinue the current program.
Required to Register Again	RRA	In a RC situation when it is clearly known that student will be required to register again in the same course.
Not Cleared	NC	When the instructor-in-charge did not get enough opportunity to evaluate a student.

* Reports "I" and "GA" are temporary and are replaced by the grade/report as and when the condition(s) under which they were awarded are cleared.

student's performance in the semester, is known as "Eligibility Sheet" (ES). This is unique for each student.

(h) Instructor-in-charge - Every course is conducted by a member of the faculty called "Instructor-in-charge," with the assistance, where necessary, of one or more "Instructors." The instructor-in-charge is responsible for evaluation and awarding final grades/reports and transmitting them to update the students' records and further processing.

2.5 FLEXIBILITIES OF THE EDUCATIONAL SYSTEM

The educational system is designed to provide unique structural and operational flexibilities to fulfill the worthy objectives of the students and the administrators. The flexibilities need an administrative section and a contract of acceptance of responsibility both by the recipient and by the donor. The structural flexibilities provide enough lateral and vertical mobility for a student.

The flexibilities can be classified into two categories (i) admission oriented, and (ii) academic oriented. These flexibilities have a direct influence on the design of the SAIPS and are to a large extent responsible for making the processing and monitoring more difficult. The magnitude of complexity added to the tasks could only be comprehended by listing and describing the flexibilities in the above categories. A complete description and operational details of flexibilities can be found in Academic Regulation [3] and Bulletin [16].

2.5.1 Admission-Oriented Flexibilities

Admissions policy and educational system, as described in the above sections, provide for multiple entry points for a student. Admission-oriented flexibilities, operate as a part of admissions process. Although it not with in the purview of this Thesis, the system of monitoring after admissions has to provide scope for these flexibilities.

(a) Admissions in Both Semesters - The semester system, course by course progress and predefined semesterwise patterns for various degree programs support a structure such that admissions can take place in both semesters.

(b) Admissions with Marginal Deficiency - This provides for admission of a brilliant candidate, whose qualifications are marginally less than the prescribed minimum entrance qualification, in terms of stated courses/subjects. For such a student additional courses are prescribed over and above those for a student with normal preparation. This alters the semesterwise pattern, the sequence of courses, the progress and monitoring requirements for such a student.

(c) Admission with Advanced Standing - A meritorious candidate with a preparation higher than the prescribed minimum entrance qualification can enter at some intermediate point in the semesterwise program under the admissions with advanced standing.

Such a candidate will enter with a program where certain courses are exempted and remaining courses are to be done at the Institute. Obviously, the progress and monitoring will be different from other students. Each student entering under this flexibility will be different from the rest.

(d) Dual Degree - The modular structure of the semesterwise program and the course requirements for a program make it possible for a student to work for and complete concurrently two first degrees. The admissions to second degree normally take place after the student has spent one academic year at the Institute.

A student admitted to dual degree follows a composite program which contains compulsory courses of both the degrees, TS, PS, CDC package for the two degrees and a set of electives.

(e) Transfer - Students can be permitted to change their program to another program without having to start from the beginning in the new program. Monitoring of such students would require carrying the burden of previous program, and credits earned out of that for the new program, at the time of transfer.

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2.5.2 Academic-Oriented Flexibilities

Flexibilities, within the Academic Regulations, which make it possible for a student to deviate from the prescribed pattern and those inbuilt in the educational structure are classified as academic-oriented flexibilities. These include, choice of electives of various kind, performance improvement, departure from normal pace, withdrawal from or substitution of course(s), audit, choice of time-table etc. These flexibilities are exercised by almost all students and are a part and parcel of the computerized academic monitoring system. How these have been built into complex software is explained in the later chapters. A brief description of the flexibilities follows.

(a) Departure from Normal Pace - The course wise promotion feature of educational system enables student to choose a pace and time for completion of program. A student can choose to go slow or accelerate from the normal pace, specified in the eligibility sheet of the student, provided the rules are not violated.

One who chooses to go slow takes more time and stays longer while one who accelerates, completes the program earlier than a normal student.

(b) Repeating a Course - A student with a view to improve the performance, at own option, can repeat a course already cleared, provided it is permissible under the regulations.

(c) Elective - Each program provides slots for a fixed number of electives. The student can select courses to fill these slots from all courses outside compulsory, named courses. The flexibility in choosing the courses serves the objective of satisfying one's curiosity, enriching aptitudes, choosing specializations or preparing for further studies and competitive examinations.

(d) Optional Elective - Optional elective is an extension of concept of electives. A first degree student can do a prescribed number of courses outside the program, under the category of optional elective, to fulfill additional aspirations.

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(e) Audit - Certain courses which are not part of any program are available on audit basis. The performance in these courses is in terms of non-letter grades and does from a part of CGPA.

(f) Substitution - Within a prescribed time from the beginning of a semester/term a student can request for change of a course already registered.

(g) Withdrawal - In the middle of the semester, if a student is not able to cope with a course, they can request for a withdrawal from the course within prescribed time. The course will carry a report "W" in the grade sheet.

(h) Semester Drop and Semester Withdrawal - A student can drop a semester with prior approval and need not register in the semester. Similarly, a registered student can withdraw from the semester, on genuine grounds, any time during the semester. All the registered courses carry a report "W" in the grade sheet for such a student.

(i) Time-Table - The time-table is course-oriented and, therefore, permits various flexibilities to the students. The student has freedom of choosing one's own time-table in terms of daily and weekly hours, teachers in multisection courses and courses under various categories. A student can take courses across adjoining years. The time-table design provides support to various flexibilities like admission-oriented flexibilities, pace, repeating a course, electives and optional electives choices which cut across the year, level and disciplines, dual degree etc.

2.6 THE REGISTRATION

The educational structure at BITS has many in-built flexibilities as explained in the above sections. In order to fully and meticulously exploit them to meet the academic goals by both, the educational administrators and students, at the same time preventing any misuse, a scrupulous monitoring process is essential. This monitoring is provided by the registration process, which gives an algorithmic approach for record keeping, monitoring and control.

One of the key steps provided by the Academic Regulations, in the academic monitoring process of students on a continuous basis from admissions until graduation, is the Registration. Every student is required to formally register in each semester, right on the first day of the semester. This is one of the key reforms which has been introduced and perfected at BITS, as well as, it is one of the foundation pillars of the continuous academic monitoring process. Referring to Figure 1.3, Chapter One, one can see that the first question asked is: "Is Registered?" This marks the beginning of navigation of the student through the educational process of a semester. A student who is not registered stays away from the campus and either discontinues the studies at BITS or seeks permission to drop the semester.

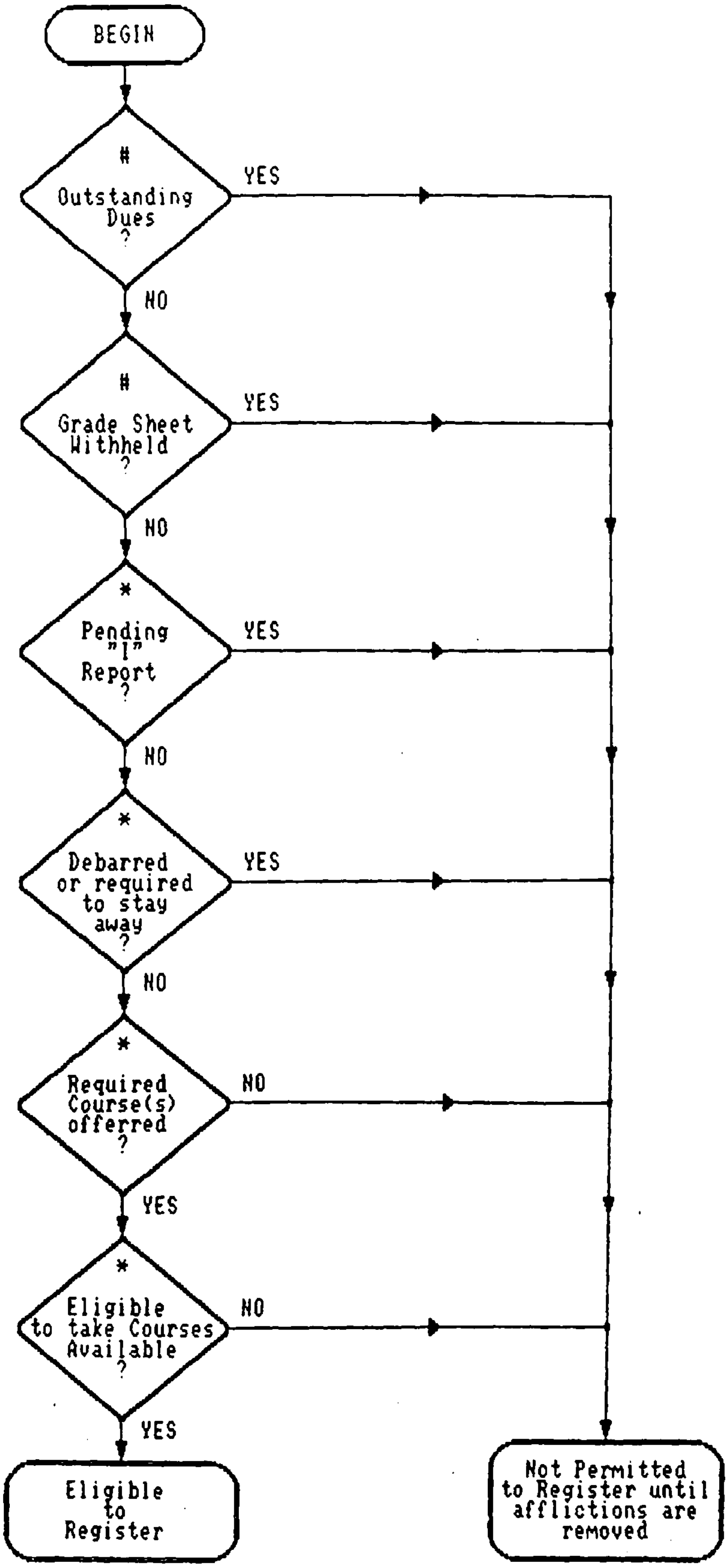
2.6.1 Registration Requirement

The registration requires an academic registration in each course of the course package worked out from the students' eligibility sheet under the guidelines of Academic Regulations, Bulletin and flexibilities of the educational system.

Students have to meet certain requirements before they are permitted to register for a semester. These requirements are explained in a flow chart form in Figure 2.3. Many of these requirements are checked by the SAIPS or other peripheral computerized processes before a student is declared as "eligible to register." Figure 2.3 also shows the checks that are or can be performed by the computerized processes.

2.6.2 The Registration Process

The process of registration begins by determining a course package for the student. This, in as much as prescribed as per the students' eligibility sheet, Academic Regulations, Bulletin and time-table is pre-printed on a "Registration Card"



NOTE:

* Checks performed by Students' Academic Information Processing System (SAIPS)

Checks performed by other peripheral processes.

Figure 2.3 - Check for Eligibility to Register.

(Appendix A) which also contains other pertinent information about the student and is used as an instrument to carry out the registration. The package also includes elective slots available to the student.

The student chooses the courses to fit in the slots, exercises flexibilities available and prepares a time-table. The process of registration is depicted as a flow chart in Figure 2.4. For each course in the package the student has to register by procuring a seat. Once the registration in all courses is over and time-table has no clashes the students' registration is said to be complete.

2.6.3 The Registration Card

The registration card described above is not merely a sheet of paper to record the section/course allotments for a student. It is a very important document and serves for a variety of needs.

For each student there is a separate registration card that initially contains the prescribed course package for the student. The student may make permissible alterations in the package in consultation with the Registration Advisor. The student gets a seat allotted in each course in the process of registration and a record to this effect is made on the registration card. After seats for all the courses are allotted, the student and the Registration Advisor sign the registration card as a token of completion of registration for the student. Thus, the registration card becomes a vital document for the monitoring process. All subsequent actions of revision and/or amendments of registration are recorded on the registration card of the student. The registration card also serves as the computer generated proforma for speedier and accurate feeding of information into the computer.

The registration card is prepared by the SAIPS for each student, who is expected and is eligible to register, and is so designed that the process of registration for about two thousand students is completed in less than five hours. The

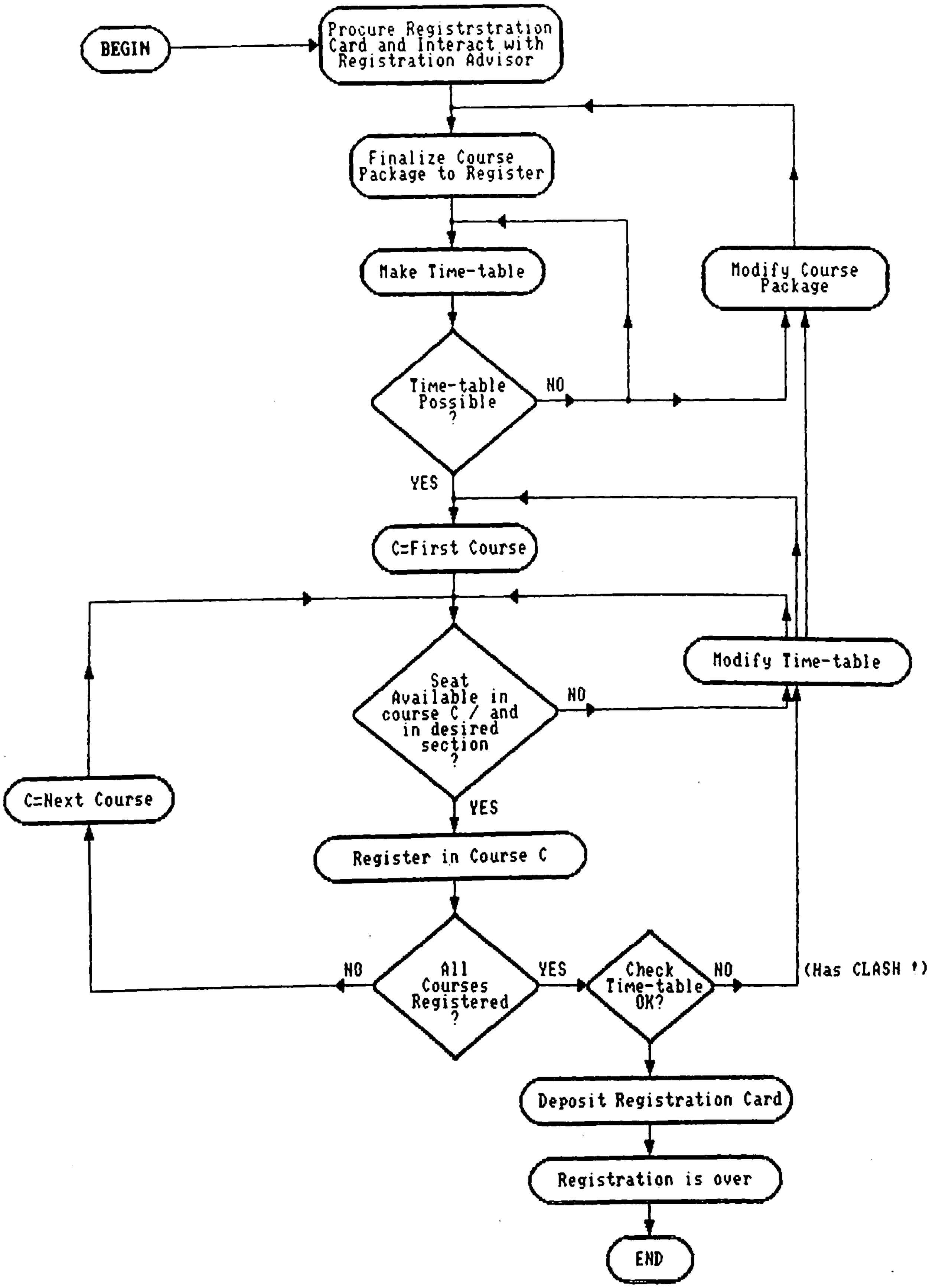


Figure 2.4 - The Registration Procedure.

complete details and software for the process of course package determination, registration card design and its preparation are presented in later chapters. A sample registration card is given in Appendix A.

2.6.4 Registration and Academic Monitoring

The registration process not only provides a meticulous monitoring at the beginning of a semester but also serves many other objectives of academic monitoring for carrying out the educational process smoothly. Some of the gains of the registration process are enumerated below.

(i) Information about the courses/sections taken by each student is available immediately after the registration. Through a transformation process, this is converted into coursewise and each instructor/instructor-in-charge gets a list of all students registered in their course/section. Thus, right in the beginning of the semester the teachers know who are the students in their course/class. The lists also serve the purpose of "attendance register" and "marks register" for the faculty.

(ii) Consolidated information on number of students in each course and/or section is available to take actions on reinforcing or dropping courses.

(iii) Statement on not registered student is available.

(iv) The registration of each student is validated in terms of the rules governing the operation. This process of validation is explained in later chapters.

(v) Revision and/or amendments of registration are easy.

(vi) Towards the end of semester, the latest information on courses from the registration card is transformed in to coursewise proforma called "Grade List." A sample of grade list is included in Appendix A. Grade List is designed for transmitting the reports/grades awarded by the instructor-in-charge and error-free, fast feeding into computer.

Many other groupings and segregations are done based on the registration information for future course of action and planning of semesters to come, viz., likely graduate, likely Practice School I/II, likely thesis, etc. The micro-details of the processing requirements for monitoring, management and planning are explained in the next chapter.

2.7 PERIPHERAL PROCESSES AND RESEARCH AREAS

There are several other related activities in the BITS educational system that directly or indirectly influence the academic monitoring and records management process. Most of these although not forming a part of this Thesis, have been computerized as peripheral process to SAIPS or independently. Many of these are defined areas of ongoing and completed doctoral research projects at BITS. Dey [23], Natarajan [54], Raman [57], Venkatasubramanian [74] etc. are some examples.

A brief description of these processes is presented in the following sections.

2.7.1 Admissions

The admissions process at BITS is fully computerized. Admissions to nineteen first degree programs are done through one application form through a well-known, time-tested and established normalization system, strictly on merit based on academic performance in the qualifying examination.

Admissions to dual degree are done normally at the end of first year on the basis of academic performance at BITS.

2.7.2 Time-Table

Time-table is one of the key input to the SAIPS. It must be ready before the tasks for a semester can begin and must be updated on-line to correctly process and monitor the academic records.

The process of making the time-table is itself a complex problem. It can be visualized as a multidimensional assignment problem with multiple constraint of courses, students, teachers, programs, rooms, hours, comprehensive examination dates and directions from administrators that have to be simultaneously satisfied and to provide for various flexibilities of the educational structure. This forms a part of ongoing research at BITS, some references are Agarwal [4], Anand [9], Narayanan [52], and Raman [57].

2.7.3 Practice School

Practice School is not just two courses to be done by a student. The organization of the Practice School I in as many as 70 different locations with 600 students and Practice School II in about 40 locations with 300 students is colossal task in itself. The task of monitoring and evaluations of students in such a wide network is therefore more perplexing. The monitoring and evaluation of PS students has been computerized, Dey [23].

It requires a meticulous planning and that too, should begin many semesters in advance. This forecasted information is provided by SAIPS. The semester allotment and PS station allotment to individual students is done in accordance with the Academic Regulation by PS Division and the information fed to SAIPS which in turn has to provide for specific academic monitoring steps for PS students.

The organizations, where students go for the Practice School, are provided with a profile on each student which contains personal and up-to-date academic information on the student. This is called "PS Profile" and is produced from the student's academic and personal records. The computerization of PS Profile has been done, Mayor [49].

2.7.4 Academic Counseling Board

Academic Counseling Board is the senate appointed body for monitoring the academically poor students. A student under the purview of ACB is steered and monitored by the ACB. ACB is empowered to overrule many of the Academic Regulations. It decides the course package and pace for the student, can amend the registration, takes mid-course corrections and interacts with the student and course instructors.

ACB is supplied with the information on the students under its purview, like, afflictions from which a student is suffering, students' latest status, a possible course package for coming semester etc., from time to time so that is takes decisions and these decisions of ACB are fed to SAIPS for further processing.

2.7.5 Statutory Bodies

There are other statutory bodies like Examination Committee, Standing Committee on Students Discipline etc. that may take decisions on academic or non-academic matters which have a bearing on the academic progress or performance of the student. For example, revision of grade/report in a course done by a student in past, cancellation of registration in one or more or all courses of the current semester as a punishment and debarring to register in a future semester.

All these decisions are input to SAIPS so that their implementation is ensured and monitoring is done without gaps.

2.7.6 Other Systems

In the University environment, the academic monitoring has to integrate with the other functions of the University administration, particularly those dealing with students.

One such system is concerned with the finance. Every student is required pay fees and other required charges semester after semester. This has been linked to the registration by the Academic Regulations as shown in Figure 2.3. Therefore, unless this aspect is integrated and computerized the monitoring cannot be complete.

At BITS, the student's accounts have also been fully computerized and it not only takes care of the Institute dues i.e. fees etc. but it also takes care of the dues they accrue in their mess, associations, coop and other recognized activities.

The students' fees and personal accounts have been computerized as a peripheral process to student's academic records monitoring system because up-to-date, fixed and status, information on the student is available there.

Similarly, students' Railway Concessions' preparations have been computerized, Banerji [13], and development is going on to build archives of passed-out and left students, Chandra [18], Narayanan [52], and Suresh [71]. The students' personal information has been also computerized, Chandra [19], Jhaveri [39], and Suresh [72].

2.8 SUMMARY

BITS Educational structure and system has very many novel features, flexibilities and complex monitoring requirements. These are unique in the educational scene of the country.

The effective use of the flexibilities and features of the educational system is made more effective and fruitful for the students and administrators by the formal Registration and Counseling procedures.

All these and the fact that each student is a separate entity having unique tailor-made semesterwise program, makes the record-keeping and monitoring a humanly formidable job. BITS has fully exploited the available computer facilities for this task. A brief historical sketch to this fact was presented in Chapter One. The next chapters deal in depth with the software development tasks and infrastructure for the educational system just described and provide the line of action for educational institutions who wants to develop their own academic monitoring and management systems.

CHAPTER THREE

ESTABLISHMENT OF REQUIREMENTS FOR COMPUTERIZATION

3.1 INTRODUCTION

The requirements from the computerized academic monitoring and management system have to be established before any design of software can take place. In the last Chapter an attempt was made to present some complexities of educational structure, educational system and its monitoring requirements at BITS. In order to develop a computerized academic records monitoring, processing and management system, the microdetails of the system should be described with all intricacies along with the interrelationships and interdependence of various events and monitoring steps. A precise description of the system, its input-output and processes, input forms and output reports and their contents should be prepared.

This Chapter deals with the first phase of this aspect, that is, to establish the processing requirements and in turn develop preliminary design for the academic monitoring in an educational system with BITS as an example.

3.2 IDENTIFICATION OF PROCESSES

The major events of academic monitoring process in the semester based system can be identified in the time frame of the beginning of the semester and end of the semester. Typical events in a flow chart form for academic monitoring process were detailed in Figure 1.3, Chapter One. The level 00 information flow diagram (IFD) of SAIPS given in Chapter One, Figure 1.2 can be exploded to reveal more details of the process. This one level deeper IFD is given in Figure 3.1. It identifies the major processes of the system and brings out the input-output and processing details. Processes which form a part of computerized system have been numbered, 1, 2, . . . 6, while the processes which are peripheral and decision making and information generators are labeled as

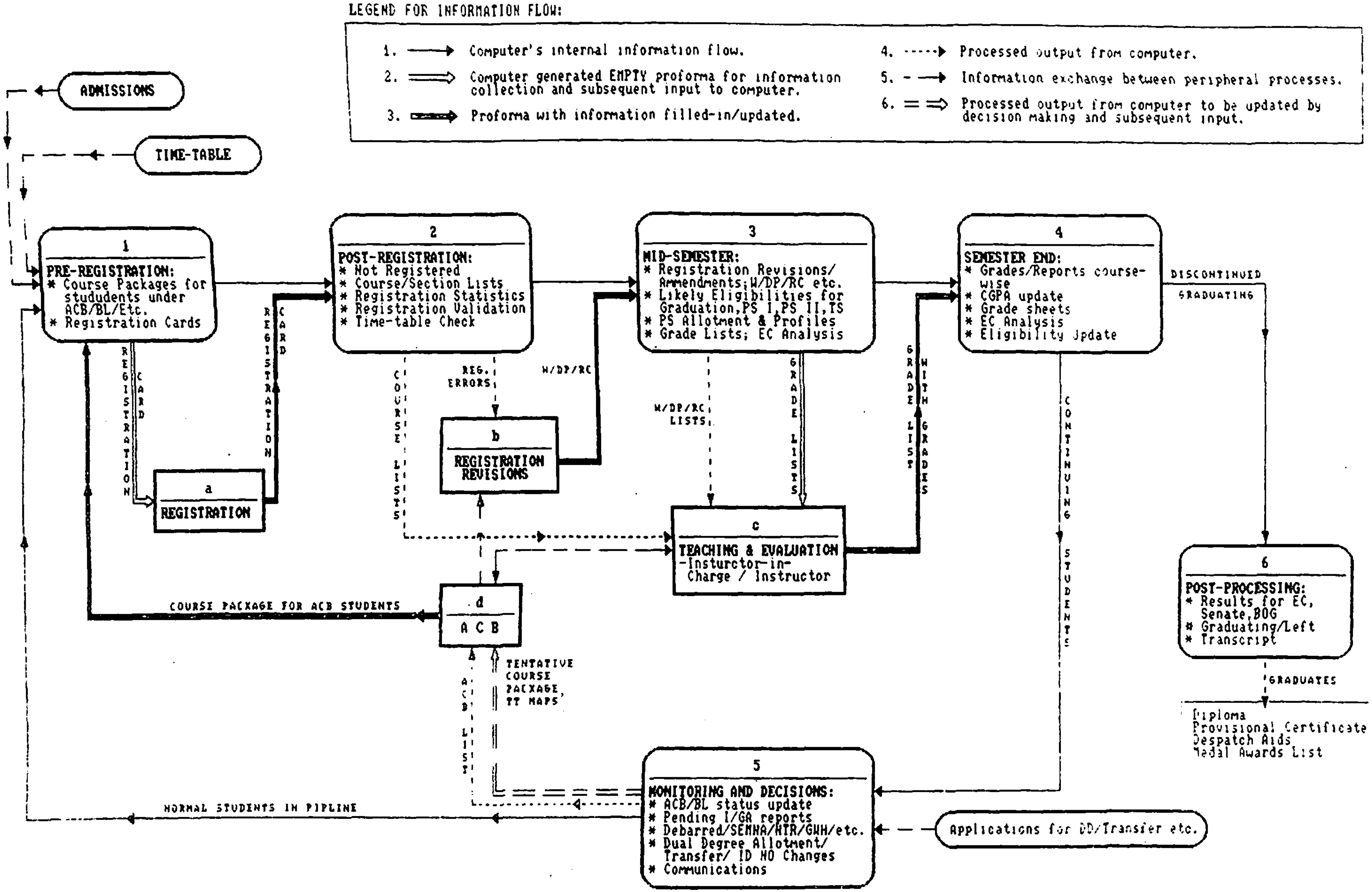


Figure 3.1 - Identification of Major Processes and Processing Needs for Academic Monitoring and Management of Students' Records. (Level 01 Information Flow Diagram)

a, b, c etc. Peripheral processes have been described in the previous Chapters. The description of processes for computerization follows. Figure 3.1 has to be referred further to expose more details.

3.2.1 Process 1 - Pre-Registration

The first process identified is for all preparation that must be done before the registration takes place. This process is called "Pre-Registration" and it includes all activities and operations that lead to smooth registration of over 2000 students in shortest possible time. The major output of this process is a registration card for each eligible to register student with prescribed course package.

The input to this process are new admits information, time-table information, ACB/BL students' course packages worked out by appropriate bodies with the help of computer generated packages for such populations, and internal information of continuing students updated from the last semester. The activities of this process must be completed well before the registration day.

3.2.2 Process 2 - Post-Registration

Registration takes place on the "Registration Day" with the help of Registration Card and a meticulous organization of whole process. The information generated by the registration process (process b, Figure 3.1) in terms of course changes in the printed package, courses chosen to fill the slots, course/sections registered is fed into the computer through a data entry process.

Once all data generated by registration process is fed-in, it is internally and externally verified. The data entry processes, verifications and related software issues are discussed in Chapter Five. This information is then processed to generate various reports like, course/sectionwise registration statistics for registered students, coursewise and sectionwise lists for Instructor-in-charges and Instructors, and not registered students lists and communications for them.

One of the most important processing which is done at this stage is "Registration Validation." Prior to computerization, this had been a humanly formidable and error prone task.

Registration of each student is checked in terms of Academic Regulations and other rules governing the operations and all errors are reported. Registration is checked for each course, course category and group of courses registered as per specified rules of operation. For example, violations of prerequisites, prior-preparations, prescribed package, time-table restrictions, registration guidelines, or registering in a not allowed course, registering in without Dean's permissions, etc. are some of the registration validation checks being performed.

The overall time-table of the student is also checked for various types of clashes, such as, hour clash, tutorial clash, comprehensive examination date clash, or no lunch hour. To accomplish this processing the Academic Regulations and other rules have been translated into software. The details, how this has been done, are given in sixth Chapter.

It is obvious that the course lists, not registered students list and registration errors are available to appropriate counters immediately after the registration is complete. This poses severe time constraints on the entire post-registration processing.

3.2.3 Process 3 - Mid-Semester

The actions taken on registration errors, student initiated or other revisions and amendments of students' registrations in terms of reports like W/DP/RC in registered courses or changes in course packages are input to the mid-semester stage.

The processing is done in several stages and time frames. Based on the up-to-date status of students', various likely eligibility checks are performed and reports are generated. These are very important documents for the future planning and scheduling of various academic activities.

Towards the fag end of the semester, the information is processed to generate coursewise proforma blanks for award of grades/reports, which are conventionally called "Grade Lists" (sample in Appendix A). Another report with summary and statistical information on registered students for each course is prepared for use of Examinations Committee as a tool for monitoring of the internal evaluation system.

The time frame of the mid-semester processes can be comprehended from the following. Academic regulations specify a time period for student initiated registration revisions, the likely eligible reports must be available sufficiently in advance, teachers should have latest status on students in their course, grade lists and EC Analysis must be available at the appropriate time and with the latest student status and administratively awarded or approved reports included in the print.

3.2.4 Process 4 - Semester End

The Semester end tasks of an academic monitoring system are associated with the processing of semester results and eligibility update based on the performance in the semester. The processing of results is done from the grades/reports submitted by the course Instructor-in-Charges in the Grade Lists.

The important reports are studentwise grade sheets and after the event EC Analysis for Examination Committee, which is also called "Grand EC Analysis." The student population is segregated after eligibility update into graduating (i.e. cleared academic requirements), discontinued and continuing.

The graduating and discontinued (left) students go for "post-processing," while the continuing students' records are cycled to "pre-registration" through "monitoring and decisions processes."

3.2.5 Process 5 - Monitoring and Decisions

In the monitoring and decisions process, the continuing students' information is processed to perform academic monitoring and decision making functions and prepare the system for next semester.

Reports on students under ACB (based on academic performance and progress), having backlog (BL) (based on academic progress), having pending "I"/"GA" reports (based on semesters' performance) are flashed for appropriate actions by concerned administrators.

The "likely eligible" of mid-semester are converted to confirmed eligibles and non-eligibles, and various course and course category based eligibilities are worked-out for use in preparation of course package for next semester.

Decisions on Dual Degree, transfer, Not to Register (NTR) etc. are also taken and various kinds of communications are generated from the system for the students.

3.2.6 Process 6 - Post-Processing

The processing of information for those students who go out of the system, either after completing the academic requirements or discontinue studies at BITS without completing the degree, is classified as "post-processing."

Takes included in the processing range from preparation of results for Examination Committee's approval, as and when the eligible population is cleared, for the award of degree; aggregation of the results for Senate and BOG, whenever their meetings are scheduled; transcript; provisional; dispatch aids; medals award lists etc.

3.2.7 Peripheral Processes

Processes a, b, c and d in Figure 3.1 and other processes not shown like, Practice School Monitoring, Thesis Monitoring, students' personal accounts, etc., are all processes where decision making is involved and new information is generated.

These processes are supplied with required information from the computerized processes (1 through 5), which is used in decision making. The decisions and other information generated through these processes becomes the input to various processes as shown in Figure 3.1.

It must be noted that in order to keep the information flow diagram readable, all the processes which feed and generate the information are not included in Figure 3.1. Only the important ones and information exchange with them have been included, micro-details of these and other processes and their information requirements will be recorded in the next sections. The success of these processes depends on timely completion of processes from which they get information while processes to which they feed have a direct bearing on them for timely completion.

3.3 TIME-SCALE IN PROCESSING AND MONITORING

In a semester based system, where each day is to be accounted for and the gap between two semester is very small, it is very important that each specified step of academic monitoring and processing is completed at the specified time and precisely. The interdependence and interrelations between the various processes is clearly evident from their description, in above section, and IFD in Figure 3.1, which also showed that failure in timely completion of any of the tasks will have a cascading effect on all the subsequent processes and in-turn on the system as a whole.

The time-criticallity of the various events, as it works-out for the BITS environment, is presented in Figure 3.2. In this Figure various computer and other external processes are identified on a time-scale for a semester. The time shown is in weeks from two landmark events of the semester, (i) the registration day, and (ii) the last day of comprehensive examinations.

The computer's processing requirements are spelt-out in greater detail in Figure 3.2 along with more precise definition

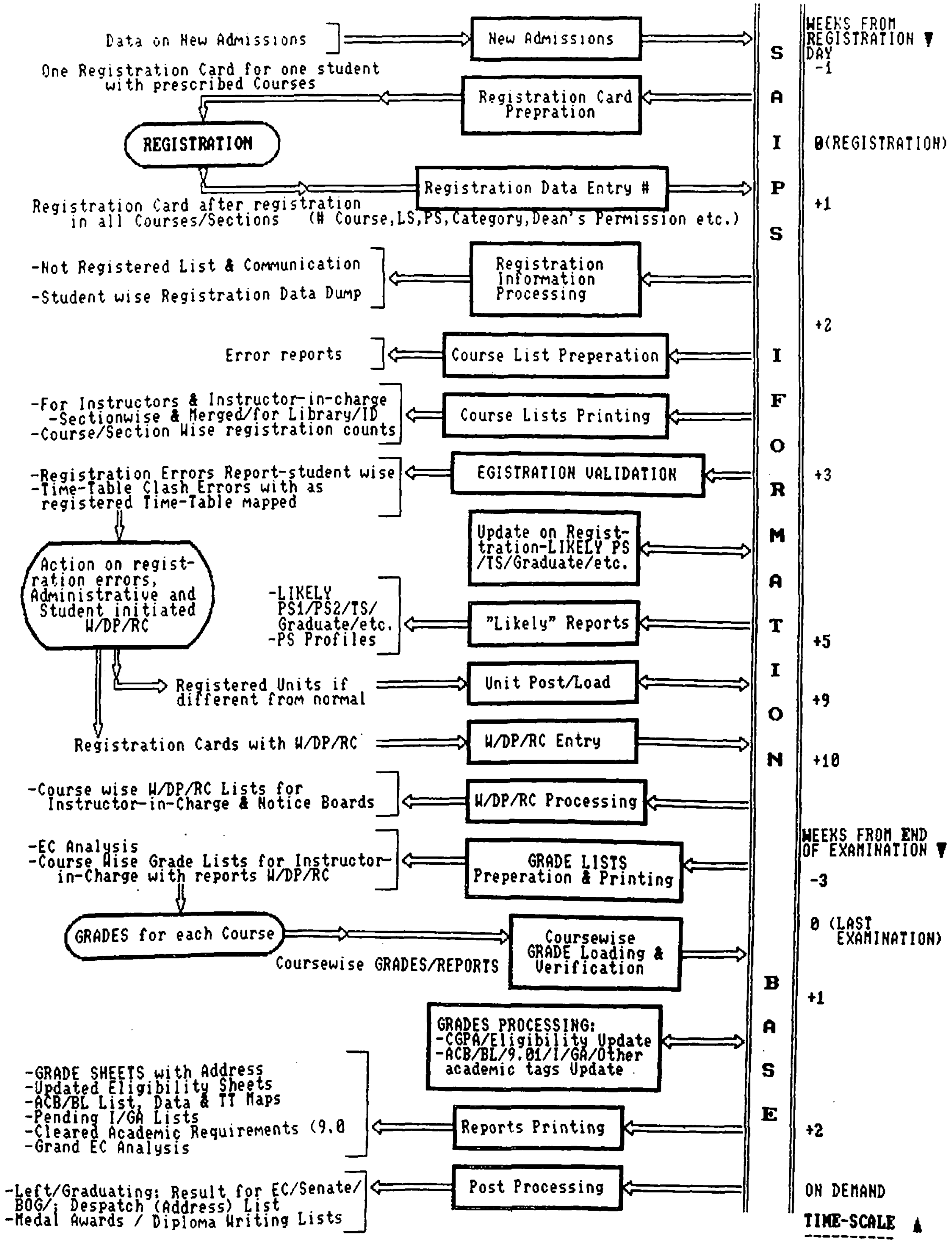


Figure 3.2 - Important Processes and Reports for a Semester.

of the input-output at each stage. The presentation in the Figure is in sufficient details and is self-explanatory to give macro details of the contents of various reports, what is to be input and what information processing is required at each stage.

This preliminary identification of processes, output reports and input information forms the basis of data design, software architecture design and software modularity. The specifications of input events and the time criticallity of subsequent events dependent on input, spell-out the requirements of data entry software, data entry forms and their design.

3.4 IDENTIFICATION OF INPUT RESPONSIBILITY AND OUTPUT REQUIREMENTS

The two aspects of requirements analysis, the process and processing identification and the time-criticallity of the processes was described in the previous sections. The third important aspect deals with the identification of counters, their duty, role and requirements to complete the software specifications for the system. This requires pinpointing,

(i) Who updates what and when? and
(ii) Who requires what and when?

With the answers to these, the interdependence of various pieces of information and a time scheduling for the input and output is evolved.

The requirements of various reports/forms and input information for them, in addition to SAIPS's own information base, are identified in Figures 3.1 and 3.2. A list of nineteen reports/forms identified is given in Table 3.1. There are some other reports which are either for manual verifications or for hard copy records or provide some piecemeal assistance to users in terms of updated information from time-to-time. Such reports are not included in the list. The information input to the system

TABLE 3.1

IDENTIFIED REPORTS/FORMS
(Samples are included in Appendix A)

Report No.	Report Description
1.	Registration Card
2.	Eligibility Sheet
3.	Not Registered Student's list and Communications
4.	Registration Errors and Time-table Clashes
5.	Registration Statistics
6.	Course Lists - Sectionwise and Coursewise
7.	Likely Graduate Students' List
8.	Likely Thesis(TS) and Practice School(PS) Lists
9.	Practice School II Profiles (PS Profiles)
10.	Coursewise Grade Lists and Analysis Sheets
11.	Address Lists
12.	Examination Committee Analysis (EC Analysis)
13.	Student Grade Sheets (Grade Card)
14.	Cleared Academic Requirements for Graduation
15.	Status Reports (ACB/BL/I/GA/etc.)
16.	Results for Examination Committee, Senate and Board of Governors
17.	Tentative Course Package and Time-table Map for ACB and Backlog Students
18.	Dual Degree Allotment - Letters, Lists, etc.
19.	Transcript and Provisional Certificates

is also similarly identified from the above two Figures and the list is given in Table 3.2.

Each output report/form requires one or more of these input information to be ready and keyboarded before the output can be generated. For example, the Registration Cards for the coming semester, for all students eligible to register, cannot be produced until the input of time-table, new admissions, TS/PS allotment, charts, and ACB/BL course packages, etc. is made. Table 3.3 gives the dependence of all the nineteen reports/forms of Table 3.1 on the input information of Table 3.2.

The counters, which are the Divisions and Units in BITS's parlance, which deal with some aspect of education or educational administration and are served by or feed to SAIPS, were identified and presented in Figure 1.5, Chapter One. The cross-section of the counters (Figure 1.5, Chapter One) and input-output requirements (Table 3.3) results in the identification of responsibilities and requirements of each counter as presented in Figure 3.3.

In Figure 3.3, the counters are categorized into, one, those feed information to SAIPS, and two, those receive information from SAIPS. As is obvious, most of the counters appear in both categories. The rules governing the operations, which come from the Senate, the Academic Regulations and the Bulletin, form another class at one end, while the Students, which receive various academic status reports, statements and communications, are at the other end.

3.5 SOFTWARE DESIGN SPECIFICATIONS

The analysis of the system and the establishment of requirements discussed in the above sections results in the software design specifications for the computerized academic records processing, monitoring and management.

The preliminary design of the system for the tasks established is clear from the level 01 information flow diagram

TABLE 3.2

INPUT INFORMATION

Input No.	Description
1.	New Admission Students' Information
2.	Coursewise Time-Table
3.	ACB/BL students' Course Package
4.	Semesterwise Charts for all students
5.	Administrative actions on student Status
6.	Registration Information
7.	Practice School(PS) and Thesis(TS) Allotment
8.	Administrative reports awarded due to registration errors or registration revisions/amendments (W/DP/RC)
9.	Students' Correct Mailing Addresses
10.	Coursewise Grades/Reports as awarded by Instructor-in-charge
11.	Cleared requirements of Graduation

TABLE 3.3

INTERDEPENDENCE OF INPUT-OUTPUT

REPORT NO. > INPUT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1.New Admission Student's Information	√		√																
2.Time-Table	√	√		√	√	√				√		√					√		
3.ACB/BL Student's Course Package	√																		
4.Semester-wise Charts	√	√		√			√	√				√		√	√	√	√		
5.Administrt-ive actions on student Status	√	√	√	√		√	√							√	√	√	√	√	√
6.Registra-tion Info-mation			√	√	√	√	√	√		√		√	√		√				
7.PS/TS Allotment	√	√		√			√	√	√								√		
8.Administra-tive awards of W/DP/RC										√			√		√				
9.Addresses			√						√		√		√					√	√
10.Coursewise Grades/ Reports		√										√	√	√	√	√	√	√	√
11.Cleared requireme-nts of Graduation	√	√	√				√							√		√			√

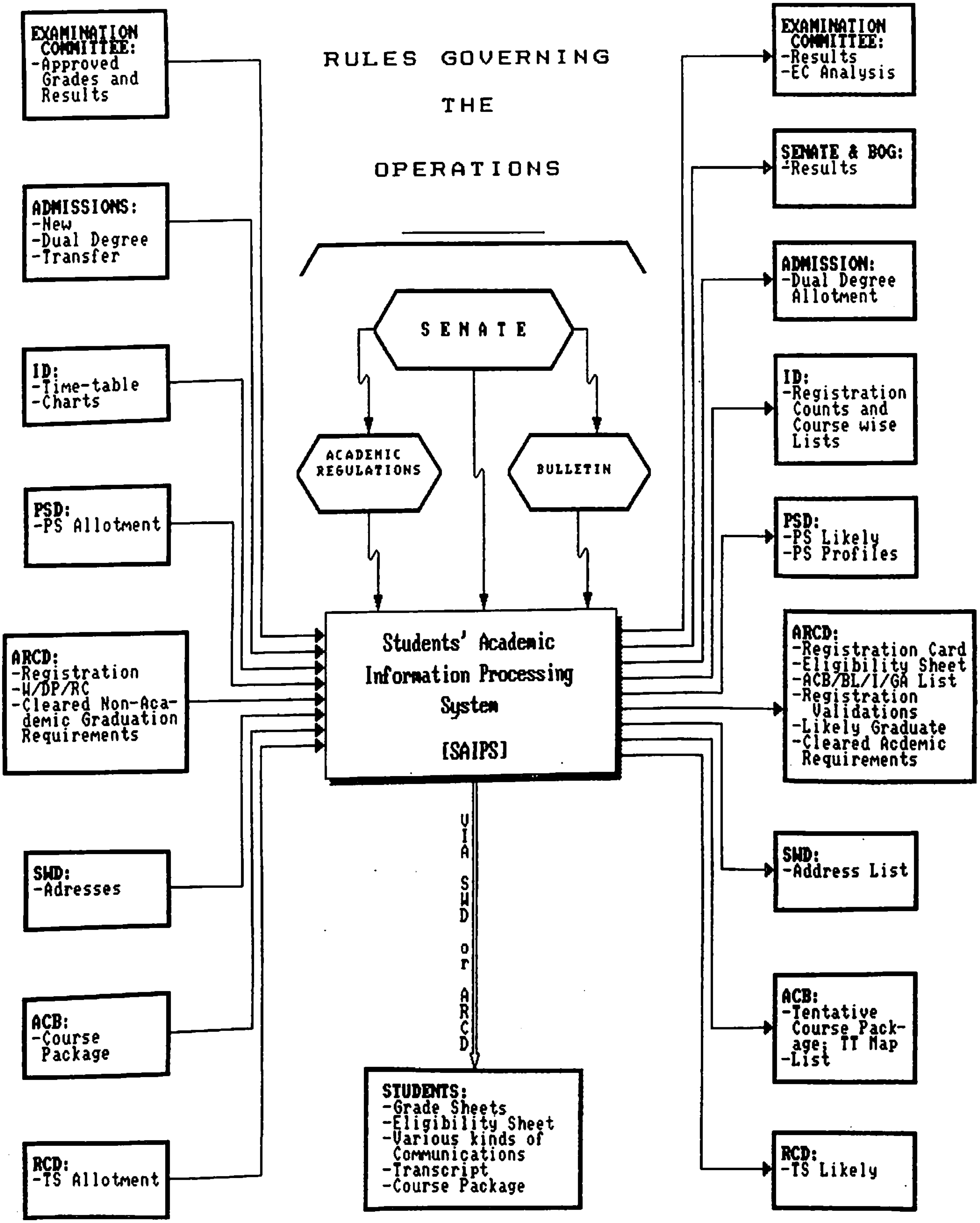


Figure 3.3 - Information Exchange Between SAIPS and Administrative Divisions, Units and Others Involved in Educational Administration and Monitoring (Counters Served).

of the computerized system, Figure 3.1. The system design activities begin with the completion of this preliminary design.

The steps in the software design process for the tasks of academic monitoring and processing are listed in Figure 3.4. It must be emphasized that the tasks of systems analysis, requirements analysis and establishment, design specifications and preliminary design appear to be distinct in Figure 3.4, one following the other, it is very difficult to separate them and complete them independently. They all are carried out simultaneously.

Similarly, the tasks of detailed design of data, input and processing cannot be carried out in isolation with each other. Each of them have a direct bearing on the other two. Therefore, although they are carried out simultaneously, the presentation is done as separate entities for simplicity and clarity.

3.5.1 Information Processing Design

The six processes, of Figure 3.1, need to be exploded to level 02 and further down, to reveal more details of information processing and to identify information transformations, contents and structures. The information processing needs are fulfilled by converting the identified processes into subsystems and modules of software for the physical systems. These exploded information flow diagrams of subsystems and modules, and their underling algorithms for final software design are discussed in Chapter Six with a description of each module and their integration into the overall software architecture.

3.5.2 Information Collection and Input Design

In order to generate the various reports and maintain the information base of the system updated, the externally generated information had to be collected and input. This input of information to the system takes three dimensions,

(i) The documents or proforma used to collect information,
(ii) The keyboarding of information into computer, and

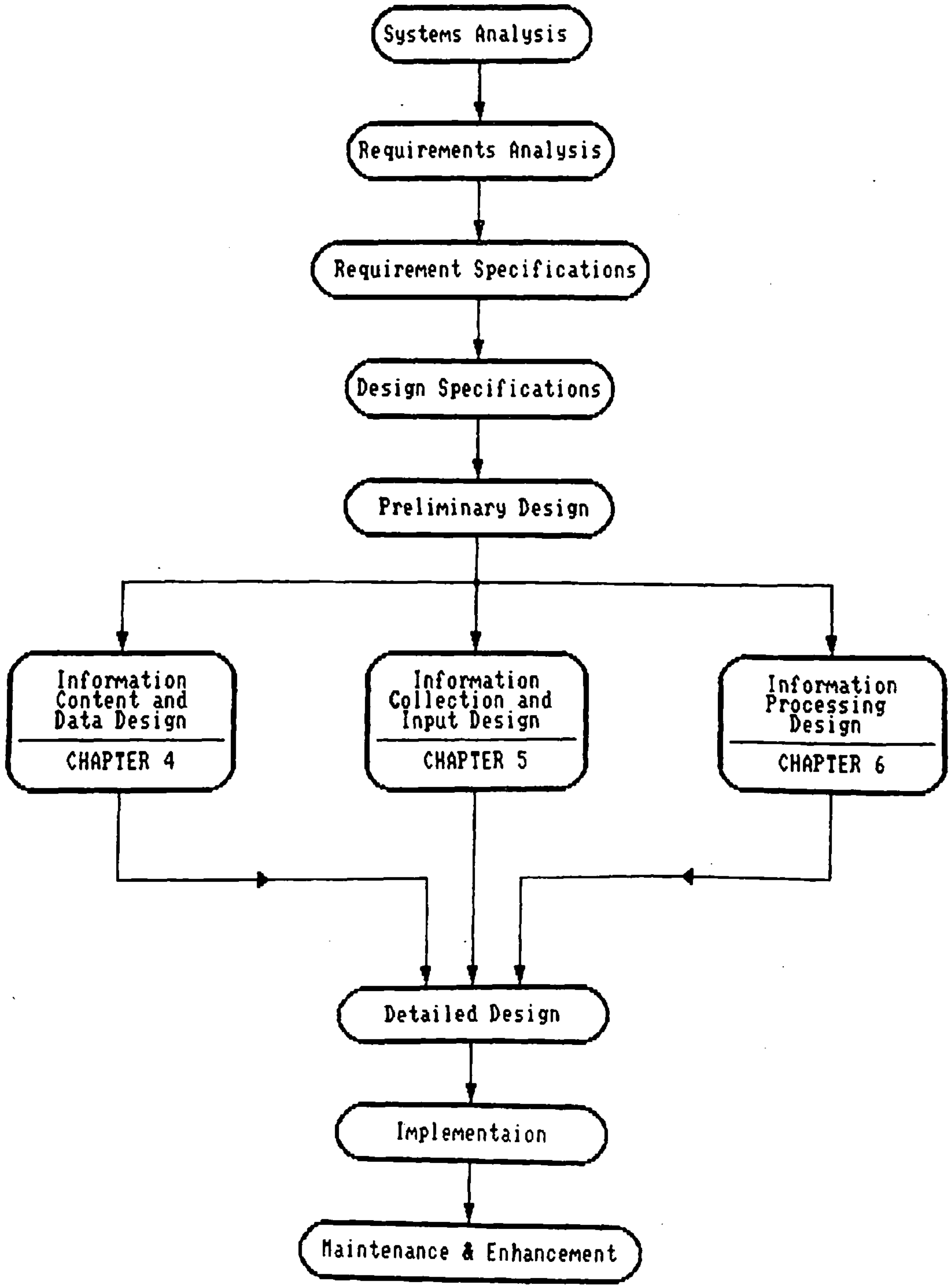


Figure 3.4 - Steps in Software Design Process.

(iii) The verification and validation of the keyboarded information.

Any information input to the system must be "clean" before it can be used in processing or updating of the system. The design of proforma, keyboarding methods and screens, and associated issues are dealt with separately, because of the nature of the system, in Chapter Five.

3.5.3 Information Content and Data Design

The software design for an information management system cannot be done without properly identifying the information content of the system. The design of records, file structures and file organization are the topics for Chapter Four. Detailed design of information base and data systems to meet the systems requirements and specifications is discussed in the next Chapter.

3.6 SUMMARY

The process of systems development has been presented in this Chapter. Beginning with the identification of the requirements for information processing, flow, input and output, and a time scale for these, the systems design specifications and preliminary systems design have been described.

The design process started in this Chapter will be completed in the next three Chapters. Each Chapter is devoted to a specific aspect of the detailed software design.

CHAPTER FOUR

INFORMATION CONTENT AND DATA DESIGN

4.1 INTRODUCTION

The detailed system design begins with the identification of software solutions to meet the design specifications established through the requirements analysis and requirements establishment phases. The identification of information content from the information flow diagrams and developing, therefrom, a detailed description of the information base that will meet the needs of all application processes expected now or in future, is the first step towards the detailed system design. The conceptual, logical and physical design of the information content and its organization is the foundation on which the entire processing software is built.

At the beginning of the design process, it is important to capture the essential aspects of the environment to be modeled without concern for how the resulting information structure might be represented within the information base. The identification of real world entities, about which information is to be collected, stored and updated, and relationships among the various entities and attributes is the first task. The information flows, processes and description of the previous Chapters will be exploded, in this Chapter, to convert information requirements (reports) to elemental level to develop a conceptual model of the information content. The logical structure is developed from this conceptual model, which is finally converted to a physical model of the records and files. The methods and control of access, organization, security and integrity issues of the information base are dealt with in the last section of the Chapter.

4.2 DESIGN OF CONCEPTUAL MODEL OF THE INFORMATION BASE

To develop an information base that satisfies today's as well as tomorrow's information needs, a conceptual model must be designed. This conceptual model reflects the entities and their relationships and is based on the information processing requirements of the system.

The conceptual model structures the information and relationships between the information elements and is independent of individual applications, hardware and the physical model. The first step in designing a conceptual model is information analysis, which provides information about the elements and the relationships between them.

4.2.1 Information Analysis

The identification of the information entities, their attributes and relationships among them, for the students' academic records monitoring and management, is done by a through and systematic study of the input, output and processes that use the information base as a repository of the information. Figures 3.1, 3.2 and 3.3, Table 3.1 of Chapter Three and sample reports and proforma in Appendix A are closely examined for this purpose. The results are as follows.

4.2.2 The Environment

The analysis of information content generates the following facts which will be used in developing the conceptual model of the information base. Some of these facts have been stated in the previous Chapters but are included here for completeness and clarity.

(a) The metrics for the academic monitoring process is a semester. A semester is specified as First Semester, Second Semester, or Summer Term of an Academic Year.

(b) A student has one identification number, called IDNO. The IDNO uniquely identifies the student, that is, the name of the student, degree(s) working for, status (whether on-rolls, registered, discontinued, academic eligibilities and afflictions, etc.) and so on. The IDNO consists of year and semester of admission, the degree program(s) and a serial number within the year of admission. The IDNO of a student can change with events like transfer, dual-degree admission, etc. but the year of admission and the serial number remain fixed.

(c) Every student follows a semesterwise pattern prescribed for the degree program(s) for which the student is working.

(d) A student can register for a number of courses in a semester using the available academic flexibilities.

(e) Time-table lists the courses offered in a semester. For an offered course, there can be one or more lecture and/or practical sections offered (multi-section), one instructor-in-charge with/without a team of instructors, day(s)-hour(s) for each section and one comprehensive examination date.

(f) An offered course is taken by a number of students.

(g) A course may have one or more prerequisites and/or restrictions, which have to be met successfully while registering in the course.

(h) For every registered student, instructor-in-charge, with the help of team of instructors, awards a grade/report at the end of the semester, for all students registered in the course. Same is repeated for all courses registered by the student.

(i) The student information is updated at the end of every semester to determine further course of action.

4.2.3 Graphical Representation of Relationships

The process of identification of information entities and relationships among them is illustrated with the following example from the environment identified above. The data-structure diagram, used throughout this Chapter to graphically represent the design of conceptual model is also explained with the example.

As identified in the above section, a student can register in many courses in a semester, and many students can register in a course. For every course registered by a student, student receives some grade or report. This information about the

TABLE 4.1

A Tabulation of Students, Courses and Grades Received

COURSES > STUDENTS(IDNO)	BITS C321	CS C311	HUM C232	EEE C432
86B1PS252	A	B	NC	
87A7PS005		E		
87A8B4903	C	D	B	A
87A3PS234	C			A
86B2A3453	B		D	E
88B5A7546	E	A		
...				

students, courses and grades can be tabulated as a matrix as shown in Table 4.1.

The information entities for this example are STUDENT, COURSE and GRADE. A conceptual model is developed for these entities, to establish relationships between them, based on the following premises:

* A student may register in a number of courses,
* Any number of students can register in a course, and
* A specific grade/report can, and must, be related to one and only one student <u>and</u> to one and only one course registered by the student.

The relationship between the entities STUDENT and COURSE represents the fact that a student may register for zero, one or many courses, and none, one or many students can register in a course. This relationship is called "many-to-many" relationship or mapping.

In the data-structure diagram, entities are denoted by rectangular boxes and an arrow joining one entity to another is used to represent a relation between the two entities. A double-headed arrow is used for a "many" relation. Thus, the relationship between entity STUDENT and entity COURSE can be written as:

STUDENT <<------>> COURSE

and represented pictorially in Figure 4.1.

A specific grade tells more about the student and the course. Same grade will be received by many students and in many courses, but for a given student-course pair, there is a specific grade. Similarly, same grade will be obtained by many student-course pairs. Thus, the relationship between the entities STUDENT-COURSE pair and GRADE is a one-to-many, while the relationships between the entities STUDENT and GRADE is may-to-many, and between the entities COURSE and GRADE is also many-to-many. These can be written as:

STUDENT <<------>> GRADE

COURSE <<------>> GRADE

STUDENT * COURSE <----->> GRADE

Figure 4.2 gives a pictorial representation of these relationships. There are many more forms of relationships possible between the entities from simple one-to-one to ternary and higher degree relationships. Figure 4.3 shows some of these forms of the relationships and their data-structure diagrams.

4.2.4 Information Elements

Every report in Appendix A is examined closely to identify the information content at elemental level and all cross-references are built between the information elements and the reports.

As an illustration, the information entities of the Registration Card (Appendix A.1) are:

SEMESTER, IDNO, NAME, PRNO, STATUS, COURSE_NO, TYPE, TITLE, SECTION_NO.

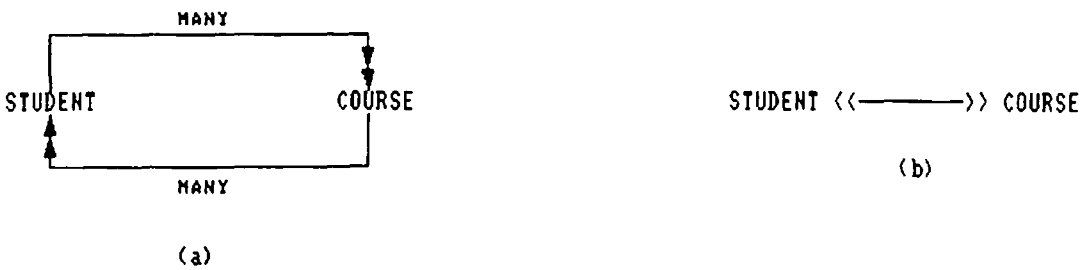


Figure 4.1 - A Pictorial Representation of many-to-many Relationship.

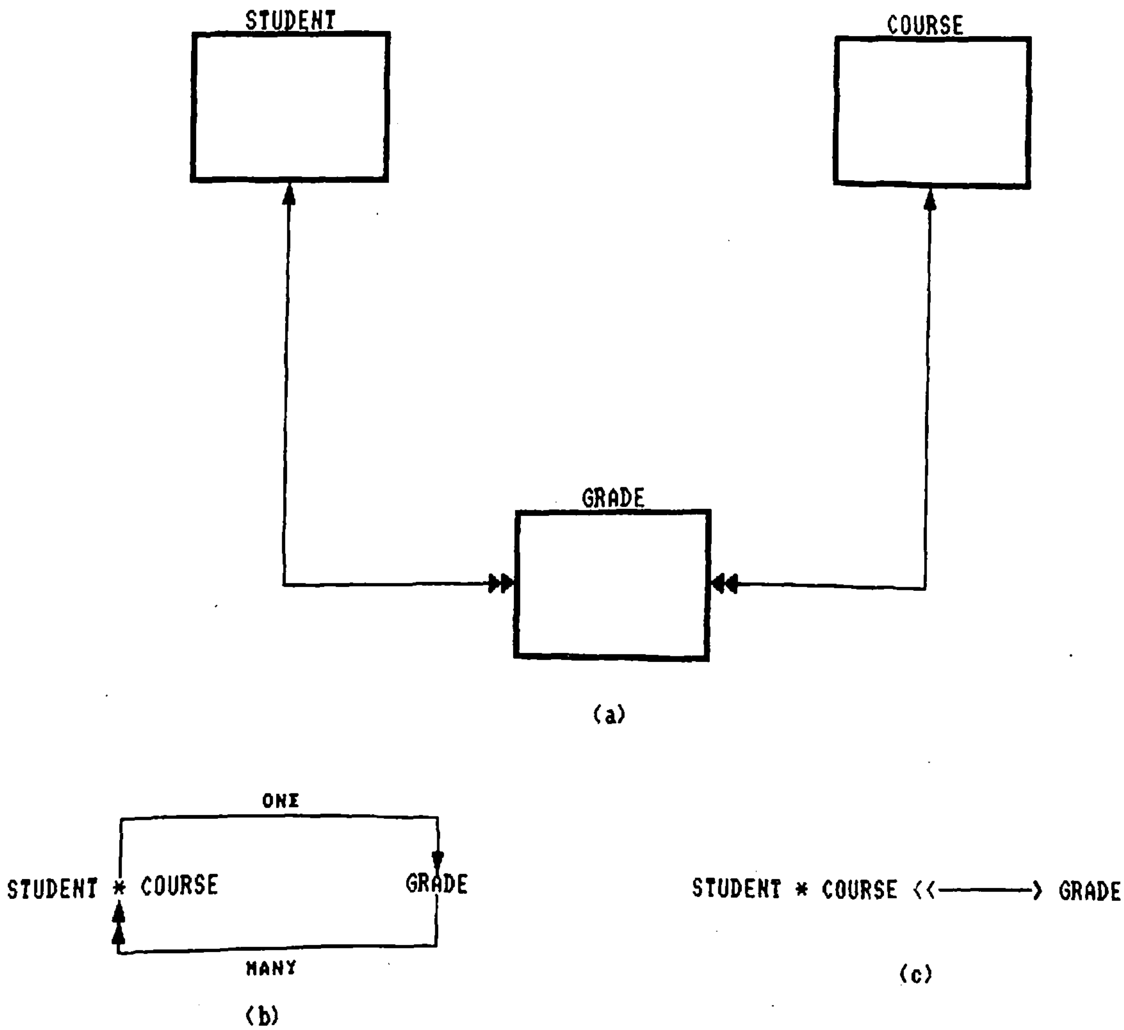
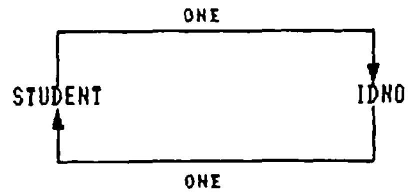
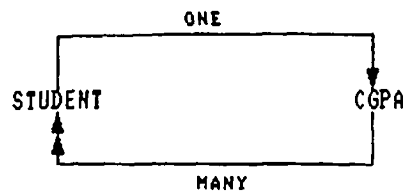


Figure 4.2 - Graphical Representation of Relationship Between Entities STUDENT, COURSE and GRADE.



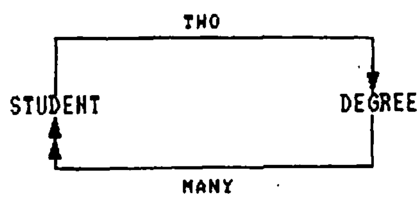
STUDENT <———> IDNO

A. One-to-one relationship - Every student has a unique IDNO and every IDNO identifies a unique student.



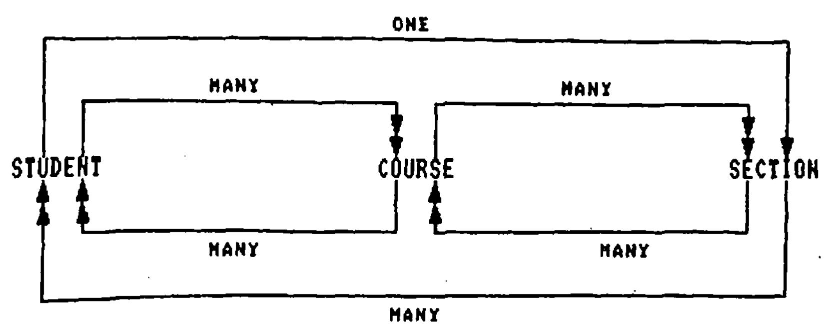
STUDENT <<———> CGPA

B. One-to-many Relationship - For every student there is a unique CGPA while many while many students will have same CGPA.



STUDENT <<———> DEGREE

C. Two-to-many Relationship - A student can work for two degrees simultaneously.



D. A Complex Relationship Between Three Entities, STUDENT, COURSE and SECTION.

Figure 4.3 - Different Types of Relationships Between the Entities.

The Alphabetical order list of all information elements identified is given in Figure 4.4 and Table 4.2 gives the cross-references between the information elements of Figure 4.4 and key reports identified in Table 3.1, where the information is referred to.

4.2.5 Relationships between the Information Elements

The relationships between the identified information elements (shown in Figure 4.4) are determined based on the reports and identification of primary key elements and non-primary key elements is done. For each set of elements so determined, third normal form [41] relations are developed by merging the relations identified from individual reports. The relations that emerge at the end of this exercise are explained below. In each case the primary key is underlined.

I. SEMESTER <----> ACADEMIC YEAR, FIRST/SECOND SEMESTER or SUMMER TERM

A given semester is identified as FIRST/SECOND SEMESTER or SUMMER TERM of an ACADEMIC YEAR. This is a one-to-one mapping and the primary key picked is SEMESTER.

II. IDNO <<----> NAME, ADDRESS, CHART, STATUS, CGPA, CUP, PRNO.

For a given IDNO there is only one NAME, ADDRESS, CGPA etc. But for a given STATUS or a given CHART there can be many students. Even many students can have the same NAME. This is a one-to-many mapping with IDNO as the primary key.

III. COURSE_NO <<----> TITLE, UNITS, TYPE, PREREQ.

Similar to above relation, each course is uniquely identified by its course number, COURSE_NO, which becomes the primary key. For a given COURSE_NO there is one TITLE, UNITS, TYPE and PREREQ. But there are more than one course with same TITLE.

IV. CHART <<----> SEMESTER, COURSE_NO, CATEGORY.

Each CHART has specified courses, COURSE_NO in specified categories, CATEGORY, evenly distributed over the required SEMESTERs for a specific degree or dual degree program. The

TABLE 4.2

CROSS-REFERENCE TABLE BETWEEN DATA ELEMENTS AND REPORTS

REPORT NO.*> DATA ELEMENT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1.ADDRESS			√						√		√		√					√	√
2.CATEGORY	√	√		√			IR	IR	√				√	IR			IR		√
3.CGPA		√							√			√	√	IR	√	√	√	√	√
4.CHART	IR	√		IR			IR	IR	IR				IR	IR			IR		
5.COMP_DT				√															
6.COURSE_NO	√	√		√	√	√	IR	IR	√	√		√	√	IR			√		√
7.CUP		√											√		√			√	√
8.DAY_TIME				√															
9.DEG_TIT									√							√		√	√
10.GRADE	IR	√		IR			IR	√	√	√		√	√	IR		√	√	IR	√
11.IDNO	√	√	√	√		√	√	√	√	√	√		√	√	√	√	√	√	√
12.IC_NAME					√	√				√		√							
13.NAME	√	√	√	√		√	√	√	√	√	√		√	√	√	√	√	√	√
14.NO_SECTION	√			√	√	√													
15.NO_STUD					√	√				√		√							
16.PREREQ	IR	IR		√				IR											
17.PRNO	√																		
18.SEMESTER	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
19.STATUS	√	√	√	√						√							√		√
20.TITLE	√	√		√	√	√			√	√		√	√		√		√		√
21.TYPE		√		√					√										
22.UNITS		√								√			√						√

LEGEND:

IR – Internally Required for the preparation of the report but is not a content of the report.

√ – Information Appears on the Report/Form.

* – Details of these reports are given in Table 3.1, Chapter Three.

SNO	Information Element	Description
1.	ADDRESS	Address of the student.
2.	CATEGORY	Category under which a course is done.
3.	CGPA	Cumulative Grade Point Average of a Student.
4.	CHART	Chart Code of the semesterwise pattern of the degree program(s) for the student.
5.	COMP_DT	Comprehensive examination date for a course.
6.	COURSE_NO	Course number.
7.	CUP	Total units and unit-grade products for a student.
8.	DAY_TIME	Which day(s), what hour(s) a course is taught.
9.	DEG_TIT	Title of the degree(s) awarded to the student.
10.	GRADE	Grade or report received by the student in a course.
11.	IDNO	Identification number of student.
12.	IC_NAME	Name of instructor-in-charge.
13.	NAME	Name of student.
14.	NO_SECTION	Number of lecture/practical sections offered or number of lecture/practical section registered.
15.	NO_STUD	Number of students in a section/course.
16.	PREREQ	Prerequisites, restrictions, eligibilities, and availabilities of a course.
17.	PRNO	Priority number for registration.
18.	SEMESTER	Academic year and First/Second semester or Summer Term of that academic year.
19.	STATUS	Status of the student in terms of: (a) New admission/ACB/BL/etc. (b) On-Rolls/Registered/Graduating/Discontinued/etc. (c) Academic performance and eligibility status.
20.	TITLE	Course title.
21.	TYPE	Course Type - CDC, DCOC, First Degree, etc.
22.	UNITS	Course units.

Figure 4.4 - List of all information elements identified from the reports in Appendix A and cross-referenced in Table 4.2, in alphabetic order.

same COURSE_NO appears in many CHARTs. This is also a one-to-many mapping with CHART as the primary key.

V. COURSE NO * SEMESTER <<----> IC_NAME, COMP_DT, NO_SECTION, DAY-TIME.

For a given COURSE_NO in a given SEMESTER there is only one IC_NAME, one COMP_DT, specific NO_SECTIONs and one DAY-TIME for each section. But one faculty, IC_NAME can be instructor-in-charge of more than one course in a semester, and a number of courses have the same COMP_DT and same DAY-TIME. For a different SEMESTER, there can be different COURSE_NOs, different NO_SECTIONS, IC_NAME, or DAY-TIME etc.

Therefore, the primary key is a compound key of COURSE_NO and SEMESTER with a one-to-many mapping between the primary key and the rest of the elements. This relation along with the course title, L, P, units, room number(s) and faculty names for each section, is the time-table for a given semester.

VI. IDNO * SEMESTER <<---->> COURSE_NO, NO_SECTION, GRADE, CATEGORY, NO_STUD.

A given student (IDNO) takes in a given SEMESTER many courses (COURSE_NO) under different categories (CATEGORY), registers in required number sections out of many sections offered (NO_SECTION) for each course and receives a GRADE in each registered course at the end of the SEMESTER. A given course (COURSE_NO) and section number (NO_SECTION) is taken by many students and many students receive the same GRADE, in a specific semester. This is a many-to-many mapping with composite primary key, IDNO * SEMESTER. It is a combined representation of three relations because they have identical composite primary key.

This relation is not in a third normal form but can be transformed into a third normal form if the primary key is further compounded with COURSE_NO. This results in a third normal form relation as:

IDNO * COURSE NO * SEMESTER <<----> NO_SECTION, CATEGORY, GRADE, NO_STUD.

A given student (IDNO) in a given SEMESTER, for a given course (COURSE_NO) registers in specific section(s) (NO_SECTION) under specific CATEGORY and receives a specific GRADE. This relation is a combined representation of three relations because they have identical composite primary key.

VII. IDNO * SEMESTER * COURSE NO * CHART <<----> GRADE.

Mapping of the student's (IDNO) course (COURSE_NO) registrations and performances (GRADE) for a given SEMESTER into the student's eligibility sheet (CHART) determines student's status, likely eligibilities and final eligibilities for various stages of academic monitoring. This is a one-to-many mapping with a composite primary key.

4.2.6 The Conceptual Model

The conceptual model of the information base for SAIPS is drawn in a pictorial format form from the third normal form relations I to VII as follows.

(a) A relation for which the primary key consists of only one element represents an entity. Relations I, II, III and IV are, therefore, representing entities SEMESTER, STUDENT, COURSE and CHART, respectively.

(b) A relation with a compound key of two elements represents a relationship between two entities. The compound key of relation V, COURSE_NO * SEMESTER represents a relation between the entities COURSE and SEMESTER. The relation V is a derived entity. This entity is called TIME-TABLE. The relation between the COURSE or entity SEMESTER and entity TIME-TABLE is one-to-many because in a given semester many course are offered and a course is offered in many semesters.

(c) Relation VI has a compound key of three elements, IDNO * COURSE_NO * SEMESTER. The element IDNO comes from the entity STUDENT, while other two are the compound key of the entity TIME-TABLE, which was identified in (b) above. This relation represents student's registration at the beginning of the semester and the performance in terms of grades/reports at the end of the semester. The two entities are called REGISTRATION and PERFORMANCE.

(d) The relation VII has a compound key of four elements drawn from entities REGISTRATION/PERFORMANCE and CHART. This entity is called ELIGIBILITY.

A pictorial representation of the conceptual model is given in Figure 4.5 with each entity represented as a box. The relation number and entity name is written on the top of the box and the primary key and other non-primary key elements are listed inside the box. The primary keys of the entities are underlined. The model is drawn in a hierarchy with entities with single element primary key at the top, level 1, derived entities with compound primary key of two elements at level 2 and so on.

4.3 THE LOGICAL MODEL DESIGN

The conceptual model in Figure 4.5 and the set of third normal form relations are used to derive a logical model of the data. In the conventional process of development of a logical model, the first consideration is deciding which database model will be best suited for the particular conceptual model. The second consideration is availability of the database management (DBMS) software package on the available hardware (computer machine) to be used for the information processing system.

In the BITS example, no DBMS software package was available on the hardware (IBM-1130 and HP-1000). This has led to development of a complex software of totally different kind, where the software tasks are increased many-fold. The software has the additional burden of providing and maintaining the database security, data dictionary, storage and retrieval and

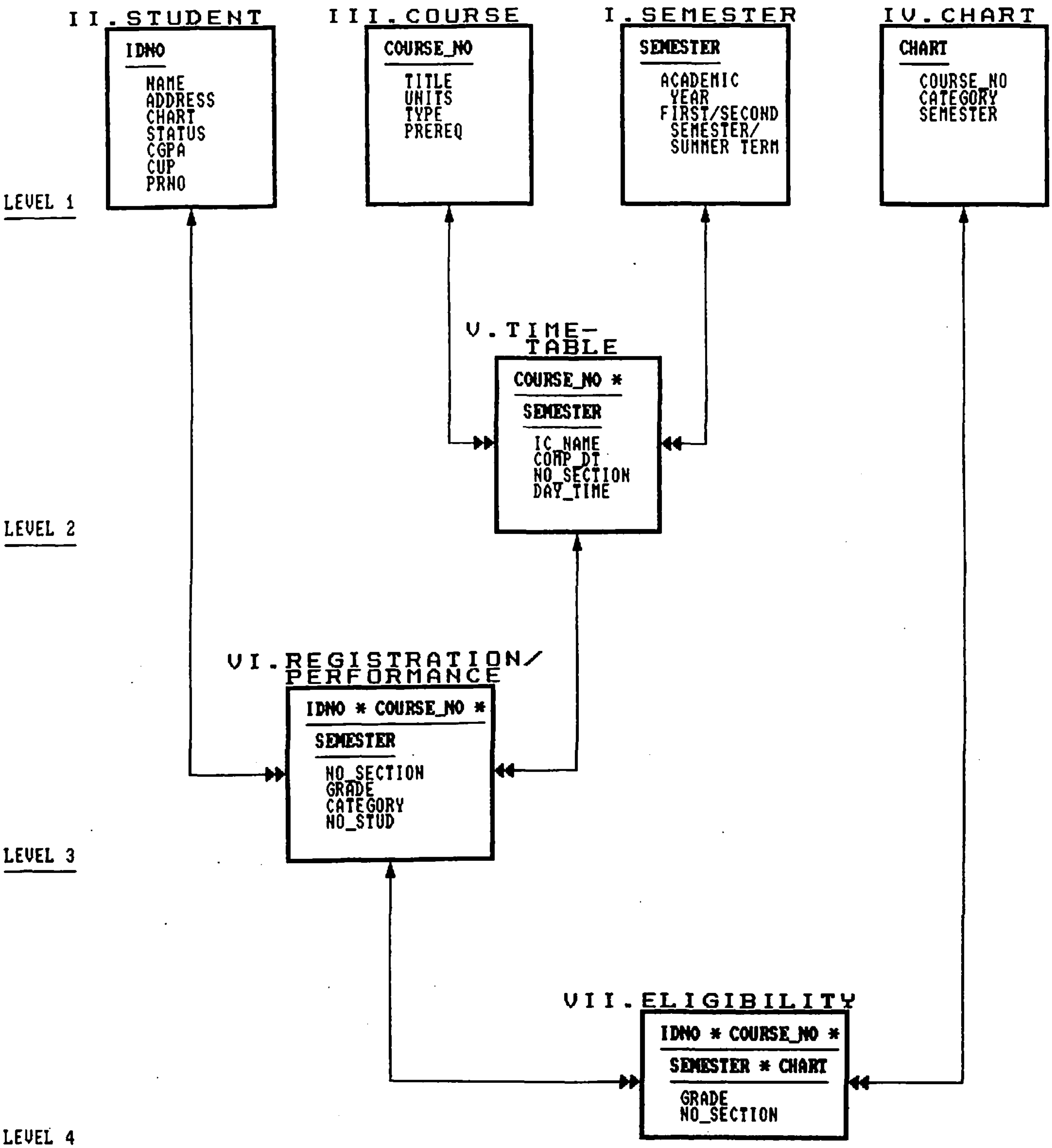


Figure 4.5 - The Conceptual Model of the Information Base for Monitoring and Management of Students' Academic Records.

many other tasks which any DBMS software would carry-out as a routine. The absence of a DBMS software package has resulted in a more complex but flexible design. It has been exploited to advantage. The good features of all database models, relational, hierarchical and network have been used, which is not possible when one uses a standard DBMS software package based on a particular database model.

The mapping of the designed conceptual model of Section 4.2, Figure 4.5, into a logical model, is described in the following sections.

4.3.1 Mapping of Conceptual Model to Logical Model

The conceptual model is mapped into a logical model by defining relations and their attributes. One attribute or a combination of attributes will represent the primary key for the relation. Every box in Figure 4.5 represents a relation which can be looked as a "table" in which no two rows (tuples) are identical. Each relation or table can be regarded as a file and each attribute of the relation becomes a field within the file.

The seven boxes in Figure 4.5, with respective relations and their attributes inside the boxes are, thus, converted into following seven files:

File 1: SEMESTER file with fields ACADEMIC YEAR, FIRST/SECOND SEMESTER or SUMMER TERM.

File 2: STUDENT file with fields IDNO, NAME, ADDRESS, CHART, STATUS, CGPA, CUP, and PRNO.

File 3: COURSE file with fields COURSE_NO, TITLE, UNITS, TYPE, and PREREQ.

File 4: CHART file with fields CHART, SEMESTER, COURSE_NO, and CATEGORY.

File 5: TIME-TABLE file with fields COURSE_NO, SEMESTER, IC_NAME, COMP_DT, NO_SECTION, and DAY-TIME.

File 6: REGISTRATION/PERFORMANCE file with fields IDNO, COURSE_NO, SEMESTER, NO_SECTION, CATEGORY, GRADE, and NO_STUD.

File 7: ELIGIBILITY file with fields IDNO, SEMESTER, COURSE_NO, CHART, GRADE, and NO_SECTION.

The one-to-many or many-to-many relations of conceptual model exist between the entities of the files because the files contain common fields having common values.

The mapping of conceptual model into a logical model as done above is a relatively easy process. Every box from the conceptual model becomes a relation or a table or a file, and the user is supplied with the user view of the information, which is in tabular format. This is due to using a normalization approach to designing the conceptual model.

4.3.2 Design of Files

The logical model obtained is modified to eliminate conflicts and reduce redundancies. The modified model is refined and new relations and/or redundancies are added to improve the performance according to processing requirements.

In arriving at the final design, various aspects of system performance, security, and processing requirements have been taken into considerations. A translation of the conceptual model relations into as many files results in information storage in many different files. The data independence, flexibility, reduced redundancy and avoidance of anomalies gained by the normalization process carried in the conceptual design are available with such a model.

But, too many files in the logical model should be avoided. Distribution of the information in too many different files means that application programs have to retrieve it from different files. This increases physical input/output (I/O) activity and leads to excessive overheads.

The reduction of number of files will alleviate the problems described above, but if carried too far, it would result in a single file for the entire database, in the extreme case. The data independence, flexibility, reduced redundancy, and avoidance of anomalies gained by normalization in the conceptual model would be lost. Therefore, the objective is to reduce the number of files in the logical model while preserving the desirable features of the model.

In the following section the above design is modified and refined for each of the seven files of the logical model.

4.3.2.1 SEMESTER File

The SEMESTER relation (file 1) has only two attributes (fields), ACADEMIC YEAR and SEMESTER NUMBER/TERM. The combination of these two fields uniquely defines what is referred to as a SEMESTER, for example:

SEMESTER = 89,2

implies SECOND SEMESTER of ACADEMIC YEAR 1989-90. Therefore, the two fields in combination form the primary key called SEMESTER. In other words, the SEMESTER file can have only one field called SEMESTER which is also the primary key and this file will contain semesters like 89,1; 89,2; etc. in sequence upto the current semester.

An entire file is devoted to a piece of information which serves the only purpose of a reckoner for the current (latest) semester. The information about semesters is contained in other files, like TIME-TABLE, and REGISTRATION for maintaining the identified relations. The file has only one field, contains no information which is not present in other files, contains nonvolatile information, and almost not contributing anything. There are no attributes which depend only on semester. The file can be said to serve no useful purpose and can be eliminated. Therefore, the SEMESTER file is removed from the logical model. The current semester information is stored in another file called MISCELLANEOUS file, which contains all such small information, its details will be discussed later.

4.3.2.2 STUDENT File

A user view of the STUDENT table (file) is shown in Figure 4.6. The file is made-up of the attributes (fields) IDNO, NAME, ADDRESS, CHART, STATUS, CGPA, CUP, and PRNO. The IDNO is the primary key (key attribute) for the relation because its values are unique, that is, there are no two tuples (rows) with same IDNO. The primary key is same as the one identified in the conceptual model. The non-key fields are NAME, ADDRESS, CHART, STATUS, CGPA, CUP, and PRNO.

The mailing address is normally long (60 to 80 characters) requiring ADDRESS field to be big in size. All other fields of STUDENT file put together may not be as large. A close examination of the processing requirements reveal that address of the student is required in a very few reports (Table 4.2), whereas the other information in the STUDENT file is required to be accessed often. This means, for every processing requiring STUDENT file and not the address in it, there will be extra I/O overhead of the address.

To avoid this overhead, as well as to simplify the storage, retrieval, and processing, the STUDENT file is split into two files. One, STUDENT MASTER file, containing all fields except the ADDRESS field, and two, ADDRESS file containing the addresses of the students.

In the STUDENT MASTER file some fields are added to facilitate the processing at the cost of increased redundancy, like, year and semester of admission, type (program) of the student, etc. Similarly, some fields are added to keep student's history, like, previous IDNO, dual-degree preferences, etc. These small pieces of student dependent information are not kept in separate files because that would increase the number of files. The overhead is also negligible as the size of the information is small.

4.3.2.3 COURSE File

Course file contains the fields COURSE_NO, TITLE, UNITS, TYPE, and PREREQ. A sample course file is shown in Figure 4.7. As a course can have more than one prerequisite/restriction (PREREQ), each prerequisite/restriction would require one record in COURSE file.

If a course X, say, has three prerequisite/restrictions, then three records are required to store the fact that course X has three prerequisites/restrictions. In these three records, all fields except the PREREQ field would be same causing a large amount of redundancy.

The logical design is modified to reduce this redundancy by providing what is known as "multiple value field" in the file. That implies, if field PREREQ is defined to be multiple valued, then only one record is required to store all the three prerequisites/restrictions and data values of COURSE_NO, TITLE, UNITS and TYPE are stored only once.

In the COURSE file fields PREREQ and TYPE are multiple valued and all other fields are elementary (single valued).

4.3.2.4 CHART File

Semesterwise patterns for different programs are stored in the CHART file. The sample of semesterwise pattern, Chapter Two, Figure 2.2, shows the information to be contained in the file for one semesterwise pattern of a given program.

The course titles and units are not stored in CHART file because these are available in the COURSE file. Therefore, only fields required in the CHART file are CHART (chart identification number), SEMESTER, COURSE_NO, and CATEGORY. If each of these fields is considered to be elementary field, one semesterwise pattern would required as many records as there are courses in the semesterwise pattern, with CHART field having same value in all the records and SEMESTER field having same value for all the courses in a semester. The redundancy is obvious.

IDNO	NAME	ADDRESS	CHART	STATUS	CGPA	CUP	PRNO
89B4A7956	SHIVA RAMA KRISHNA	15/6 FLORA 3RD FLOOR NEW DELHI	B4A7 II Sem	.On Rolls .Registered .Likely PS2 .etc.	8.06	prod= 854 UNIT= 106	0057
89A8TS245	..	..	A8TS	..	7.28	..	..
89A8PS247	..	..	..	..	..	..	..
..							

Figure 4.6 - A User View of the STUDENT File.

COURSE_NO	TITLE	UNITS	TYPE	PREREQ
CS C332	SYSTEMS PROGRAMMING	3	CDC for A7	CS C311
CS C332	SYSTEMS PROGRAMMING	3	CDC for A7	CS C321
CS C332	SYSTEMS PROGRAMMING	3	CDC for A7	CS C331
ME C481	PROJECT APPRAISAL	3	DCDC of A4	AADC C212
MATH C111	LINEAR ALGEBRA	5	AB, C-DP	MATH D131 CON
...				
...				
...				

Figure 4.7 - A User View of the COURSE File.

The logical design of CHART file does not get simplified even with use of multiple valued fields as described in COURSE file.

For one semesterwise pattern, CHART field is only required once while each course information requires SEMESTER, COURSE_NO and CATEGORY fields. If these three fields are grouped together as one field, say S_C_C, the concept of multiple value field can be applied to this new field (S_C_C). The resulting logical model of CHART file will have two fields, CHART and S_C_C, with S_C_C being a multiple valued field. Thus, the semesterwise pattern could be stored in one record of the file as shown in Figure 4.8. A group of continuous fields that are related, for example, fields SEMESTER, COURSE_NO and CATEGORY (or S_C_C field), is called a "periodic group." With this periodic group field and CHART field, one record will suffice for one semesterwise pattern having as many occurrences of the periodic group field as there are courses in the semester wise pattern.

This logical model still has the redundancy of semester within all courses of a semester. The numbers of courses for a semester is six, on the average. In order to reduce this redundancy, the design is modified. The SEMESTER field is de-linked from the periodic group and number of courses in each semester (semester counts), starting with the first semester of the semesterwise pattern, are stored separately. The semester counts for a typical semesterwise pattern (Figure 2.2, Chapter Two) are:

Year	First			Second			Third			Fourth		
Semester	1	2	3	4	5	6	7	8	9	10	11	12
Count (number of courses in the semester)	6	6	0	7	7	1	7	6	0	5	1	0

Here, each academic year is divided into three semesters, the First Semester, the Second Semester and Summer Term, and Semesters are counted as 1,2,3,4 etc. starting from 1 for First Semester of first year, 3 for Summer Term of first year, 4 for

First Semester of second year of the semesterwise pattern, and so on.

The semester counts tell that the first six periodic groups (COURSE_NO and CATEGORY in them) belong to first semester of first year, the next six belong to second semester of first year, and so on. From this information, semesterwise chart can be easily generated back. The semester counts form a multiple value field with attribute SEM_COUNT for a given chart.

Normalization process would require that the semesterwise pattern information should be stored in two files, one with attributes CHART, COURSE_NO and CATEGORY, and other with attributes CHART and SEM_COUNT. If this is done, there will be an increase in number of files. The information in two files is required together to generate the semesterwise pattern and, thus, two files will increase the overheads.

The solution is found by providing "multiple record types" within a file. This is done by defining a single record type for the file containing all the fields of several different record types. For the CHART file the records of semester counts and records of course information are kept in the same file. The final design of the logical model of CHART file has a CHART field, multiple valued fields SEM_COUNT and periodic group of fields COURSE_NO and CATEGORY, as is shown in Figure 4.9.

4.3.2.5 TIME-TABLE File

The TIME-TABLE file is for the information of courses offered during a semester. The SEMESTER field is removed by providing a TIME-TABLE file for a specified semester because time-table of previous semesters is only of archival value in academic records processing.

In Section 4.2.2, it was explained that a course can have one or more sections, each with different day-hours, one instructor-in-charge, one or more instructors for each section and one comprehensive examination date. The TIME-TABLE file for a typical course may look as shown in Figure 4.10. The COURSE_NO,

CHART	S_C_C			S_C_C			
	SEME-STER	COUR-SE_NO	CATE-GORY	SEME-STER	COUR-SE_NO	CATE-GORY	
89A7 PS	89,1	MATH D131	-	89,2 D131	SCI	-	..
90H1 07	90,1	BITS F533	-	90,2	BITS F524	EL	
..							

Figure 4.8 – A Modified Logical Model of CHART File.

CHART	multiple valued			periodic group		
	SEM_ COUNT	SEM_ COUNT	..	COUR-SE_NO	CATE-GORY	..

Figure 4.9 – The Final Logical Model of CHART File with Multiple Record Type. Multiple Valued Field is SEM_COUNT and Periodic Group of Fields COURSE_NO and CATEGORY.

COURSE_NO	SEMESTER	IC_NAME	COMP_DT	NO_SECTION	DAY_TIME
AADC C111	90,1	skg	8/12 FN	1	M W F 3
AADC C111	90,1	tkr	8/12 FN	1	M W F 3
AADC C111	90,1	PND	8/12 FN	1	M W F 3
AADC C111	90,1	kkm	8/12 FN	2	T ThS 2
AADC C111	90,1	tkr	8/12 FN	2	T ThS 2
AADC C111	90,1	ynk	8/12 FN	3	M W F 8
...					

Figure 4.10 – TIME-TABLE File for a COURSE

IC_NAME, and COMP_DT fields are repeated for each record, and there are more than one record per section because of more than one instructor for the section.

This design is modified by splitting the TIME-TABLE file into three files. The first file contains only single valued (elementary) fields, COURSE_NO, IC_NAME, COMP_DT and a pointer field, which is added to point to the starting location of records for section information of the course in the next file. This file is called TTINFO. The second file, called TTEXPF, is for information about a section it has the fields COURSE_NO, NO_SECTION, DAY_TIME and first instructor (IC_NAME). A pointer field is added to this file which points to the starting location of records for more instructors, if any, in the third file. Another pointer field is added to point to the record of this file itself which contains details of next section for the same course. This pointer is set zero if there are no more records (sections) for this course. The third file, has only two fields, one is for the instructor (IC_NAME) and second for a pointer to next instructor for the same section. If no more instructors are there the pointer is set to zero. This file is called TTPNTR.

The logical design of these three files is like a hierarchical database model. The structural diagram of the TIME-TABLE files is shown in Figure 4.11.

4.3.2.6 <u>REGISTRATION/PERFORMANCE File</u>

The REGISTRATION/PERFORMANCE File with STUDENT + COURSE + SEMESTER relation at third level in Figure 4.5, establishes the linkage between STUDENT, COURSE, TIME-TABLE and SEMESTER as shown in Figure 4.12. The primary key is composed of IDNO, COURSE_NO, and SEMESTER. The non-key attributes are NO_SECTION, GRADE, CATEGORY, NO_STUD.

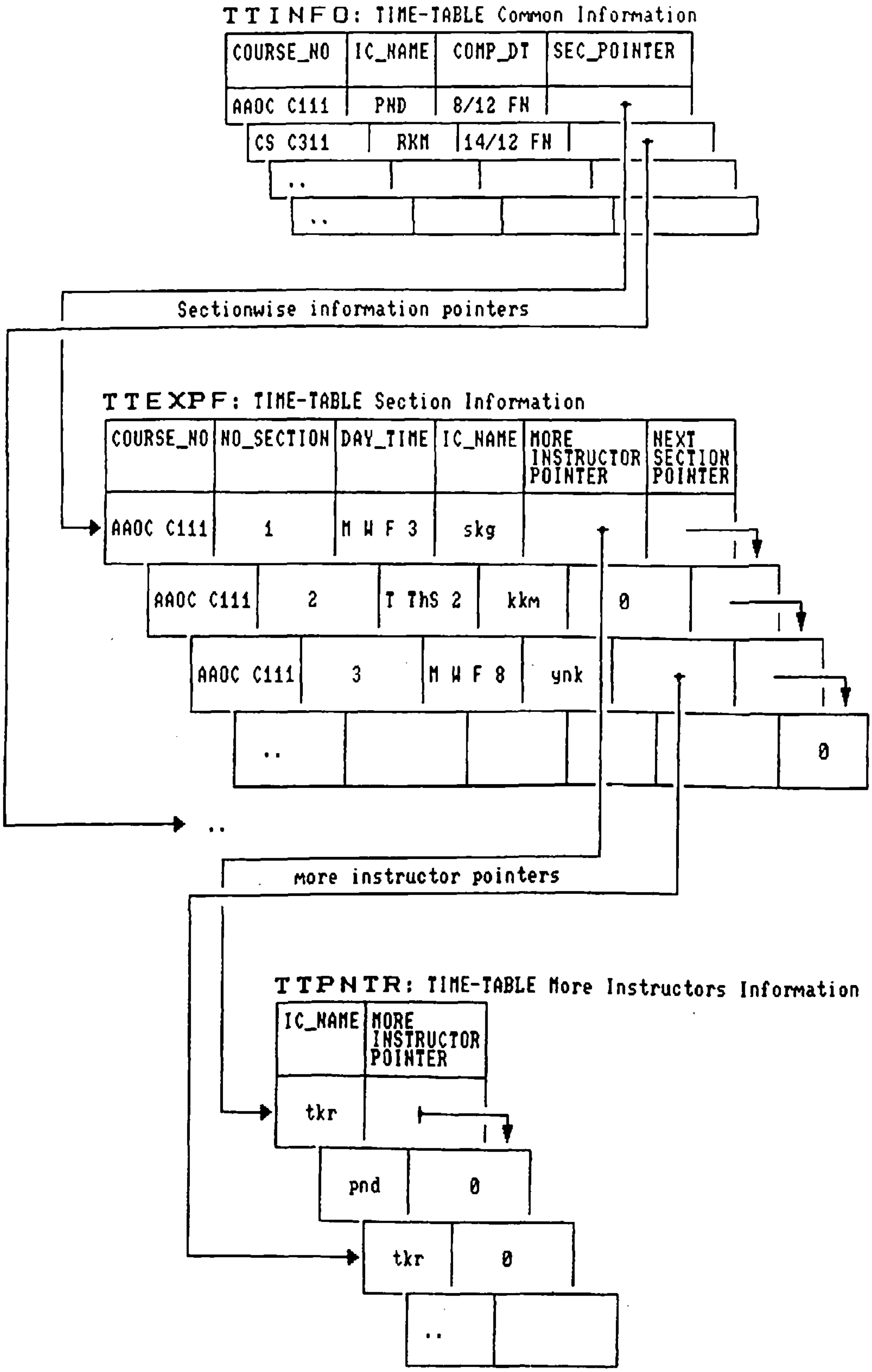


Figure 4.11 - Logical Model Structure Diagram of the TIME-TABLE Files.

Once again the SEMESTER field is dropped by storing information about the current semester only. If every student on the average registers for six courses, six records will be required for one student and all will have same IDNO. This redundancy is reduced by noting the fact that for each course registered by a student, there is a COURSE_NO, CATEGORY, NO_SECTION and GRADE. These four fields are taken as a periodic group. This would require only one record per student and the logical structure of the record will be as shown in Figure 4.13.

The REGISTRATION File, thus, has the elementary field IDNO, which is also the primary key, and a periodic group of fields COURSE_NO, CATEGORY, NO_SECTION and GRADE.

4.3.2.7 ELIGIBILITY File

Finally, what a student is required to do as per the semesterwise chart and what has been done in the past and in the current semester is linked into ELIGIBILITY file by establishing linkages at the fourth level, Figure 4.5, between CHART File and

IDNO	COURSE_NO	SEMESTER	NO_SECTION	CATEGORY	GRADE
89B4A7956	CS C311	90,1	1	EL	A
89A8TS245	AAOC C111	90,1	3	OE	C
..					

Figure 4.12 - A User View of REGISTRATION/PERFORMANCE File.

IDNO	periodic group				
	COURSE_NO	NO_SECTION	CATEGORY	GRADE	..

Figure 4.13 - The Modified Logical Model of REGISTRATION/ PERFORMANCE File.

REGISTRATION/PERFORMANCE file of current semester. The file has the information of past performances, present performance and future requirements. For every student IDNO, semesterwise pattern (CHART), performance (GRADE) and semester of performance (SEMESTER) for all courses (COURSE_NO) in the CHART is required to be stored. That is, the semesterwise pattern for a program is translated into a student's semester program chart.

The logical design of the ELIGIBILITY file is thus, an extension of the CHART file in which two more fields, SEMESTER and GRADE are added to the periodic group of fields COURSE_NO and CATEGORY.

This logical design needs a further modification because of the following reason. In a semesterwise pattern (CHART), a course (COURSE_NO) can appear only once, but a student can repeat or may have to repeat a course which would result in more than one performance (GRADE) and semester of performance (SEMESTER) for a course. To allow for more than one performance (GRADE) in a course (COURSE_NO), one more field, a pointer field, called NEXT_POINTER is added to the periodic group of COURSE_NO, CATEGORY, GRADE and SEMESTER fields.

For more than one performance in a course (COURSE_NO) the repeat pointer (NEXT_POINTER) points to a location after all the first occurrences or previous occurrences of periodic group and creates a new periodic group to store the information.

The final logical design of the ELIGIBILITY file has IDNO as the primary key and COURSE_NO, CATEGORY, GRADE, SEMESTER and NEXT_POINTER fields as the periodic group.

4.3.3 Update of Logical Model for Processing Requirements

The modified and refined logical model of the information base is critically evaluated in totality for the processing requirements. Through this process needs emerge for adding some more files to the logical model. These are explained in the following paragraphs.

Information processing often requires to know total number of students on rolls, total number of courses in the COURSE File, total number of instructors available etc. etc. All these pieces of information are referred often and if kept in separate files, will cause a lot of overhead. Hence, all such individual, non-dependent pieces of information including the current year and semester, as described while removing SEMESTER file from logical model, are kept in a block file which can hold multiple record type. This file is called MISCELLANEOUS.

A particular ordering of information is always required on the reports/forms generated by the system. For this purpose following two index files are added to the logical model.

(i) Index on IDNO field of STUDENT MASTER file, called IDSORT.

(ii) Index on COURSE_NO field of the COURSE file called CRSORT.

Each of these index files has only one field, which gives the position of the record in the file in sorted alphanumeric order of the key field.

4.3.4 Update of Logical Model for Performance

The performance of the system and its capability to meet the computational demands depends to a large extent on the structure of information storage and availability. Other factors which control this are the hardware, which is not easily substituted if performance is not satisfactory and the software. The software for a process is again depended on the information structure. Therefore, in order to achieve the desired performance, the logical model of the information is required to be updated.

The students' registration/performance information is used throughout a semester and is processed many times, in multiple ways for different requirements (Table 3.3, Chapter Three). One logical view of this information is studentwise which is available in REGISTRATION/PERFORMANCE file (Section 4.3.2.6). Any student dependent query can be easily generated from this file.

The relation represented in the REGISTRATION/PERFORMANCE file is IDNO * COURSE_NO, but with the logical model designed

(Section 4.3.2.6), it will take long time to answer any query based on COURSE_NO. For example, to find number of students registered in a course (NO_STUD), the records of all students have to be searched. This will be an expensive operation.

Similarly, at the end of semester, grades/reports (GRADE) are awarded by the instructor-in-charge for each student in the course. This information (GRADE) has to be entered and verified for all courses for all registered students in shortest possible time with absolutely no errors.

To achieve all these, two files are added to the logical model.

The first file contains the relation IDNO*COURSE_NO such that there is one record for each student-course pair. The fields are IDNO, SECTION_NO, GRADE and a pointer to next record for same course (COURSE_NO). Note that COURSE_NO field of the REGISTRATION/PERFORMANCE relation, Section 4.2.5, Figure 4.5, is not in the file. Through the pointer field a chain of all students in a course is maintained. The file is called COURSE-LIST file.

To mark the beginning of a course in the COURSE-LIST file, a pointer file called HEADER is created. The HEADER file has fields, COURSE_NO and a pointer to first record of this course in COURSE-LIST file.

With this logical model the chain of students (IDNO) registered in a course (COURSE_NO) is readily available. Any course based process can therefore be performed on this file at the maximum speed. The logical model of these two files is given in Figure 4.14. In order to generate the IDNO-wise sorted chains for all the courses and avoiding re-sorting of chain for each course, an index file is created. This index file, on IDNO field of STUDENT MASTER file, tells the correct position of any IDNO on the sorted list of IDNOs. This index file is called RECPOS.

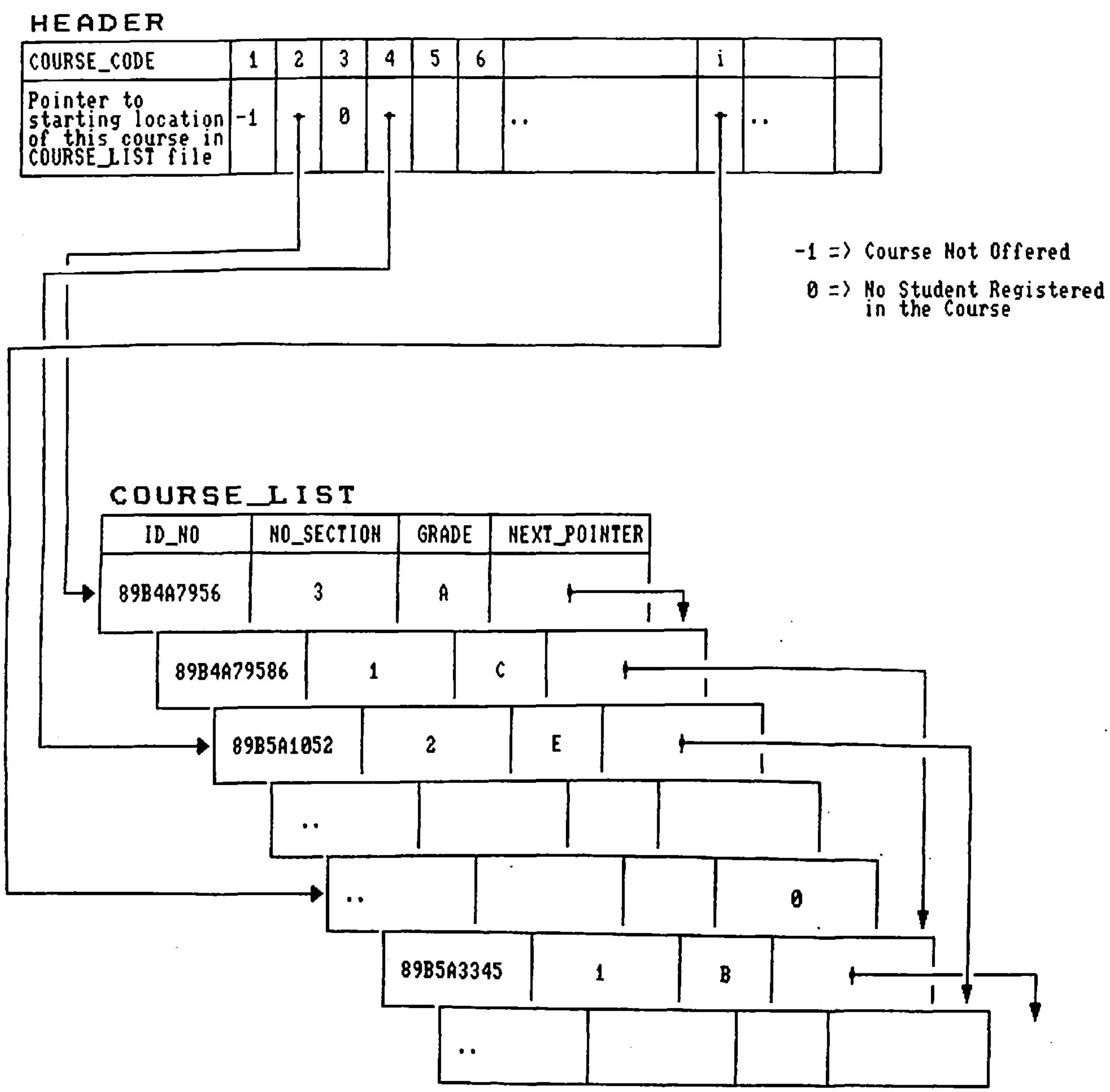


Figure 4.14 - Logical Model Structure Diagram of COURSE_LIST and HEADER Files.

Addition of these three files means duplication of the information contained in the REGISTRATION/PERFORMANCE file. Such a high redundancy is introduced to achieve the required performance and in order to avoid any inconsistencies, no information is entered in both the files independently. Each entry is made into either of the file can transported to the other file. No other files need to be added to improve performance.

4.4 THE PHYSICAL MODEL DESIGN

The physical model describes the manner in which information is stored and accessed. This is one of the major factors affecting the performances of the software interacting with the information stored. Two important metrics for physical model are (i) access efficiency, and (ii) storage efficiency. A detailed discussion on these metrics for the files of students' records database is available in Mathur [48]. The physical model design requires design of physical model access methods model and design of internal storage model for information base.

4.4.1 Physical Model Access Method

The direct access method is used in the physical model for all the files in the logical model. The main characteristic of the direct access method is that there is a direct correspondence between the record key and the physical address of the record. This permits the storage and retrieval of the physical record at a unique storage location.

The added advantage of this method is that it does not require a common field between two files to maintain a relation between the files if the records in the two files are maintained in the same physical order. This means that the files ADDRESS, REGISTRATION/PERFORMANCE and ELIGIBILITY do not require the field IDNO in them. Similarly, TIME-TABLE file (TTINFO) does not require a COURSE_NO field in it.

4.4.2 Physical Model of Information Base

The logical model of the information base was designed in Section 4.3 keeping performance and processing requirements in mind. This is now to be converted into a physical model.

The physical model design has been carried out by

(i) identifying the files,

(ii) identifying the fields in each file, and

(iii) specifying the characteristics of each field, like, size, content, range of magnitude, nature of information in the field, etc.

The physical design has been made based on the following assumptions:

(a) All the files are of direct access type.

(b) The maximum number of on-roll students can be 4500. That means records of graduated and discontinued students are removed from the file, every year.

(c) Maximum number of courses in the COURSE file can be only 960.

(d) Maximum number of instructors available at any time can be only 960.

(e) Maximum number of courses registered by a student in a semester is 10.

(f) The name of student can have a maximum of 13 characters and does not have any punctuations.

(g) There can be a maximum of eight IDNO changes for a student.

4.4.3 Physical Model Storage Optimization

Secondary storage (disk) space occupied by the physical model is always a critical factor in the design of the physical model. Attempt is always made to reduce the space requirements without significantly effecting the performance.

In the design of the physical model this is achieved by coding the information of certain fields. A grade/report (GRADE) which emerges for a course can be either an alphabet or a word or two words. These if stored as such, GRADE field would require a large space. By coding all possible twenty six grades/reports as numeric from 1 to 26, the GRADE field will required only 5 bits of space. All such codes are given in Appendix B.

Similarly, COURSE_NO and IDNO are two fields which occur in many of the files in addition to COURSE_NO file and STUDENT_MASTER file, respectively. COURSE_NO is typically twelve characters long while IDNO is nine characters long. To reduce space occupied by these, they should be coded, Instead of generating a coding scheme and using complex computations for the same, the code used is the physical record number of the record for the COURSE_NO in COURSE file or for the IDNO in STUDENT MASTER file. This is possible because of direct access files.

This technique minimizes the size of the COURSE_NO and IDNO fields to one word (2 bytes) each. For the COURSE_NO only 10 bits are required under the assumption stated in Section 4.4.2. The COURSE_NO and IDNO fields are also renamed whenever the code is used. COURSE_CODE is used for code of COURSE_NO and RECORD_NO is used for the code of IDNO.

Another optimization is done for the space occupied by the faculty name (IC_NAME) field in the TIME-TABLE files. Each faculty name requires a large space and is repeated several times in the file. To minimize this, all faculty names are put in a separate file called FACULTY and once again record number of this file is used in the TIME-TABLE files in place of full faculty name. The faculty file record number is called TSRN.

4.4.4 The File Structure

The physical model is conventionally called "file structure." The final, detailed description of each of the files in the physical model, number of records, record size, file size, etc., are placed in appendix B. Multiple valued fields, periodic groups and multiple record types are all specified for each file. All fields, their contents, size and characteristics are meticulously explained through record structure diagrams for each file. For each field, minimum length required has been used. Free space has been provided wherever it was necessary for future changes/enhancements.

4.5 SUMMARY

The complete design of information content and information storage in terms of the database requirements for management and monitoring a academic records has been done in this Chapter. The identifications of information entities, their relations and converting them into a conceptual model is done in the first phase. The conceptual model was converted into a logical model which was modified for performance and processing considerations. Therefrom, the physical design of the access method and physical storage for the information base has been developed and optimized for performance, and storage. Detailed file structures have been developed with minute details for implementing the required software for the students' academic records maintenance and monitoring.

The software for processing of academic records has been built around this designed physical model (the file structure). Next two Chapters deal with the detailed design of the software for various aspects of the processing.

CHAPTER FIVE

INFORMATION COLLECTION AND INPUT SOFTWARE DESIGN

5.1 INTRODUCTION

The design of the software, for the processes required to be carried out by the system, is the task after the detailed design of the information content and storage file structure. This software design task has been split into two parts. One deals with the software design for information collection and its entry into computer, which is the topic for this Chapter. The other part deals with processing of the information to meet the requirements of educational administration and monitoring. This is described in the next Chapter.

All transactions with computer take place through the keyboard and screen display in an on-line system. The user accesses the system, enters, edits and updates information in the files, processes queries, and generates output in an interactive mode. The user is in continuous dialogue with the computer. As a result, an extra dimension is added to the software design, that is, design of screen formats. The screen format design is done so that system prompts and responses (dialogue) are user-friendly.

The information entry in response to screen prompts should be error free. Large volume of error free information entry requires organization of input information in preset format. To achieve this, formatted information collection is enforced by the system and software design is required to generate these information collection proforma.

Software design for these two activities, screen formats (dialogue) and proforma, requires consideration of issues involving human beings - the users of the computer system. For this reason, software design for these has been separated from the other information processing intensive software design.

5.2 IDENTIFICATION OF INPUT INFORMATION

The input information comes from a variety of sources, on variety of forms (proforma) and at different times. In order to design the software for information entry and proforma generation, a full picture of the input information is required. A complete list of input information, source document for each input and the frequency of input is prepared from the requirements analysis and specifications developed in Chapter Three, Figure 3.1, Figure 3.2 and Table 3.2. The detailed description of each input is given in the following sections.

5.2.1 Identified Input Description

The information content of each of the identified input, Table 3.2, Chapter Three, which has to be keyed-in by the operator is explained below:

(i) IDNO, Name, CHART, STATUS, CUP and CGPA (if any), etc. for all new admission students' is input at the beginning of each semester from the application form.

(ii) Time-Table information for all courses offered in a semester is input at the beginning of each semester. Course number, number of lecture/practical sections, instructor-in-charge, tutorial day-hour, room number, comprehensive examination date; day(s), hour(s), room number and instructor(s) for each lecture/practical section are input from the updated time-table printout.

(iii) Input of course package for ACB/BL students' consists of the students' IDNO, and course number with category, if any, of the courses allotted to the student. The input document is the updated "tentative course package" produced from the computer.

(iv) When a student is admitted with a semesterwise chart which does not exist in the CHART file, the whole semesterwise chart is keyed-in from the Bulletin. The input information is chart code, pattern number, number of courses in each semester and course number and category of all the courses in the semesterwise chart.

(v) Administrative actions on the student STATUS are input as and when initiated by the appropriate bodies of the Institute. Some examples of the administrative actions are "Not to Register", "Debarred to Register", "permitted to delay PS I" and "permitted to discontinue." The input document is the orders issued for each sanction.

(vi) The input of Registration information involves entry of course number, lecture section number, practical section number, course category and Dean's permission for each course registered in a semester. This input document is the Registration card, which is generated by the computer, on which the above information is generated through the process of registration. The changes in the registration information, like substitution and withdrawal, are also input from the registration card.

(vii) Entry of allotment of Practice School semester is once a year from the allotment information on computer generated "Likely PS/TS list." Actual PS/TS allotment entry is done from the respective allotment lists, once a semester.

(viii) Entry of reports (W/DP/RC) for registered courses, which are generated due to revisions/amendments of registrations, is done twice a semester. The Registration Card is used as the instrument for this.

(ix) The mailing addresses of students' are updated for the pipeline students continuously throughout the semester from the updated computer generated address list. The addresses of new admission students are entered every semester, from the application form.

(x) The coursewise grades/reports awarded by the instructor-in-charge are submitted on the Grade List produced as information collection proforma from the computer. The input is course number, IDNO and grade/report awarded for each student in the course. This input is also once a semester.

(xi) The list of students', who have cleared the requirements and are eligible for award of degree is updated for graduation clauses like cleared dues, etc. The information entered is IDNO of cleared students. This information is supposed to be updated as and when a student clears the requirements of graduation.

5.2.2 Additional Input Description

There are some more inputs which did not surface explicitly in the above section and in Chapter Three. Additional information is required for courses and instructors, to update the existing information or to add new entrants, in the COURSE and TIME-TABLE/FACULTY files.

(a) Course Information - One such additional information is about the courses. The input is as and when a new course is added or an existing course is changed. The input required is course number, course title, units, lecture hours, practical hours, prerequisite(s), restriction(s), equivalent(s), and course type details. The source document for this is the Bulletin or the Senate.

(b) Faculty Information - The instructors' names are kept in the FACULTY file (Section 4.4.3, Chapter Four). New persons join on the faculty, and some of the existing faculty leave or are assigned different duties. Thus, the faculty information has to be updated continuously. For new faculty the name is input and for existing faculty the status is updated.

A summary of all these input information along with their source document and frequency of input to the system is given in Figure 5.1.

Input No.	Description	Input Document	Frequency
1.	New Admission Student's Information	Application Form	1
2.	Coursewise Time-Table	Updated Time-table Printout	1
3.	ACB/BL student's Course Package	Tentative course package from computer	1
4.	Semesterwise Charts for all students	Bulletin or Senate	1
5.	Administrative actions on student Status	Orders for actions	*
6.	Registration Data	Registration Card	1
7.	Practice School(PS) and Thesis(TS) Allotment	Computer generated lists	1
8.	Administrative reports awarded due to registration errors or registration revisions/amendments (W/DP/RC)	Registration Card	2
9.	Student's Correct Mailing Addresses	Updated Address List or Application Form	*
10.	Coursewise Grades/Reports as awarded by Instructor-in-charge	Grade Lists	1
11.	Cleared requirements of Graduation	Computer List of Likely Graduates	*
12.	New Course Information	Bulletin or Senate	*
13.	Instructors Information	Time-table	*

Frequency: 1 implies input once a semester,
2 implies input twice a semester, and
* implies input as and when necessary.

Figure 5.1 - Summary List of Input Information.

5.3 DESIGN OF INFORMATION INPUT SOFTWARE

The design of the information entry software for the information identified above is described in this section. The information has to be entered by the operator(s) from time to time. For any operator entry environment, the primary aim should be to take all precautions to reduce the incidence of an entry error while permitting the operator to key-in the information at their own pace. The operator should be able to key-in the information without waiting even when multiple users are using the computer and/or multiple operators are entering the information.

The software for the information entry has to take care of these aspects. The specifications of the information entry software are first explained and then the software design details are given.

5.3.1 Reliability Considerations

The very nature of the information, that is, academic records of the students, demands accurate, error-free and reliable operation not only in records maintenance and processing, but also in entry of information. Confidentiality and vulnerability of the information require stringent control on information entry and complete prevention of manipulation of any kind.

In the design of information entry software, the objectives have been to obtain error-free and reliable input, in shortest possible time, with minimum verification needs and with economy of effort. In other words, the systems design focuses on the need to ensure minimum human errors in entering of the information in the computer.

In order to achieve these objectives, following guidelines have been used in designing of the system, as a whole, and input software:

(i) Every information is input only once.

(ii) Only thoroughly validated and verified information can be used for processing.

(iii) The proforma used for entering information into computer, is used to capture the information at the origin of information.

(iv) The proforma is produced from the computer, as far as possible, and includes the peripheral information required for the process of generation of new information and intelligent entry of new or updated information.

5.3.2 Time Constraints

Time is one of the critical factors in the educational environment, (Figure 3.2, Chapter Three), because of stringent time schedules to meet the deadlines and the very requirement of completing the first event before the second one, which is dependent on the first, takes over and leads to a collapse of the system.

Entry time is minimized using two approaches. The first approach is to provide an interactive mode of entry to the operator, where operator knows what to key-in where and can edit the keyed-in information for any typing mistakes. Information validation checks are performed and error messages are displayed with options for the operator response. This method of on-the-spot (on-line) error correction results in faster, error-free information input as compared to one without any checks at entry time. If the error detection and correction is done only after entire information has been entered, the corrections made may introduce more errors which would require repeating the whole process several times until all errors are removed, thus, requiring much larger time to obtain error-free information.

The second approach to reduce information entry time is by providing multiple entry, that is, number of operators do the entry simultaneously. Whenever large volume of information to be entered this method is used. The examples are, entry of registration information for all students and entry of grades/reports for all courses.

5.3.3 Multiple Operator Entry

The simultaneous input of information by more than one operator requires special considerations in the software and makes the software more complex. More than one operator using the system means:

(a) invocation of the same software package from different terminals to perform the same or different task,

(b) simultaneous access to the stored information by more than one package or by same package running on different terminals,

(c) likelihood of entry of same information by different operators, and

(d) possibility of input of two different pieces of information, for same record, at the same instant. This would result in either a deadlock or one destroying the other by over writing causing wrong input, whereas, both operators would have given correct input.

Software takes care of all these situations and avoids all possible errors that may result due to more than one operator working on the system.

It provides for simultaneous invocation of same or different packages on different terminals whenever it is not going to result in any clash. At the same time, operations which require exclusive execution, like CGPA update, cannot be performed if any other work is going on.

Similarly, sharing of the information base (files) is made possible for simultaneous information entry and retrieval. Exclusive use is enforced in critical processing situations. Sequencing of read/write operations is done to avoid any dead-lock or destructive situation when more than one operator is entering the information.

Software is geared to check for duplicate entry of same input, from different or same terminal, and flashes appropriate messages if it happens. But, if the second entry is an update, operator is provided with appropriate options to make the revised entry.

5.3.4 Human Factors

In an on-line system, the user is in continuous dialogue with the computer through the screen, where each one only communicates by writing on the screen. The user-computer interactions in the on-line system assumes a dual role for the user. The user, not only uses the computer for running the specified package but also has to play the role of the computer operator. The operator performs, in interactive mode, one or more of the following functions:

(i) Log-in at a terminal and invoke the package.
(ii) Call up a specific option for processing or input of information.
(iii) Enter information interactively or respond to prompts displayed.
(iv) Edit the keyed information for any typing errors.
(v) Respond to error messages.

The user psychology, thus, has to be considered as an important factor in the software design.

Human-machine interaction involves many human factors that have been considered in the design. Human operations, memorization, reasoning, visual perception and dialogue are important human factors among others.

In the software design for information input human factors have been addressed in terms of:

(a) Optimizing Human Operations,
(b) Minimize Memorization,
(c) User-friendly, Menu-driven Operations, and
(d) Error Control.

(a) Optimizing Operations

The operations to be performed by the operator can be measured in terms of number of key strokes required to be made to input a specified length of information. Wherever possible the operator keystrokes are minimized in such a way that error-free entry is made at the optimum speed because less input will result in lesser errors and faster entry. Some typical examples of input optimizations are explained below.

(i) Entry of record number, which can be at the most a 4 digit number, instead of IDNO, which is nine characters long. The record number has only numerals (0 to 9) while IDNO is alphanumeric. Keying-in of IDNO requires not only more key strokes but also movement of fingers over the entire keyboard, making the entry slower.

(ii) Similar to (i) above, course code is used instead of course number for inputting courses, wherever possible.

(iii) For entering a record number, say 43, a formatted read will require input as "0043" that will take at least 4 key strokes (one each for 0, 0, 4 & 3), whereas an unformatted (or free format) read will require only 2 key strokes (one each for 3 & 4). This optimization has been provided throughout the software.

(iv) Information input is minimized by only entering what is not available in the system. No information, which is directly available in the system or can be logically derived through a process, is entered as a new input. Exceptions to this are situations of double entry of same information for verification and elimination of operator errors. Use of information available internally is made at the cost of extra processing, primary memory or secondary memory or all of them.

(b) Minimizing Memorization

Software design is made in such a manner that operator is not required to memorize the information to key it or to understand it. Many pieces of information are coded for optimizing on storage space (Section 4.4.3, Chapter Four and Appendix B), but the user is not required to remember them. For example, grade "A" is coded as 1 (Appendix B) but the operator enters "A" only wherever it has to be input and not the code "1." Similarly, the system output will always reproduce the information in the original form and not the code. The translation task, from information to code and vice-versa is carried out by the software.

(c) <u>User-friendly, Menu-Driven Operations</u>

The entire software has been designed to be menu-driven and user-friendly. Every package, when invoked, greets the user with the package description and update version followed by the main menu. All successful completions of the desired tasks and on completion of execution of the package, user is informed by termination message whereas abnormal terminations generate an error termination message. Figure 5.2 shows a typical user session with the computer including the "login" procedure to check for the valid users and "logout" procedure to close the account and prevent any unauthorized access to the system. Figure 5.3 shows more details of the process of execution of a task chosen by the operator.

Knowledge, education level and training of the operators have been the prime concern in designing menus and sub-menus. The messages have been kept brief and clear and are in simple English. Figure 5.4 shows a typical main menu for "Registration Information Entry and Validation" and a sub-menu for one of the tasks on the main menu. The operator can go from the main menu, in Figure 5.4(a), to a sub-menu by selecting an option, for example, option 2 on main menu will result in sub-menu in Figure 5.4(b). Selection of an option on a sub-menu may result in a sub-sub-menu or prompts to the operator for necessary information or return to main menu.

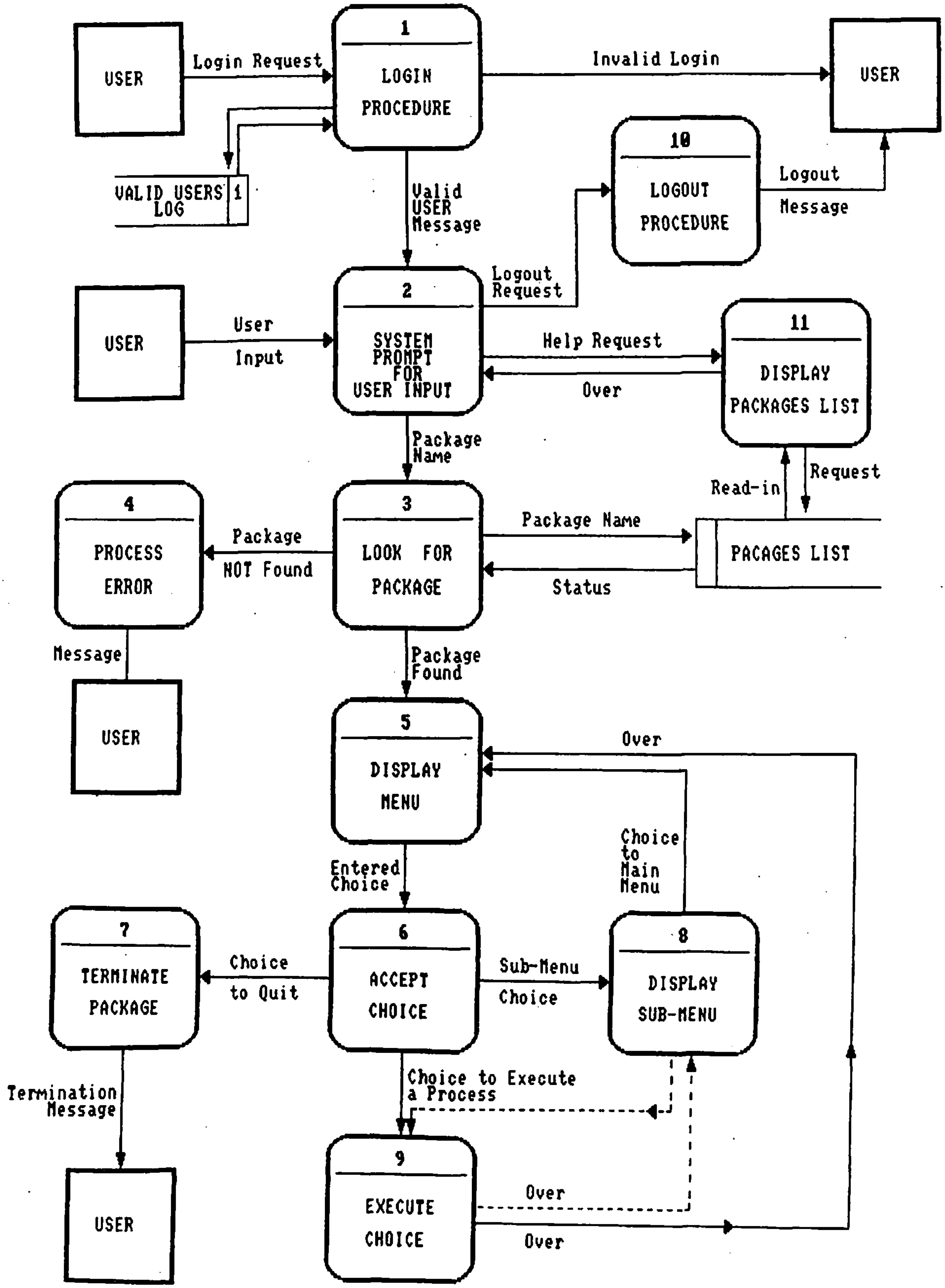


Figure 5.2 - A Typical User Session with the System.

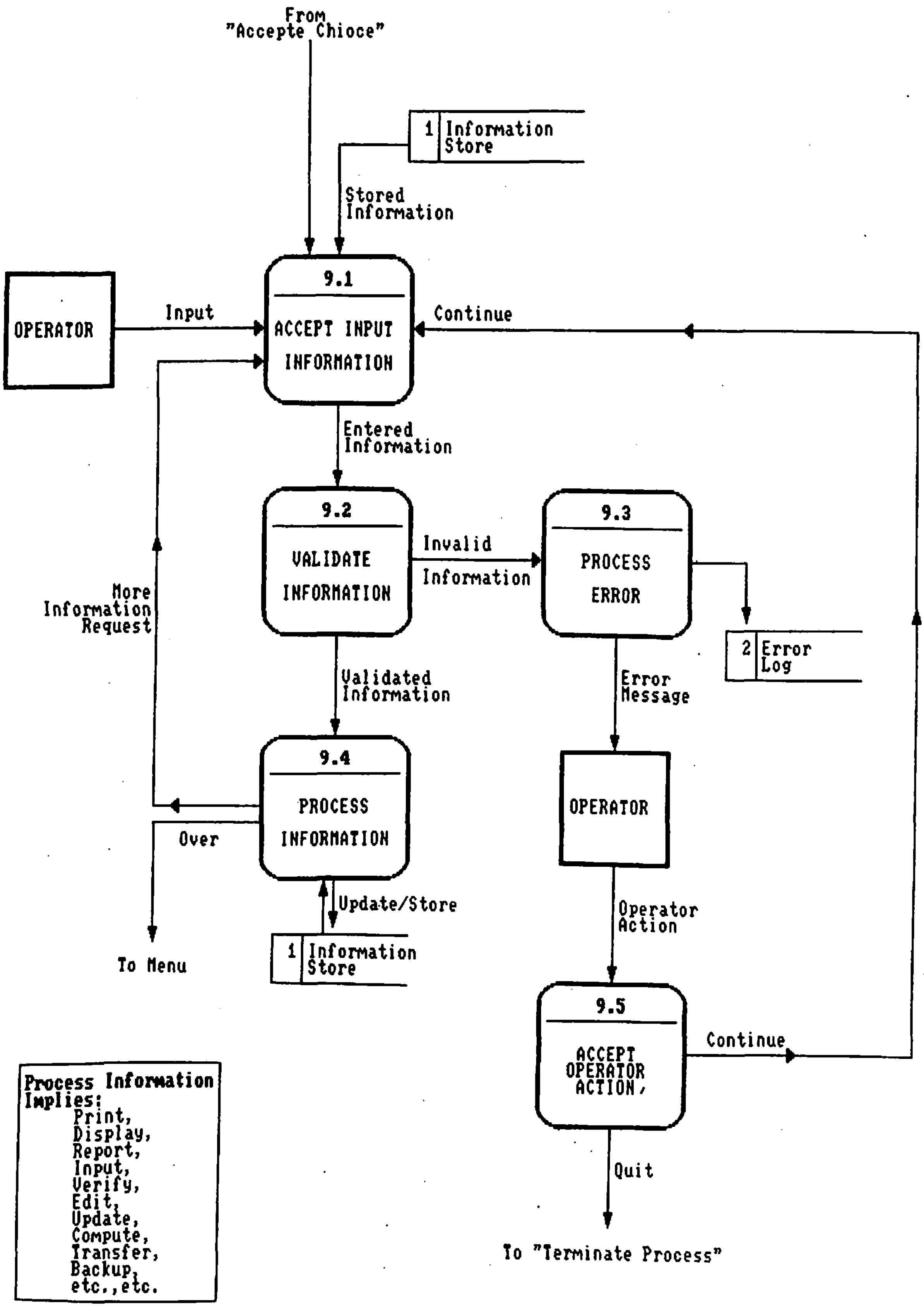


Figure 5.3 - Explosion of Process "Execute Choice" (Process 9 of Figure 5.2) - Level 01 Information Flow Diagram.

```
Registration Information Entry and Validation Package
        Ver 3.1  4.19 PM SUN., 19 MAY , 1991

         Current Year: 1990-91   Current Semester: 2


    You Can Perform Following Tasks:

         1: Set/Re-set Registration Flag
         2: Enter Registration Information
         3: Modify/Correct Registration Information
         4: Display Registration Information
         5: Print Registration Information
         6: Unit Entry-Posting
         7: Enter Category Information
         8: Auto Verify/Correct Registration Information
         9: Post Repeats
        10: Enter Single Course Registration
        11: Exit

        Choice    ?   2
```

(a) The Main Menu

```
Registration Information Entry and Validation Package
        Ver 3.1  4.19 PM SUN., 19 MAY , 1991


Registration Information Entry:

            1. Enter Total Information
            2. Enter Sections Only

        Option     ?    _
```

(b) Sub-Menu for Choice 2 - "Enter Registration Information"

Figure 5.4 A Typical Main Menu and a Sub-Menu for Registration Information Entry

User-friendliness is further enhanced by dialogue and screen designs. These are explained in the next section.

(d) Error Control

Errors that are possibly made by the operator during the information entry are normally of two types: typing errors and comprehension errors. In the software, mechanisms are provided to check operator typing errors as far as possible. An input of a character will not be accepted in a numeric field, for example, in course code or record number field. Similarly, in student's name (NAME field), no numbers or characters other than a space and alphabets "A" to "Z" are accepted.

Whenever an error occurs, a brief but clear error message is displayed and the operator is prompted for the correct entry in a manner which is least disturbing to the entry process. In some situations, the operator is provided with options in a menu form. The operator can choose an option, which may be as simple as reentry of the information or a complex one which may lead the operator to navigate through a series of checks, verifications, entry of other information to apply corrective measures and finally return to the original entry screen.

The interactive mode of input provides the feature of making corrections to the information keyed, as the keyed information is displayed on the screen simultaneously, before signaling the computer to accept the information.

5.3.5 Screen and Dialogue Design

The user interacts with the system in a two-way dialogue via the screen and keyboard. A prompt or a message is a dialogue between the user and the system. The acceptability of the system depends upon the degree to which the system can be made as easy as possible to use. However, more freedom to the user implies more complexity for the software and there is always a need of striking a balance between the two.

The input is of several different kinds (Figure 5.1). Some entry screens take more than one input information on one screen while some entries run into multiple screens.

User-friendliness, visual perception of the operator and other human factors have been the main criteria for screen and dialogue design. At times, system performance efficiency has been compromised to make screen and dialogue more responsive to the user-needs.

The software provides the following features in the screens and dialogue.

(i) All prompts and messages are short, simple, clear and in simple English. They do not confuse the user with imprecise or misguided dialogue.

(ii) System prompt, requiring user attention is accompanied with a "beep" (audio prompt) of varying duration. A single beep is used for a "pat" to the user or for requesting an input while a long beep is used for errors, length varying with the severity of the error.

(iii) The prompts and messages are provided in consistent manner. This reduces the reading time for the user.

(iv) The uniformity in screens is provided such that opening message – package name, version number, date of last revision and main menu, display area of prompt and screen format are consistent throughout the packages in the software.

(v) The system displays simple instructions on the screen which tell the operator how to proceed and continue the dialogue. Some such instructions are "0 to Exit", "Enter Y or N", "a to Abort" and "press Return to continue."

(vi) The format, in which the information is to be keyed-in, is displayed, guiding the operator, where to key-in what.

(vii) The operator can edit the information keyed-in to correct any keyboarding errors, before asking the system to accept the input for further checks and verifications or use.

5.4 VALIDATION OF INPUT INFORMATION

Any information entering the students' academic information processing system must be correct, correctly entered and thoroughly verified before it can be used for the purpose it is intended for. This verification and validation of information is crucial for the error-free processing of sensitive academic records and cannot be left to error prone, slow and tedious manual verifications. Software has been designed and developed to provide for verification and validation of the information, not only for the new input but also for the information stored in the system.

All input software is interactive (Section 5.3), which accepts the operator entry only after proper verifications. Every new input to the system is first subjected to the routine edit checks with appropriate prompts and error messages, on detection of an error. The edited information is then subjected to cross-checking of values across multiple entries or stored information. Finally, validated information enters into the system and stored in the files.

For the new information entering the system the onus of correctness of the information lies with the source of information, but the software has been so built that it detects the errors made at the source and prevents wrong input to the system.

The primary objectives of the verification and validation software are:

(i) Not to accept wrong, contradictory, inconsistent, arbitrary, and erroneous information input.

(ii) Avoid and/or detect and correct operator typing mistakes.

(iii) Identify inconsistencies in the stored information, which may be due to wrong input or corruption of information by unknown errors.

The verification and validation checks performed by the software can be classified into two categories (i) on-line checks, and (ii) off-line checks.

5.4.1 On-Line Validation

On-line checks provide validation of information when it is keyed-in and if found wrong, the system immediately prompts the operator to reenter information correctly. Operator is not allowed to proceed further till the correct entry is made, or the operator chooses to "quit" and terminates the information entry process. The keyed-in information is neither stored nor utilized until it passes the on-line checks. All input is subjected to on-line verification, but the checks that can be performed on-line are limited.

5.4.2 Off-Line Validation

The off-line check implies a verification and validation of the keyed-in information after it has been stored. Software for the off-line checks is separately built and invoked after the information input is over. The errors detected can be corrected interactively by the operator, that is, as soon as a verification fails, the system prompts, on the screen, for correct input. The verification process waits for the input from operator. The new input is reverified by the same validation process. This process of operator input and reverification is repeated until either a correct input is made by the operator or the operator decides to skip the error for a later correction or terminates the verification process itself. This approach makes the off-line checking process an on-line correction process.

The second method is to spool all errors and violations to printer and get the printout at the end of the off-line verification process. Corrections are made by the operator by reentering the information. After the reentry, entire information is reverified. The process is repeated until all errors are removed.

5.4.3 On-Line verses Off-Line Validation

The decision to perform a check on-line or off-line depends upon many factors.

(i) All on-line checks can be performed off-line whereas, all off-line checks cannot be performed on-line.

(ii) As on-line checks are built into the input software, they tend to slowdown the entry process even when no errors are detected. Therefore, complex and time consuming validations are not performed on-line.

(iii) A validation may require an information that has not been keyed-in. In other words an anticipatory verification cannot be performed. An example of such a situation is a verification request like "Have the grades of all the student in a course been input?" while the grade entry is going on. Therefore, such checks can only be performed after the entry is over, that is, off-line.

(iv) Checks requiring an aggregation of input information and stored information for verification of the input are preferred off-line.

The guiding factor for the decision on this issue is that the entry process is not sloweddown, and at the same time not too many of wrong entries are accepted, which on later verification, off-line, will require a large chunk of information to be entered again, doubling input time and effort.

In practice, some checks are performed on-line because they are unavoidable while others which do not hamper the entry speeds are also preferred on-line. Checks which are time consuming and can be delayed, are performed off-line. It is also possible to do the verification in the background while the entry is in progress, but the present hardware technology does not permit this.

5.4.4 Description of Validation Checks Performed

Depending upon the input type, volume, source and document, a variety of on-line and off-line checks are performed. Most significant fact to note is that the information entered through the input process, cannot be utilized and processed further until it clears all the validation checks provided in the input software as on-line checks and checks built into validation software for off-line checks.

For this the processing software has been build incorporating checks on the verification status of the input information. Such processes cannot be performed until all checks are cleared by the entered information required for the process. Some typical processes where such checks have been built into the software are described below.

(i) Course lists cannot be printed after registration information entry, until the entered registration information passes all checks specified, on-line and off-line.

(ii) Grades for a course are not loaded and stored in the file until the computer generated and the instructor-in-charge reported analysis of grades match.

(iii) Coursewise grades cannot be posted into the student's file unless the grades for all courses offered in the semester are loaded and verified.

The primary focus in performing these checks is on detection of errors arising out of erroneous input, error in source (for example, registration by a student in a not offered course/section), logical errors and system errors. The validation checks can be classified as:

(a) Range Validation Check,
(b) Alphanumeric Validity Check,
(c) Consistency Check,
(d) Relational Check, and
(e) Checksum Check.

Each of these checks is described briefly in the following sections with examples of the situations where the checks are applied in the students' academic records processing system.

(a) <u>Range Validation Check</u>

One of the simplest method of identifying an invalid information is to determine whether it lies within the expected minimum and maximum values already established. Such a check prevents certain "impossible" input to the system that, otherwise, may cause havoc.

For example, in registration information entry, several range checks are applied. The student's IDNO or record number should be within the range of existing IDNOs or record numbers. The course codes should be in the range of 1 to maximum course code, the section number should in the range of 1 to number of sections offered, etc. All these are simple and direct range checks.

Some examples of more complex and indirect range checks are given below.

* In the input of a semesterwise pattern, number of courses entered for a semester can neither be more nor less than the semester count for that semester and total courses in a chart cannot be different from sum total of semester counts.

* Number of grades awarded and number of grades input for a course cannot be different from number of students registered in the course.

Range check is not only meant for the input, it is also applied during various processes and computations. For example, in CGPA computation, a negative CGPA or a CGPA of more than 0.00 and less than 2.00 or a CGPA of more than 10.00 is INVALID.

Range checks can be applied either on-line or off-line depending upon the check being performed. For example, during registration information entry, range check of IDNO/Record number is unavoidable on-line, and range check on course code is applied on-line without causing any slowing. The range checks on offered sections requires interface with time-table files and will obviously slowdown the entry process, therefore, it is applied off-line.

When a violation of range check takes place, the software informs the operator of the range violation and displays the permissible range and/or error in the input and its location.

(b) <u>Alphanumeric Validity Check</u>

To check whether an entry at a prescribed position matches the pre-established table of valid values or not alphanumeric validity check is applied. It means, in a numeric field any character other than numbers 0 to 9 will be declared as invalid and in an alphabetic field any character other than A to Z is invalid.

A more intricate alphanumeric validity check is applied to IDNO which has a mixture of numbers and alphabets in the same field. The IDNO is alphanumeric and has fixed positions for numbers and alphabets. There is a table of valid values for each position in IDNO, as well as there is a table of valid IDNOs. Therefore, any input of IDNO is first checked for its alphanumeric validity and if found valid, it is subjected to range and other checks. Course number is another similar example.

(c) <u>Consistency Check</u>

In some situations where same item is entered more than once, on the same entry or on different entries, a check on equality of values is called consistency check. Intentional reentry of information is done, in certain situations, to perform verification of the input information. The contention is that, if the first and the second input (normally made by two different operators) are consistent (exactly match), no error is made by the operator in keying-in the information. This ensures correct input of information.

In entry of information, which is of critical nature and where manual verification cannot be done accurately and in a reasonable time, double entry and verification is built in the software, where two entries are made for the same information by two different operators, one after the other. The first entry is saved in the file and the second operator's entry is compared with the saved information. If the two entries match exactly, the information is assumed to be correctly entered. It is tagged as "verified" and cannot be altered. If a mismatch is detected between the first and the second entry, the saved information is unloaded from the file and is required to be reentered and verified by the two operators, respectively.

(d) Relational Check

A relational check is performed to validate a related group of information items, pertaining to one or a group of records. The group is supposed to satisfy certain obvious and certain not so obvious conditions. The conditions are pre-established and can be of equality or inequality type. The relational check is applied to the aggregate information and not to the individual piece of information, which is the case in range check. However, a relational check may be applied on one item involving a group of records and may involve one or more range checks in it. Here are a few examples of relational check conditions.

(i) Two records in the student's master file cannot have same IDNO.

(ii) Two courses cannot have the same course number, in the course file.

(iii) A student cannot register in same course twice in the same semester.

(iv) Total number of course-student pairs are same as the total number of student-grade pairs.

(v) The grades/reports turned-in by the instructor-in-charge correspond to students registered in that course.

(vi) The analysis of grades generated by the computer from the keyed-in grades should match the analysis reported by the instructor-in-charge.

(vii) A course cannot appear more than once in a semesterwise pattern.

(e) Checksum Verification

Checksum verification is a method of maintaining the integrity and security of stored information or information transported from one source to another. A checksum for the information in a record and/or file is computed using a "checksum function." The checksum value is compared with the known value of the checksum, if the previous value and new values match, it is implied that the information in the file is cogent.

To implement the checksum verification method, checksum functions are defined and checksums are maintained for the stored information. Each and every legal entry/update of information in the files is made to pass through the "checks and controls software" that updates the checksum(s) for the file and/or records. Any unauthorized or illegal modification or any corruption due to hardware errors, power fluctuations etc. will not pass through this software and hence checksum(s) will not be updated. A verification on matching of checksums can easily pin-point where, if any, illegal modification or corruption has taken place. The checksum functions, algorithms and software for this method, as applied to the students' academic records processing system is described by Ravi Chandra [18].

Another application of this method is in situations where information is to be ported from one machine to another machine and either no hardware-cum-software tools are available to effect the machine-to-machine transfer, e.g. IBM-1130 and HP-1000 or the two machines are operating on different operating systems but a hardware link between the two is possible, e.g. HP-1000 and HCL-MAGNUM.

In the former situation, the information is dumped from 'old' machine in suitably coded form, for minimizing entry and errors as explained above (Section 5.3), with proper checksums and is entered into 'new' machine by operators. In the 'new' machine checksums are re-computed and matched against the checksums of the 'old' machine. No wrong information is, therefore, ported. In 1985, using the checksum verification method, entire academic records were ported from IBM-1130 to HP-1000 and in all 4 errors were detected. Complete details of this are available in Mathur and Mittal [47].

In case of two different machines with a hardware link, checksum(s) generated at source end are matched against the checksum(s) computed from the data received at the other end. This is required for ensuring error free transportation.

Checksum verification is susceptible to the symmetrical errors and group mixup errors. For example, if one number is offset by say, " -p" and some other number in the set is offset by "+p", a simple checksum function (for example: checksum = sum of integer value of stored bytes) will fail to detect the error. This is known as symmetric error. In group mixup error, if item d1 exchanges position with say, item d7, the above checksum function will generate the same checksum value and error will not be detected. These errors can be minimized by designing more complex checksum functions and by maintaining more than one checksum, using different checksum functions, for the same set of information.

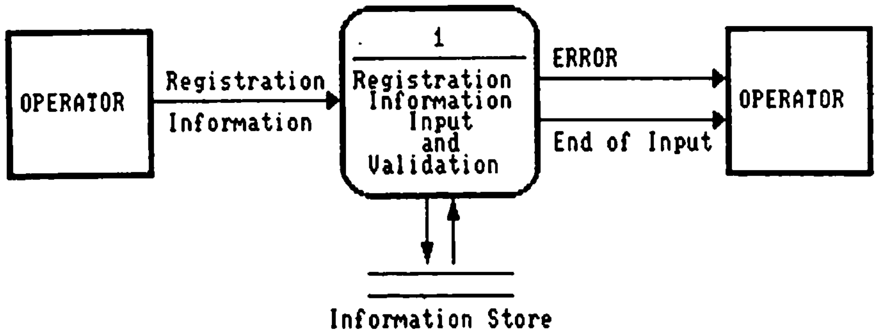
5.4.5 The Registration Information Input and Validation Design

The design of the process of entry, verification and validation for the registration information is explained in detail with the help of Figure 5.5 along with the dialogue and screen formats design.

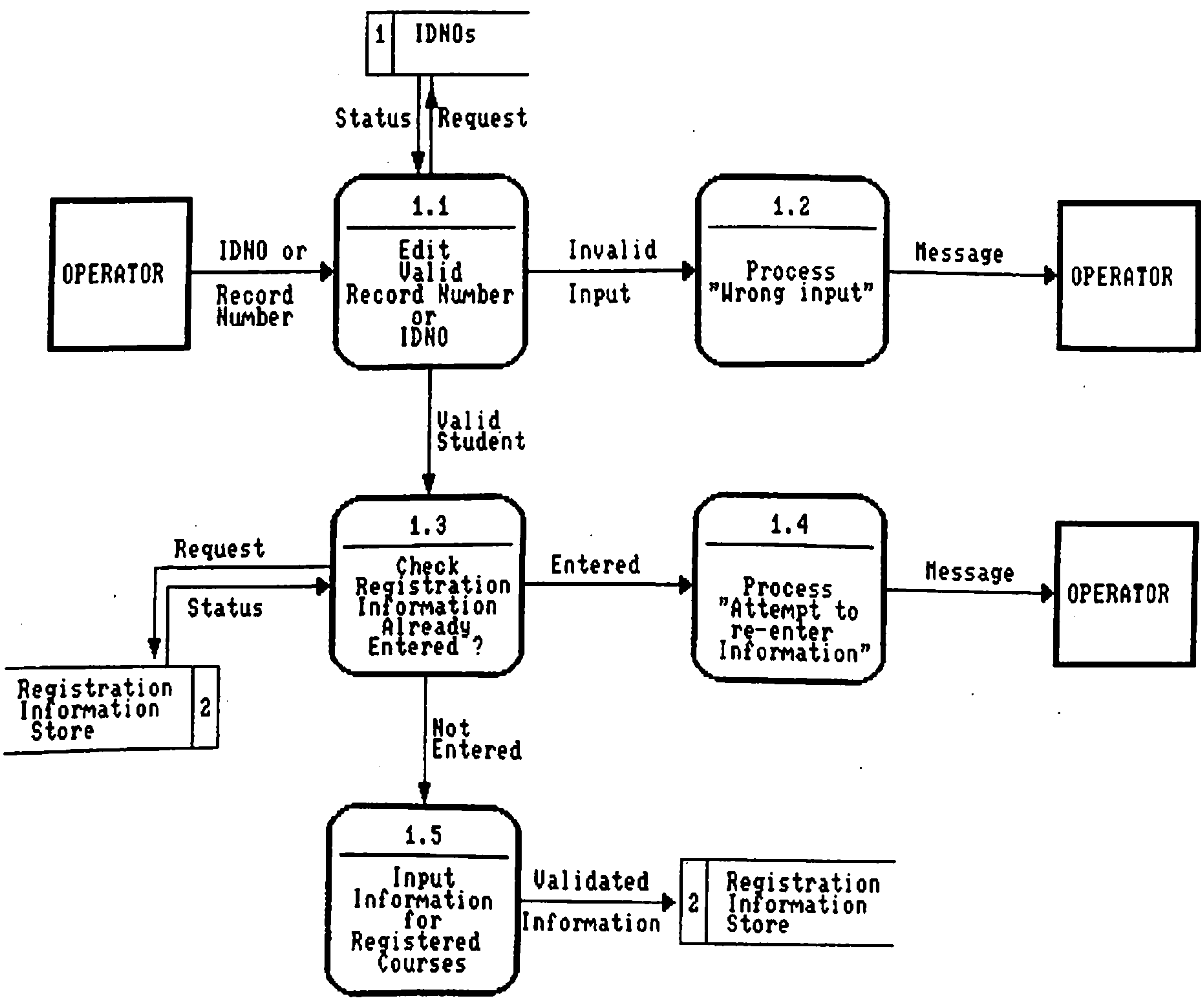
Figure 5.5(a) shows a simplified information flow diagram for the process of input and validation of information. The operator enters the registration information, which if passes all validation checks, is stored in files and operator is told about the successful entry. If an error is detected in the input the error message is displayed and operator is prompted for action with appropriate options.

The details of the preliminary checks provided in and performed by the input software are shown in Figure 5.5(b). The first input from the operator is student's IDNO or record number from the Registration Card. This input is subjected to on-line, alphanumeric and range validation checks (Process 1.1). Only when a valid IDNO/record number is input by the operator, the process of input is continued, otherwise the error is processed (Process 1.2) and operator is duly prompted. The next check performed is to find out whether registration information has been already entered (Process 1.3). To do this, the stored registration information is looked-up. If the student's registration information has been already input, operator is informed and prompted for next student (Process 1.4), otherwise the process of input of registered courses' information begins (Process 1.5). All these validation checks are unavoidable on-line.

Figure 5.6 gives the further processing details for input and validation of courses related information for a student and validation of aggregated information. The operator is prompted to input information for a registered course, lecture/practical section number and category. This input is on-line validated for valid course code, section number(s) and category using alphanumeric and range validation checks (Process 1.5.1). Until the end of input for a student is keyed-in by operator (Process 1.5.3), the operator is prompted for input of next course for the same student (Process 1.5.4). At the end of input for one student, the entered information is stored in files and total number of courses input for the student is displayed (Process 1.5.5 and Process 1.5.6) for a consistency check followed by input request for next student's information (Process 1.5.8).



(a) Simplified Process of Registration information Input and Validation - Level 00 Information Flow Diagram.



(b) Process of On-line Validation of Input of Student's Preliminary Information - Level 01 Information Flow Diagram

Figure 5.5 - Registration Information Input and Validation Process.

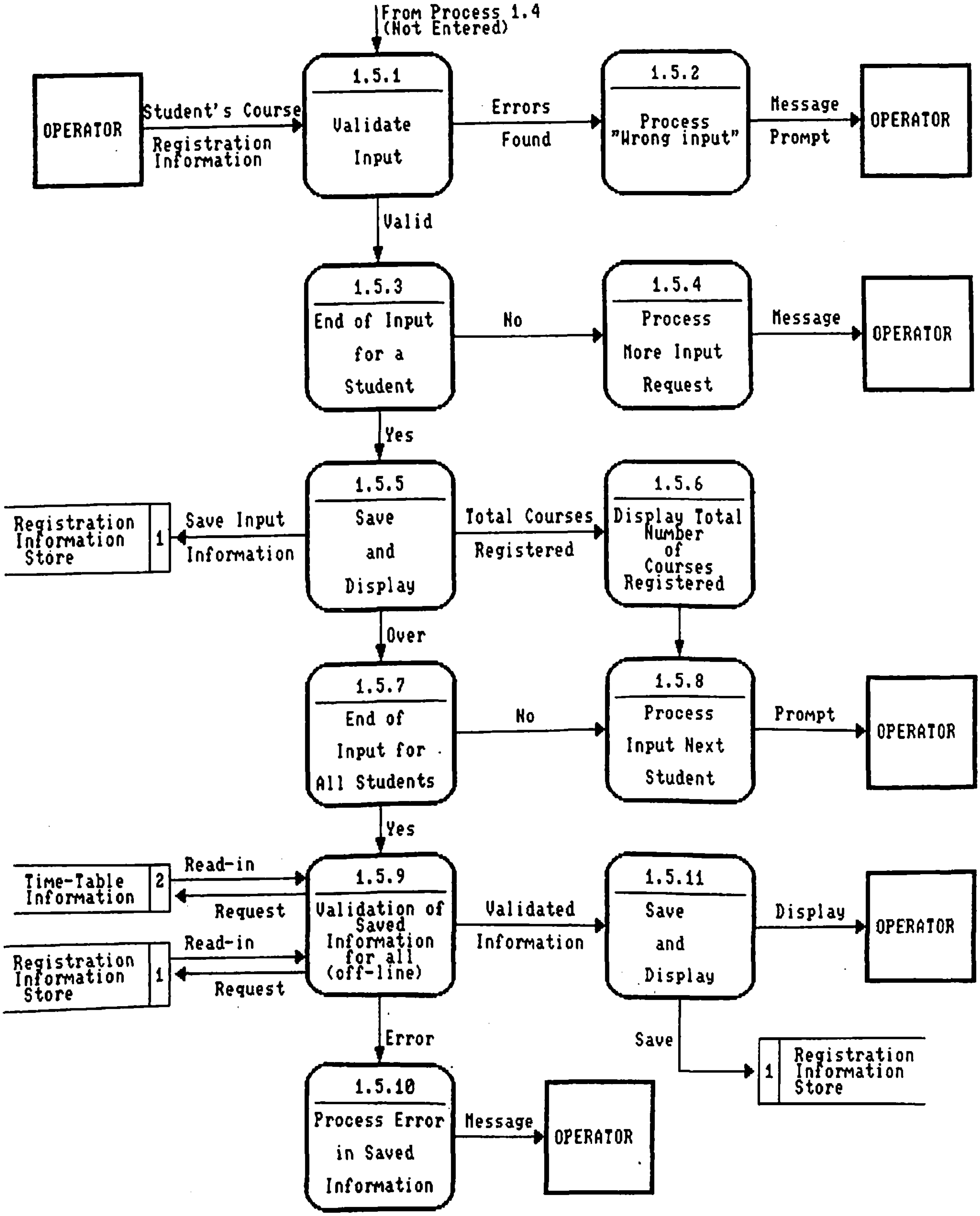


Figure 5.6 - Process of On-line Validation of Input Registration Information and Off-line Validation of Aggregated Information - Level 02 Information Flow Diagram.

The end of input of registration information for all students (Process 1.5.7) marks the beginning of the off-line validation of stored information (Process 1.5.9), otherwise the operator is prompted for input of next student's information (Process 1.5.8). The stored information is subjected to consistency, range and relational validation checks for a final validation before processing it. These checks on the aggregate information are performed off-line. The stored registration information for a student is read from the files. The registration status and number of courses registered (as entered) is checked for consistency. Each course, in the stored information, is checked against the time-table for offering and section number(s) is checked against range of number of sections offered. Every course which passes all the checks is displayed with a "validated" message and saved into the file. The operator is informed of the errors detected (Process 1.5.10) and the error is handled in one of ways described in Section 5.4.2.

Further details of the process of validation of input information (Process 1.5.9 and Process 1.5.10) are necessary for software implementation. The software design detailed down to the procedural level for the validation of input registration information is described in Figure 5.7, that shows details of all validation checks performed and errors detected and reported. The process is interactive and no further processing is done unless and until the correct information is input. It also highlights the situations under which a "reverification" of the input information is invariably done.

5.4.6 Operator Education

Educating the operator about the checks and verifications performed by the input software goes a long way in achieving the goal of accurate and fast entry. By this the operator becomes more cautious to entry mistakes which are not detected by the software and makes the entry confidently with a tension free mind, which results in best output in terms of speed and accuracy from the operator.

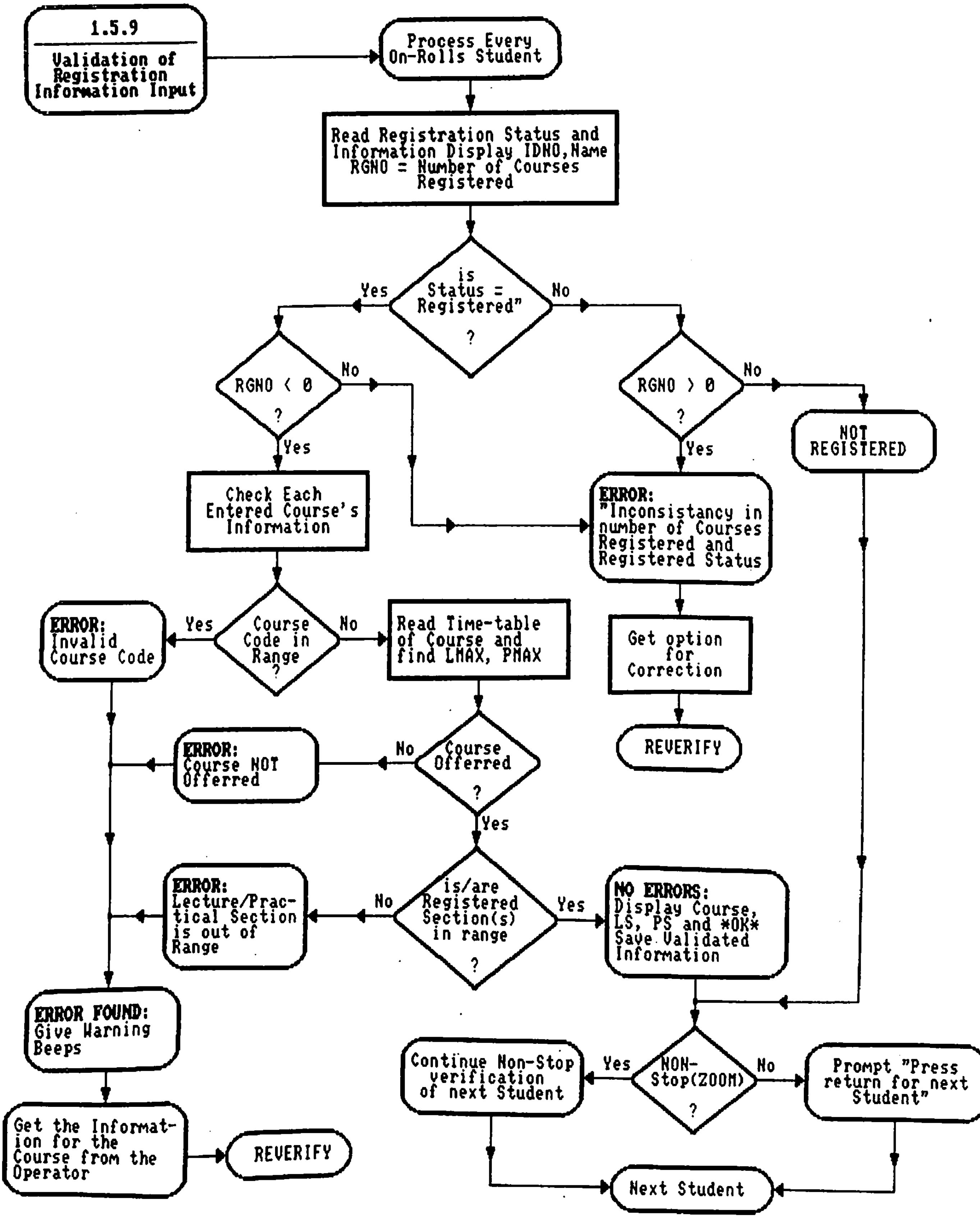


Figure 5.7 - The Process of Validation of Input Registration Information. (Process 1.5.9 of Figure 5.5)

5.5 DESIGN FOR INFORMATION COLLECTION

Input documents provide new information to the system, that is, the operator has to locate the necessary information on the document and key-in the same without making any mistake.

The efficiency, speed and correctness of input, therefore, depend upon the input document and location of information to be input, on the document. The accuracy, reliability and correctness of information on the document is another important factor. The transmission of information from one document to another, which is a manual process, is without any checks and is liable to be error prone. The accuracy, reliability and correctness of the input information is achieved by capturing the information, on the input document, as close to the point of generation as possible. This eliminates any possibility of errors which might creep-in due to transmission of information from one document to another, before it reaches the point of input to the computer.

As identified in Figure 5.1, most of the input documents for the students' academic records processing at BITS are computer printed either with the format or on pre-printed stationary. Each of these documents has been designed to meet all the requirements of input specified in Sections 5.3 and 5.4, above. These documents have the following common features.

(i) Each format is designed so as to allow input to proceed from left to right and then from top to bottom within the document and with minimum strain to the entry operator.

(ii) Each document is used as the "instrument for transaction" at the source of information, thus, capturing information at its origination point.

(iii) All the information already available in the system and required to be used in the process of generation of new information is contained in the document.

(iv) For each information generated on the document, identified space is provided. The operator, therefore, can easily identify what to input and what to ignore, without looking at the entire document.

In situations, where computer generation of input proforma is not possible, for example, new courses, a separate entry sheet is prepared with space for all the information required to be input. This sheet is manually completed from the source document (e.g. Bulletin or Senate for new courses) and input is made by the operator from the completed sheet.

A detailed description of the computer generated input documents (proforma) is given in the following sections.

5.5.1 The Registration Card

Registration Card is the most frequently used input document. During the semester, from the beginning to the end, it is used as a "transaction instrument" at the source of information and newly generated information is input from it to system, from time to time.

The Registration Card is an individualized document, that is, one Registration Card for one student. A sample Registration Card is included in Appendix A. It contains, semester, student's record number, IDNO, name, priority number, and status information at the top. The body of the registration card is divided into two parts. Left side is meant for "Original Registration" and right side is used for "Amended/Revised Registration."

The left side contains the prescribed course package for the student, which includes, course code, course number, type and course title. All this information aids and speeds-up the registration process (Chapter Two, Section 2.6, Figure 2.4). The newly generated information, that is, course code (if any course is added to the Registration Card), Lecture/Practical section number allotted and course category (if other than printed) are to be input from the Registration Card. All these entries are located in the left-hand end of the left part of the registration card so as to minimize not only the operator entry but also the operator search (say, eye movements) for locating the information to be input.

The right part is used for recording amendments/revisions of original registration. It is divided into requisite number of columns for all possible types of amendments/revisions provided in the Academic Regulations. The final outcome of amendments/ revisions for a course is again required to be input to computer. For this a column is provided in the left part. This is the leftmost column in which the final status of a course is recorded and information in this column is used by the operator to update the system. The software and procedural design of the Registration Card is explained in Chapter Six.

5.5.2 The Grade List

The grades/reports awarded by the instructor-in-charge are input to the system from input document called "Grade List." A sample of grade list is included in the Appendix A.

The grade list is again produced from computer to enforce input in the prescribed format and for speedier and error-free input. Entries of grades/reports are made in it by the instructor-in-charge, that is, the information is collected at its origin.

A grade list is produced for each course offered in a semester. The header information contains semester, course code, course number, course title, total number of students registered and name of instructor-in-charge. Below the header, the IDNO and name of all students registered in the course is listed with a space against each student for entry of grade/report awarded by the instructor-in-charge. The list is followed by an "analysis sheet" which has space for reporting the analysis of grades/reports awarded, for example, "Number of A Grades", "Number of B Grades," etc.

The operator input from grade list is only course code and grade/report for each student. The operator is not required to enter each student's IDNO because system displays the IDNO and name of the student, once the course code is input, and prompts the operator for the grade. The sequence of prompts is same as the order in which the names are printed in the grade list. This is possible because the input document is produced from the same information store and with all the required information. This minimizes the operator input. The input and verification of as many as 16000 course-student grades is possible in approximately 48 man-hours time. At the end of entry of grades/reports for all students for a course, the computer prompts for the analysis as reported by the instructor-in-charge. This input is minimized as only non-zero entries are required to be made by the operator. The grades/reports entered are stored, provided input passes all verification and validation checks prescribed and explained in Section 5.4. The software design for these processes of generation of Grade Lists and input of grades/reports for all courses is explained in Chapter Six.

5.6 SUMMARY

Detailed design description of information collection and input software for students' academic records processing and monitoring system has been discussed in this Chapter as the second phase of the software design process. The emphasis has been on converting and implementing processing requirements involving interaction of human beings with machines (peopleware with hardware and software) for smooth, error-free and reliable input and operations of the system.

Detailed description of input has been developed and design of the input process and software for input has been explained with considerations of time constraints, multiple input and users, human factors, screens and dialogue design.

Error free input is essential for the sensitive students' academic records. For error control and elimination, various kinds of verification and validation checks have been provided in the software. Each of these has been explained in detail with situations where each has been applied.

The input document should have error-free information and, therefore, should capture information as close to its origin as possible for elimination of any transmission errors due to exchange of hands. For this, the input document should be computer generated, that is, it has to prepared by the computer with all related information pre-printed, as far as possible, and should be directly used as transaction document in the process of information generation. The design of input document to meet these objectives and others has been presented with specific examples of Registration Card and Grade List used in the students' academic information processing system.

The next phase of the design deals with the software design for information processing requirements of the system, which are processing intensive, in the next Chapter.

CHAPTER SIX

INFORMATION PROCESSING AND OUTPUT SOFTWARE DESIGN

6.1 INTRODUCTION

In the process of management of students' academic records for educational administration and monitoring, there are several processes which require information transformation and processing to meet the administrative and operational requirements. These processes and their requirements were described in Chapter Three, information content and data design to realize these objectives has been presented in Chapter Four and the first phase of software design for the same has been presented in Chapter Five with description of information collection and input software design.

Design of software, which is information processing intensive and the soul of the SAIPS for monitoring and management of academic records, is described in this Chapter. Processing of academic information requires precise and comprehensive knowledge of Academic Regulations and rules governing the operations as was also spelt-out in Chapter Three. These rules and regulations are required to be woven into the software which operates on the designed information content and input information to generate desired results and reports. The process of software design involves interlacing of information structures, information content and information in transition with the requirements through a translation of abstract verbal rules and regulations into software architecture, structure and finally into a software procedure which can be coded into a programming language and executed to meet the information processing requirements.

Chapter Three, Figure 3.1 is an information processing model for the academic information processing activities required for academic monitoring and management of students' records at BITS. The software architecture for the SAIPS is thus evolved, using the partitioning principle, as set of six main subsystems, process 1 to process 6, Figure 3.1, which require software solutions. Each process is further partitioned into smaller subsystems based on the processing to be performed, identified as information processing activities. The software design for each of the identified information processing activity, is presented in this Chapter in the same sequence.

The design of each of the processes is explained with the help of structured information flow diagrams and flow charts, which are detailed down to program level design, requiring minimum of verbal description. The common characteristics and features of the designed software are first explained in the following section and then software design of each process is described.

6.2 FEATURES OF INFORMATION PROCESSING SOFTWARE

The program level design phase of software design comes after the system level design. It addresses the detailed design issues at the individual process level rather than at the system and subsystems level. The software design has been carried out in detail, to the program, module and sub-module level such that it can be directly translated into programming language code. System implementation has been done by actual coding, testing and debugging of code to make it run error-free. Hence, the software designs presented here for the academic processes are well tested, error-free and certified for reliable fail-safe operations.

In the design of information processing software a set of guidelines have been used and a strict adherence to these guidelines has ensured a quality software which is modular, optimal and efficient for operations. These guidelines are described briefly in the following section.

6.2.1 Guidelines Used in Information Processing Software Design

Effective modularity and unambiguous procedural detail leading to development of processing algorithm for procedural design have been achieved by applying the following five guidelines in the design of the processing software.

a. Abstraction. In the procedural and structural design, high level of abstraction is used leading to identification of modules. The description and abstraction is uncommitted to any hardware, programming language or data configuration but is so precise that it can be directly implemented.

b. Coupling. Modules are designed such that they are fairly self-contained, that is, have low coupling.

c. Cohesion. To obtain the effective modularity, modules are identified based on the task or activity. This gives highly cohesive modules which have negligible dependence on other processes or procedures before or after the module.

d. Scope. The design of modules and software structure is such that the "scope of effect" (all modules that are effected by a decision made in module) of every module is contained within the "scope of control" (all modules that are ultimately subordinate to the module) of the module. A failure to conform to this principle implies passage of increased number of control flags between the modules resulting in high coupling and poor cohesion.

e. Function. All modules are designed to have predictable functions, that is, they act as a black box producing same result, regardless of internal processing, for a given input. Proper initialization of local and global variables is done to avoid any unpredictable results.

6.2.2 Operational Characteristics of Designed Software

During the information processing operations, security and integrity of the information content is ensured by accounting for abnormal operating conditions in the software design. The software for every information processing activity has the following features:

* option to exit from any stage of the process in a non-destructive manner that is, without any damage to the

system, information in transition or already processed.

* least processed or input information loss in the event of power failure.

* option to redo the processing from the beginning such that there is no cumulative effect or to resume it from any intermediate stage.

* performing critical validation and consistency checks on the stored information before using it in different processes for different requirements. This introduces certain redundancy in the software and increases the software and processing overheads. But it is done to ensure highly reliable operation and processing of information while ensuring the integrity of the stored information. One example of such a redundancy is a consistency check on registration status and number of courses registered. This check is performed in registration information validation, registration validation, course lists preparation and grade posting processes.

* all errors encountered during the process are displayed on the screen and processing is regulated by the nature of the error. Fatal errors invariably stop the processing and terminate while non-fatal errors generally pause the processing and wait for the operator intervention. The operator has the option to continue or terminate the process. A third kind of the error is issued as a warning only and is flashed on the screen without stopping or interrupting the process. In case of fatal errors a hard copy printout is also generated.

In the report generation software, following additional characteristics have been invariably provided for optimal utilization of required resources and achieving targets of time constraints for critical, time intensive, long reports.

* option to display the report on screen or produce a hard copy printout.

* proper locking of output devices and other resources for ensuring unambiguous and error-free reports. In multi-user environment, the same resource may be required by more than one process and if locking is not done, two or more reports may be intermingled.

* whenever a report is printed, a continuous print status is displayed on the screen, to monitor the printing process.

The design of the processing software, which has been developed incorporating all of the above guideline and features, is presented below for the identified activities.

6.3 PRE-REGISTRATION PROCESSES

The processing of academic information, which is to be done before the semester begins, is classified as pre-registration processing. The main processes under the pre-registration information processing are the generation of the Registration Card and Eligibility Sheet for all students likely to register in the semester.

The information contents of these two documents are closely related and require almost similar processing. The information on the Eligibility Sheet is comprehensive in nature and gives the up-to-date academic status and progress of the student in the semesterwise pattern. The Registration Card contains extracted information of the courses required for the current semester's registration with suitable modifications, wherever necessary. The hard copy documents generated after processing involve intricate and enigmatic formatting of information under severe constraints while fulfilling needs of various kinds, of various users of the output, and of ergonomics for information input. The formatting requirements of Eligibility Sheet are more stringent.

The role and importance of these two documents was elaborated in the previous Chapters, but it is worth to recapitulate. The fact that these two documents are indispensable has been well established through the operations of the process of academic monitoring being followed at BITS for more than ten years. The Academic Regulations also spell-out the key role of these in the entire processing and maintenance of academic records. These do not only serve as aids in the registration process but also form a vital part of records and documents for decision making. The Registration Card, as was explained in Chapter Five, not only gives the information for the registration but also acts as the proforma for information collection at the source of information and transmission of the same to the computer.

In the previous Chapters the software requirements were established and specifications were developed for these. The processing of information for these, requires implementation of a major component of Academic Regulations and rules governing the operations. The software development for the Registration Card and Eligibility Sheet is explained in the following sections.

6.3.1 Registration Card

The information content of the Registration Card is the course package for the current semester's registration. The Academic Regulations and rules governing the operations describe the process of determination of this package for each student. The process is not straightforward but involves a complex logical decision making to arrive at the answer which is outcome of several rules and clauses. The processing requires an algomeration of student's academic information with current semester's Time-Table and other decisions.

The processes involved in the preparation and printing of a Registration Card are presented in Figure 6.1. This is a detailed information flow diagram for the Registration Card processing of the pre-registration process, Process 1 of Figure 3.1, Chapter Three. The main processes identified in this are determination of backlog and operative backlog (BL & OBL), prescribed semester courses and operative prescribed semester courses (PSC & OPSC) to determine the course package for a student and the process of formatting and printing the Registration Card. The determined

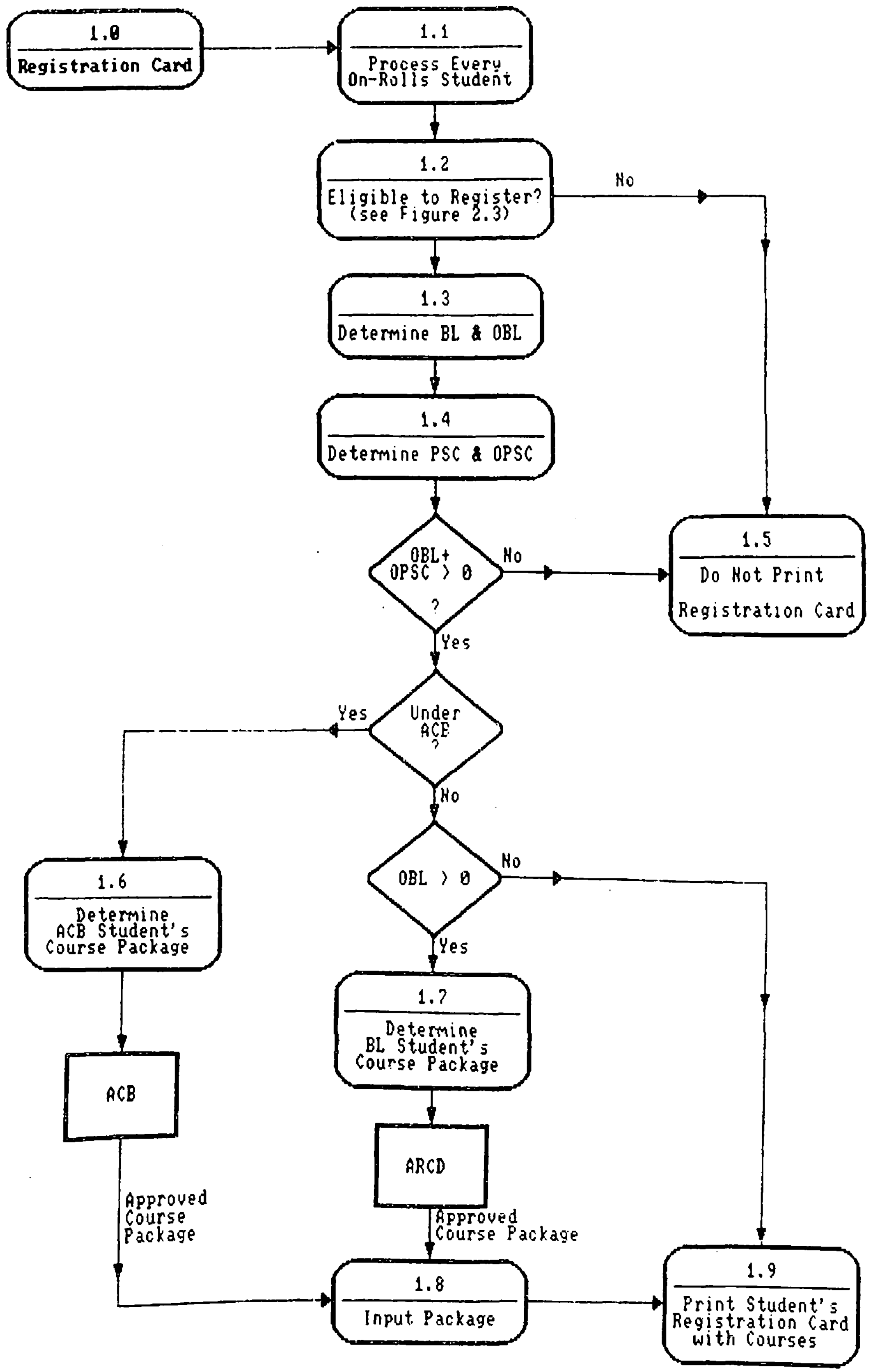


Figure 6.1 - Preparation and Printing of Registration Card.
(Process 1 of Figure 3.1)

course package is modified by superimposing the decisions of appropriate authorities for ACB and backlog students before printing on the Registration Card. The other processes are for determination of ACB student's course package, backlog student's course package, input of decisions and determination of eligibility to register in the semester. All these processes are numbered from 1.1 to 1.9 in Figure 6.1.

The software design, down to the program level for each of these processes is described in the subsequent figures with the help of structured flow diagrams and flow charts.

Figures 6.2 and Figure 6.3 give the details of software design for the process of determination of backlog (BL) and Figure 6.4 explains the software design for processing required to get operative backlog (OBL) courses from backlog of courses. In the course of identifying a backlog various checks are to be performed for prerequisites, prior-preparations and restrictions. Software procedure for applying a "minimum grade" prerequisite check is detailed in Figure 6.5 and for checking the use of flexibility of "switching" between courses located in two consecutive semesters, as per the current rules governing the operations, is described in Figure 6.6.

The software design for procedure of checking the fulfillment of prior-preparations for specified courses like Practice School or a category of courses like compulsory discipline courses (CDC) etc., as presented in Figure 6.7, translates the conditions required to be satisfied for prior-preparations into software. Many of these checks are also required in other information processing activities, to be discussed in later sections, but through the design process it is ensured that the design effort and the software for the same activity is not duplicated.

The determination of prescribed semester courses (PSC) and operative prescribed semester courses (OPSC) from PSC requires processing of information of a different kind. The software design for this information processing activity is detailed in

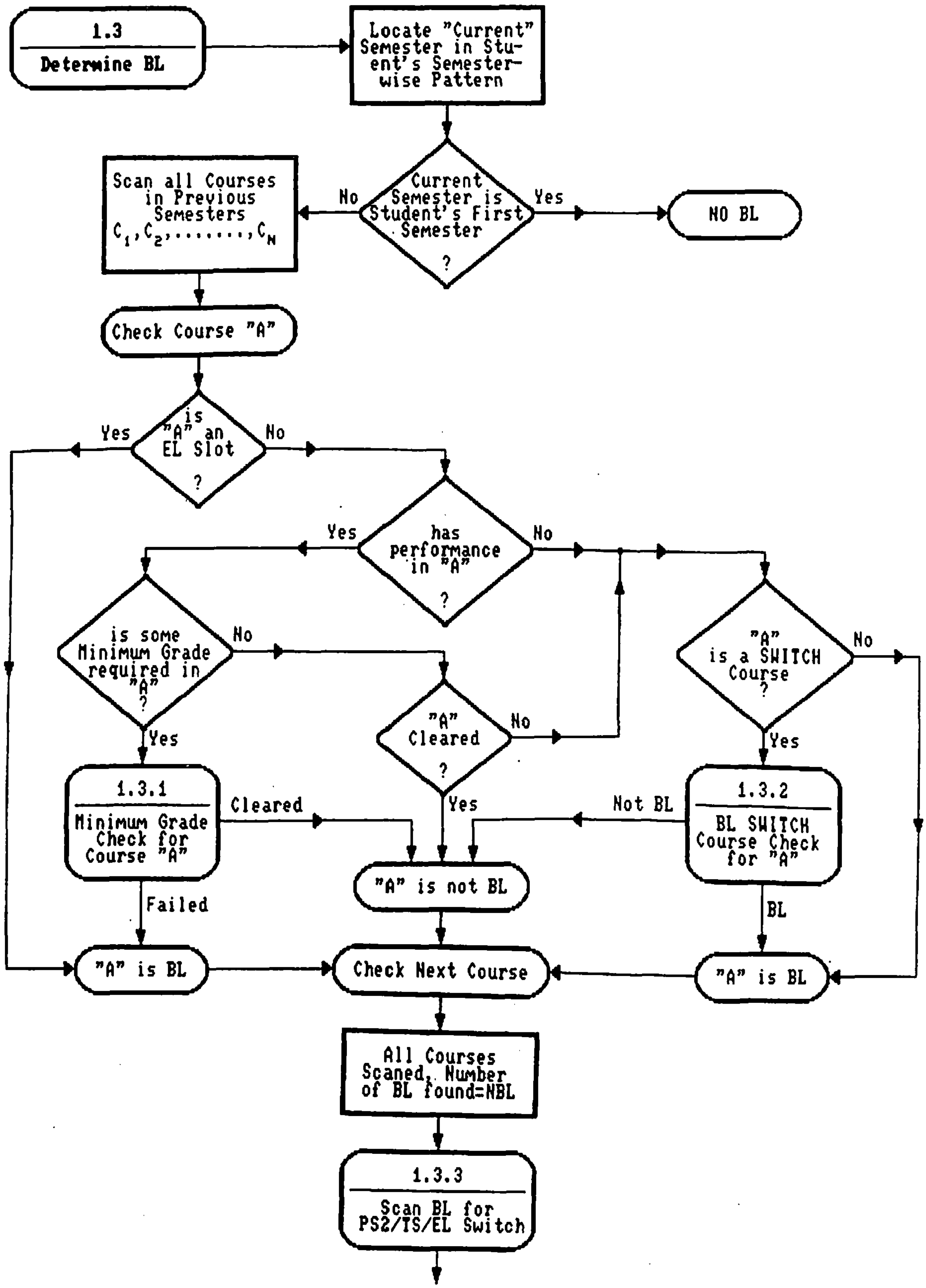


Figure 6.2 - Determination of Backlog (BL) for a Student for "Current" Semester. (Process 1.3 of Figure 6.1)

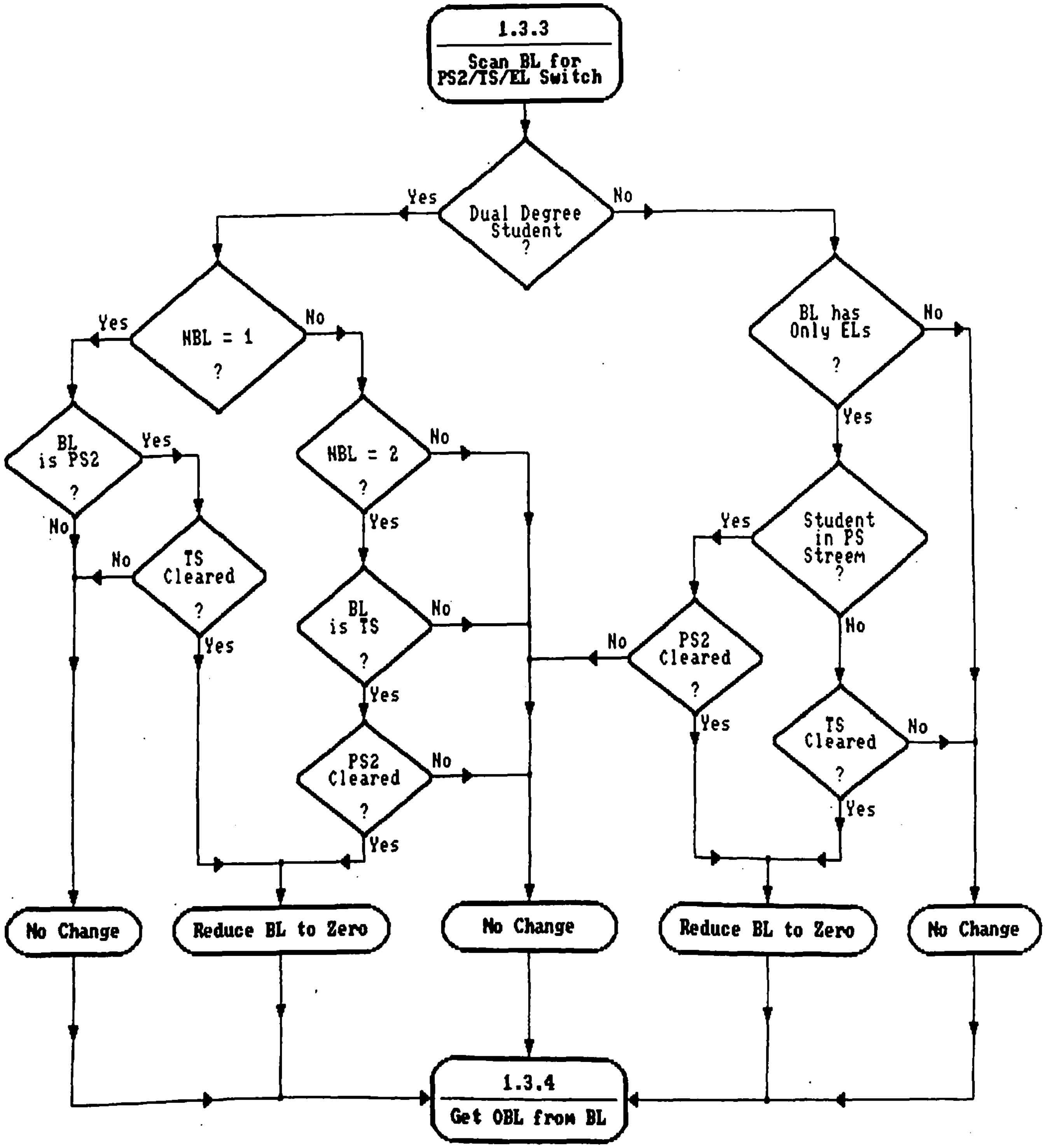


Figure 6.3 - Determination of Backlog (BL) - PS/TS/EL Switching Check.
(Process 1.3.3 of Figure 6.2)

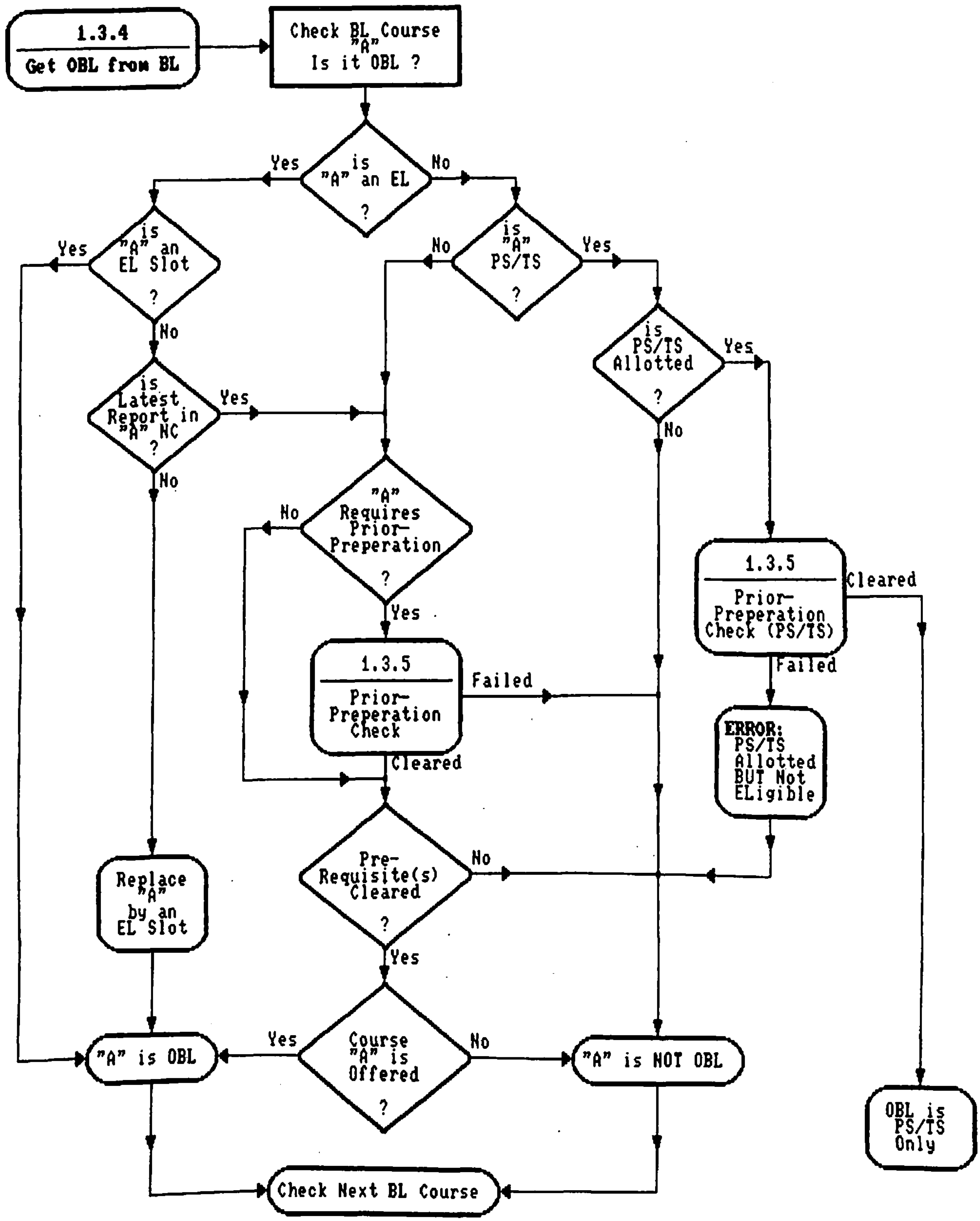


Figure 6.4 - Determination of Operative Backlog (OBL) from BL for a Student for "Current" Semester. (Process 1.3.4 of Figure 6.3)

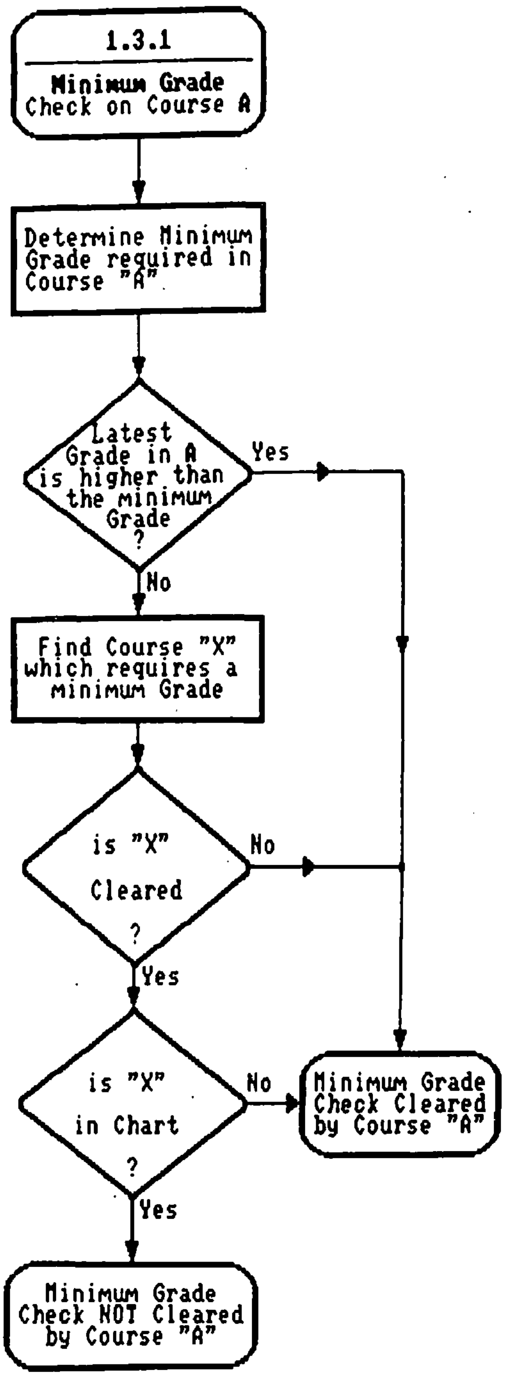


Figure 6.5 Minimum Grade Check for a Course.

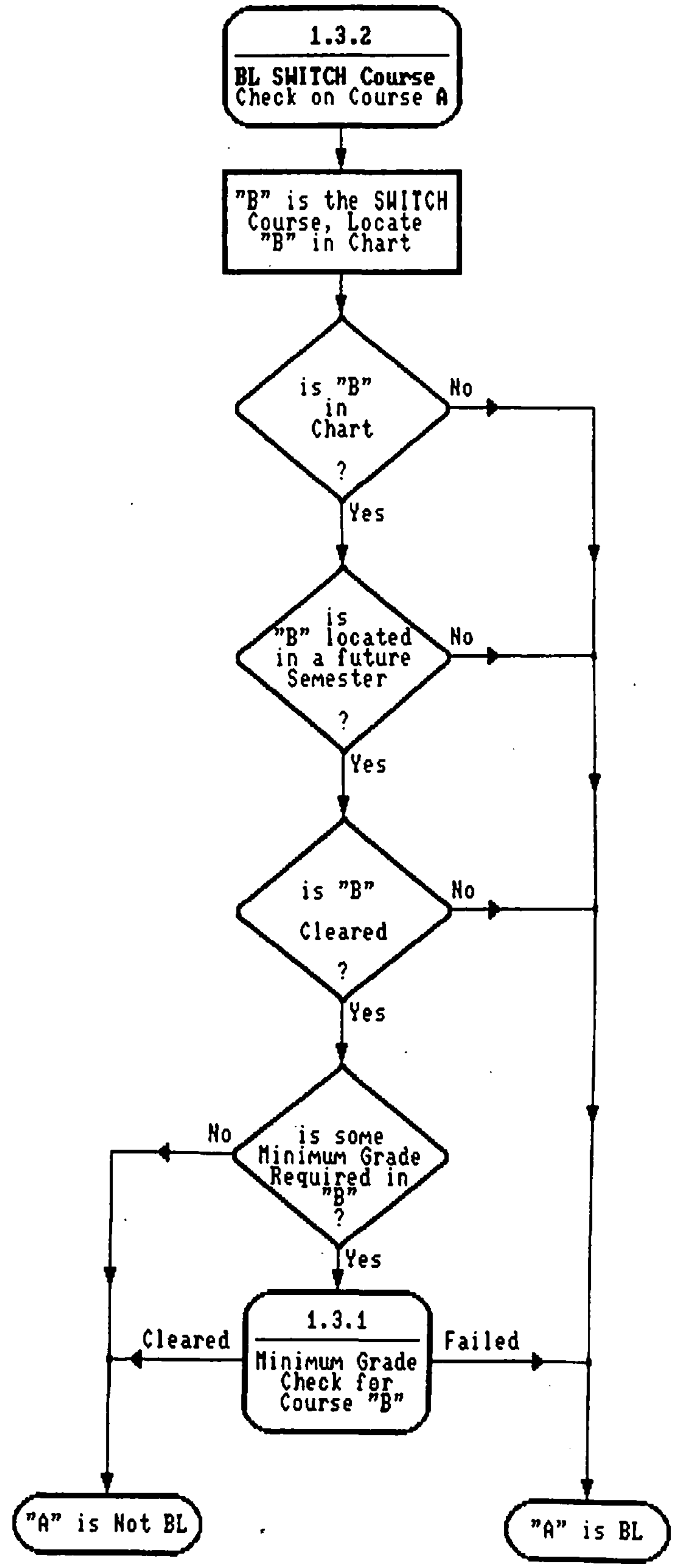


Figure 6.6 BL SWITCH Course Check for a Course.

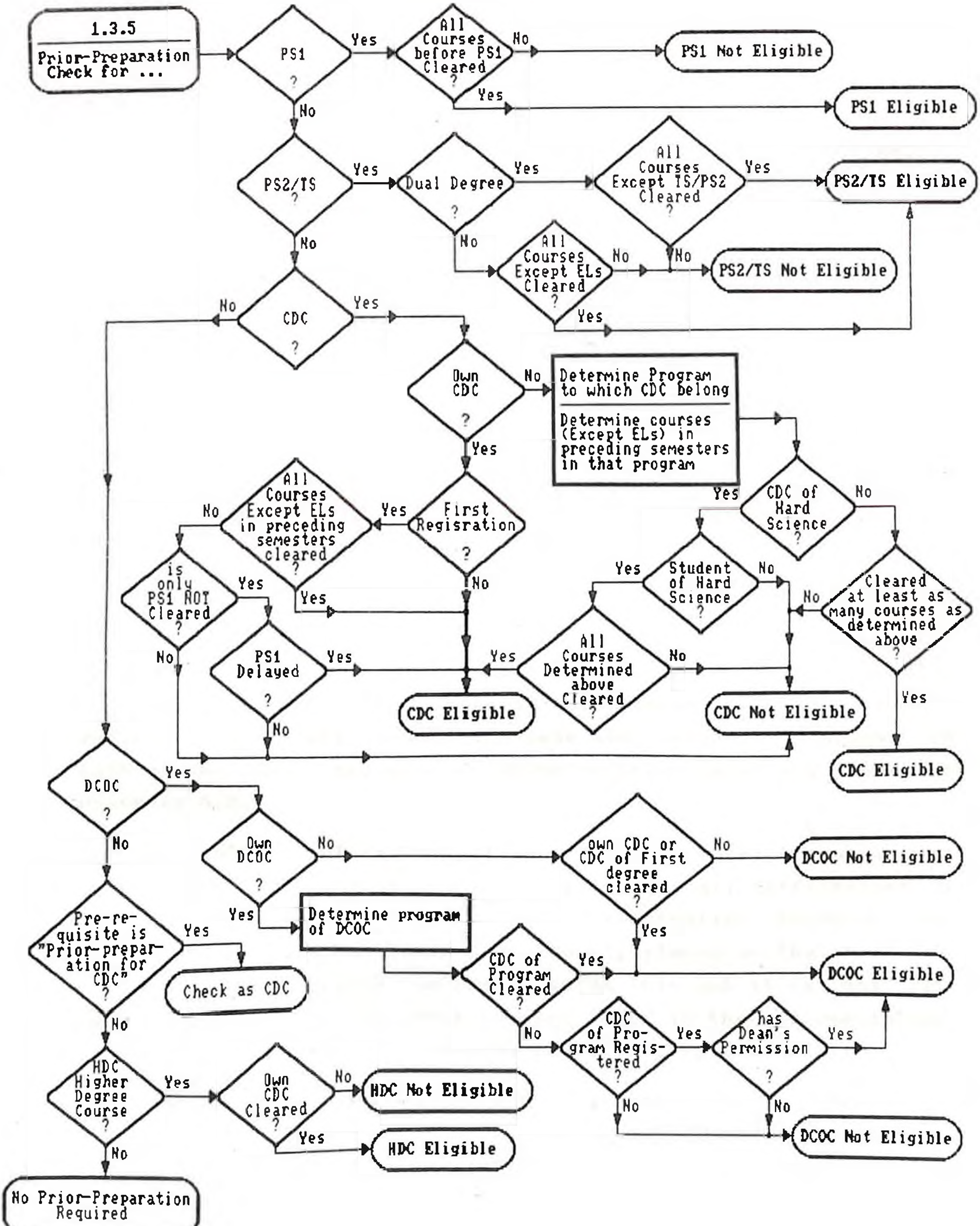


Figure 6.7 - Prior-Preparation Check for PS1/PS2/TS/CDC/DCOC/etc.

Figure 6.8. Figures 6.9 and 6.10 describe the software design for modules required more than once for OPSC determination.

The final software process of printing Registration Cards with the "prescribed course package" is presented in Figure 6.11 with details of information content, it's positioning and complex decision making required for formatting and determining presentation of information on the sheet of paper.

6.3.2 Eligibility Sheet

The Eligibility Sheet incorporates the students' semesterwise chart with up-to-date academic information, that is, all the performances in the courses done and a comprehensive list of students' status and eligibility tags. It also comprises the identification of prescribed "current" semester for the student in the semesterwise chart and with respect to current semester, backlog (BL) courses and operative prescribed semester courses (OPSC).

The processing involved in Eligibility Sheet is not much different from the Registration Card in as much as the determination of the backlog (BL) courses, prescribed semester courses (PSC) and operative prescribed semester courses (OPSC). Various symbols are used to indicate the identified courses, in each of the above category, as shown in the Eligibility Sheet in Appendix A.2.

All other information of semesterwise chart, status and eligibility tags, courses done and up-to-date all performances in them, etc. all are picked-up from the information stored in the files, assembled, formatted and properly placed on the sheet of paper. It might sound too simple to do this but it is not so. This has been one of the most complex tasks in the implementation of the students' academic records processing system at BITS.

The procedural details of the Eligibility Sheet preparation and printing are described in Figure 6.12, showing interactions of stored and processed information. The procedures for processing of information for BL, PSC and OPSC determination are

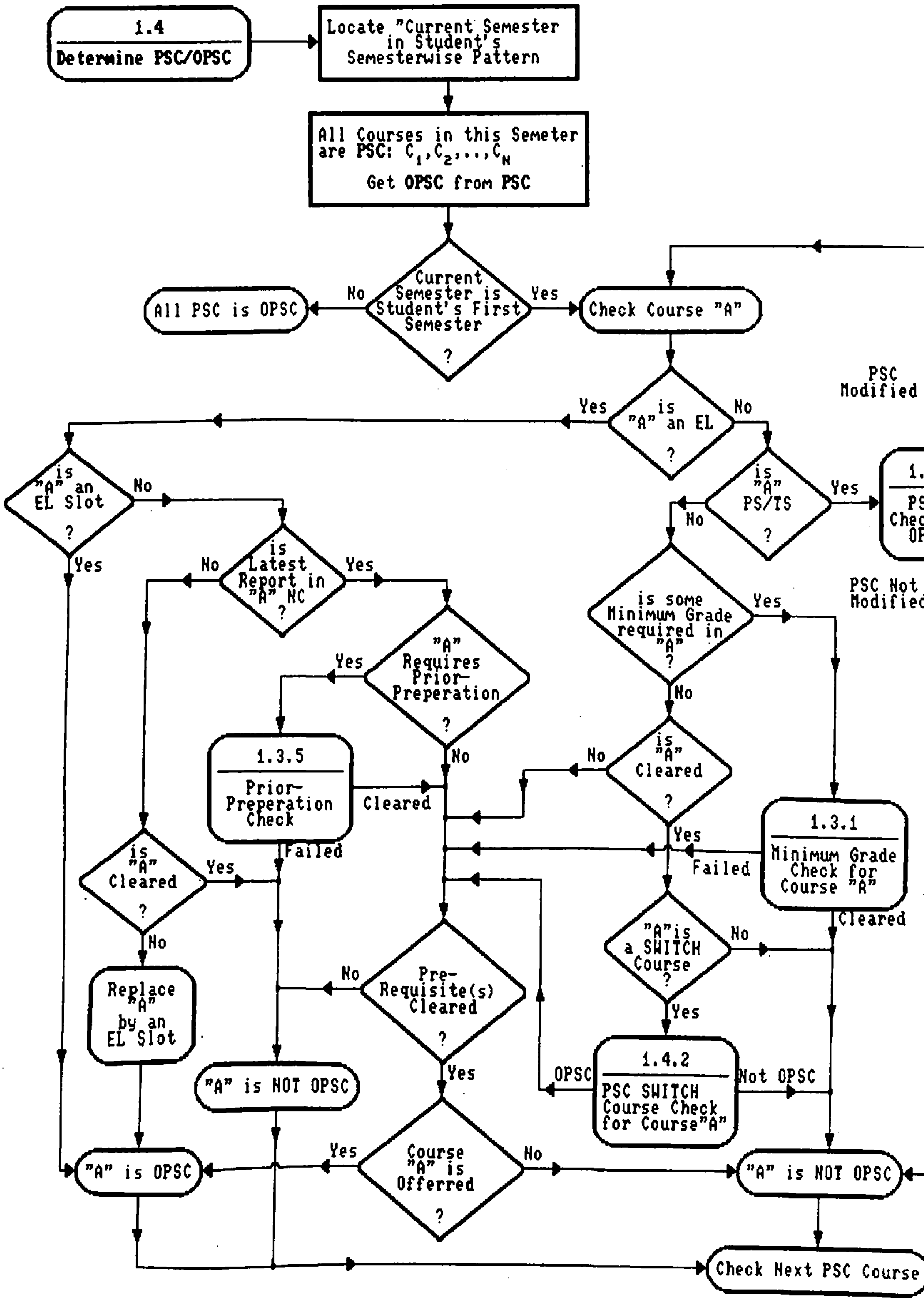


Figure 6.8 - Determination of Prescribed Semester Courses (PSC) and OPSC for a Student for "Current" Semester. (Process 1.4 of Figure 6.1)

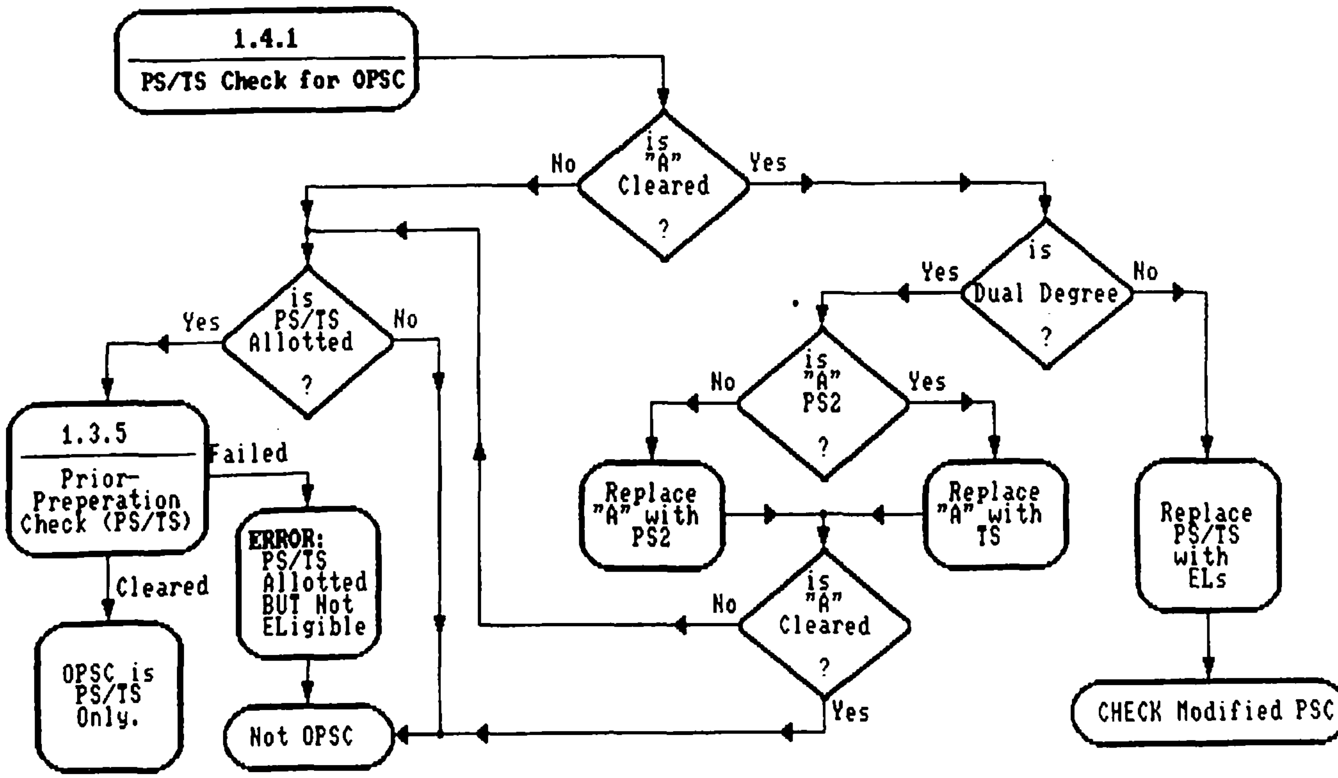


Figure 6.9 - PS/TS Check for OPSC. (Process 1.4.1 of Figure 6.8)

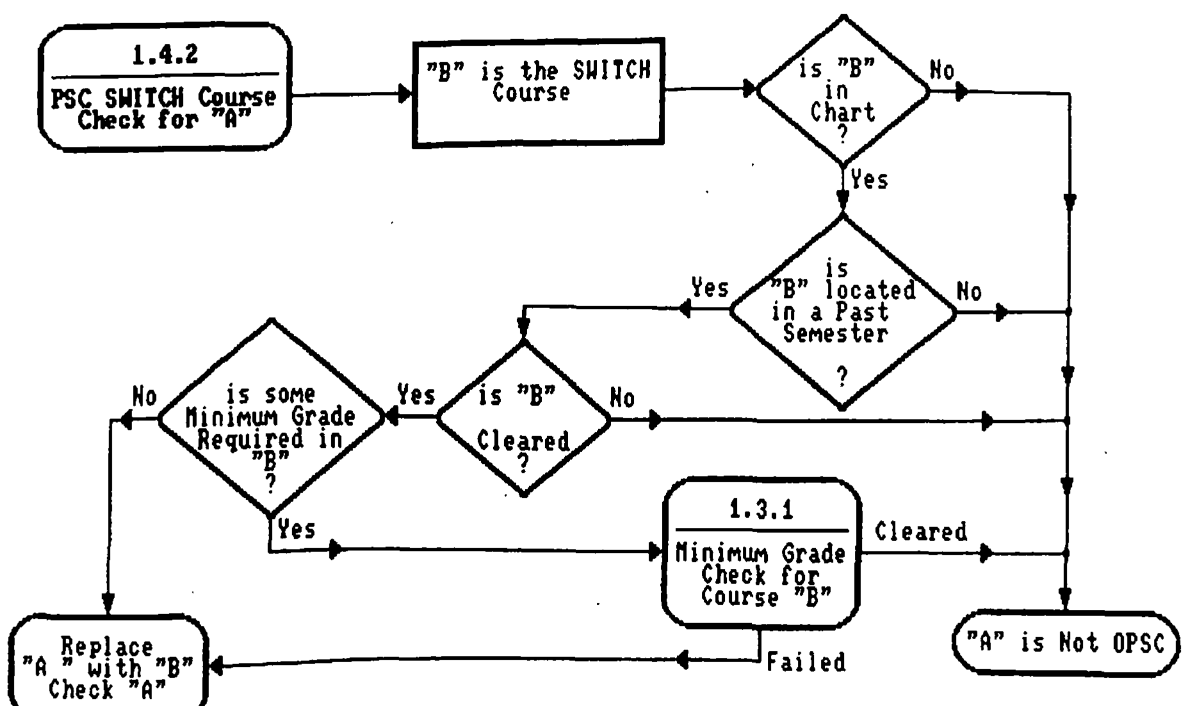


Figure 6.10 - PSC SWITCH Course Check for a PSC Course. (Process 1.4.2 of Figure 6.8)

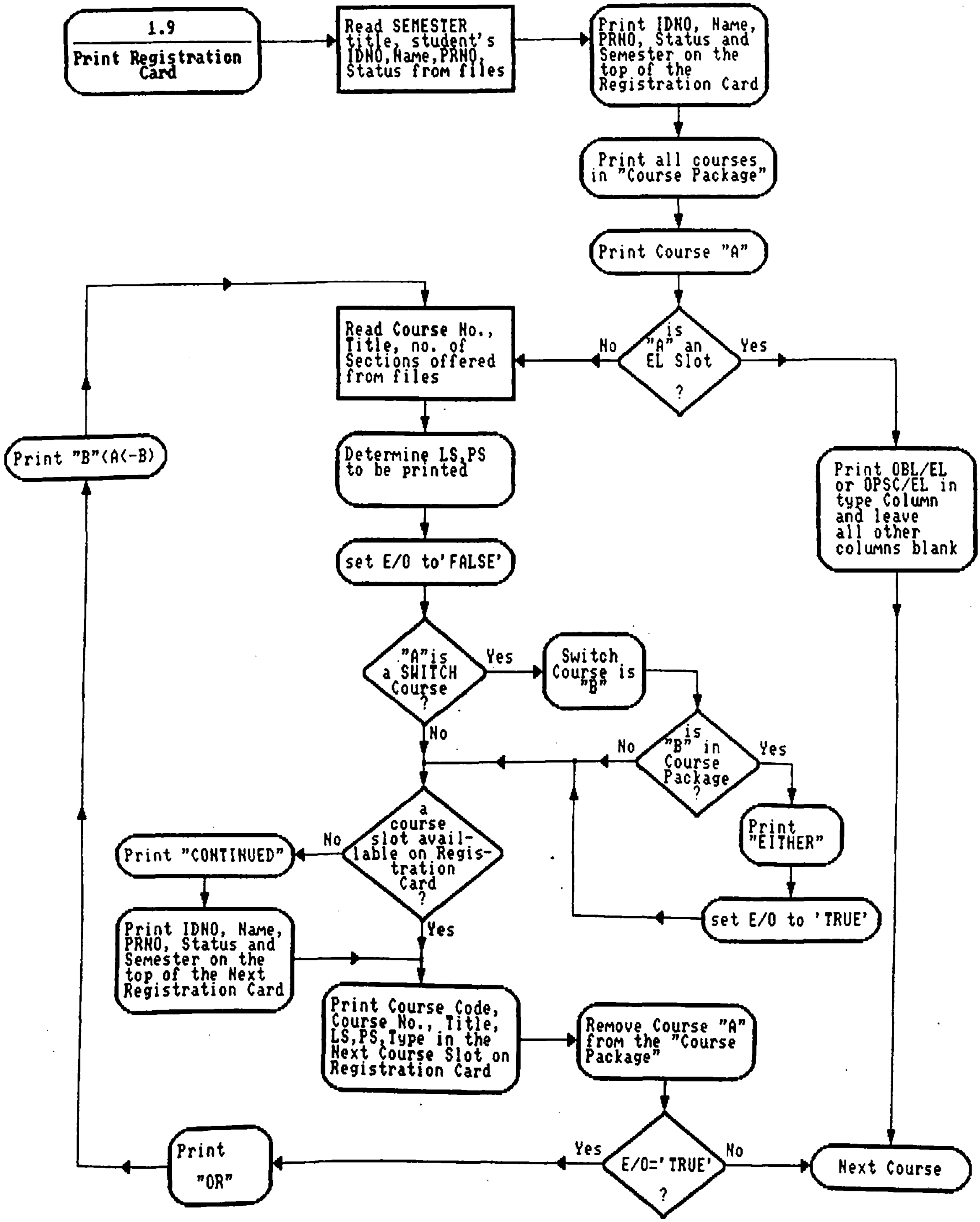


Figure 6.11 - Printing of Registration Card with Prescribed Course Package for a Student for "Current" Semester. (Process 1.9 of Figure 6.1)

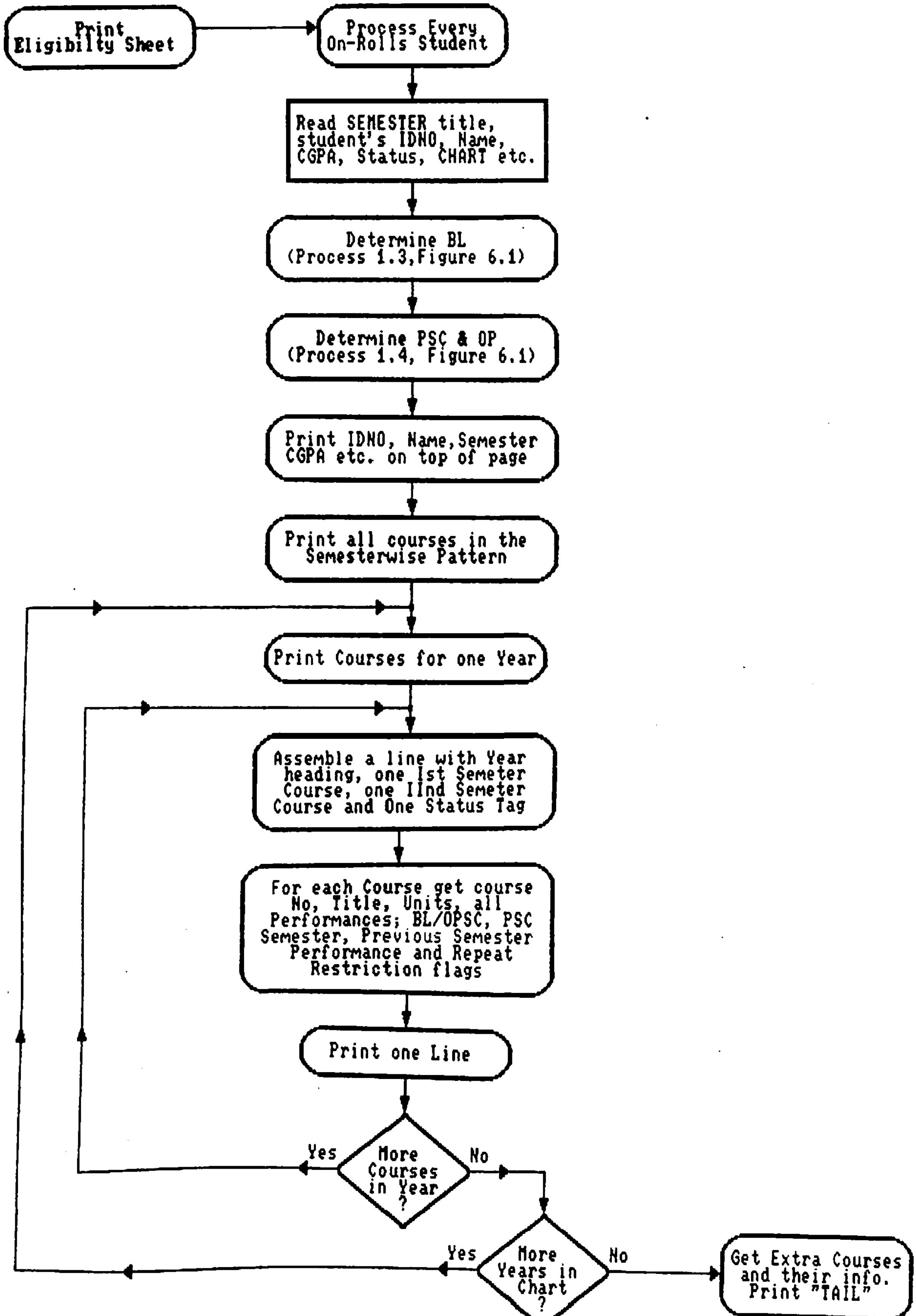


Figure 6.12 - Process of Printing of Eligibility Sheet with Up-to-date Performances and Status with Course Tags for "Current" Semester. (Process 1 of Figure 3.1)

same as that of the Registration Card, that is, Figures 6.2 to 6.9 and the processing for generation of various tags is explained later in this Chapter.

6.4 POST-REGISTRATION PROCESSES

Post-registration processing begins with the input of information, which is generated as an outcome of the registration process. This input is first, verified for entry and correctness through a laborious and meticulous process of validation checks, as was explained in Chapter Five. The validated information, after being stored in various files, is subjected to diverse processing to generate various kinds of reports and other working aids that form a crucial part of the process of academic monitoring and decision making.

These reports help in the task of academic monitoring of the students throughout the semester and provide convenient working documents for the smooth operation of the semester. Design of the software for information processing to generate these reports is described in the following sections. The important processes include, not registered students list and communication, registration validation and course lists preparation and printing, among others.

6.4.1 Not Registered Students' List and Communication

The first processing, immediately after the registration information input is complete, is to determine the students who were supposed to have registered in the semester but have failed to do so. The software design for this is built on the process of eligibility to register as described in Figure 2.3 in Chapter Two. All on-rolls students are tested for eligibility to register and out of these a list of not registered students, is prepared. Appendix A.3 has the samples of the generated reports. Appendix A.3.1 is a sample of the "not registered students' list" and the computer generated communication is in Appendix A.3.2, which is sent to not registered students for further action on them.

6.4.2 Registration Validation

The process of validation of registration requires checking of each students' registration, for each registered course, to determine whether it is in order as per the Academic Regulations and various other rules governing the operations. In simplistic terms, it requires a comprehensive knowledge of Academic Regulations and other rules to perform the checking. For the computerized process, therefore, all the rules have to be taught to the computer.

The development of software for the registration validation is, therefore, as if artificial intelligence is built into the system. The relevant portion of Academic Regulations and current rules governing the operations are taught by converting them from textual English to a logical decision making processes. The conclusion on validity or invalidity of registration in each course is drawn as an inference of several conclusions by logical reasoning process. For one registration situation, there can be more than one clause or rule. This further complicates the process of inference drawing. The conclusion on each course's registration is drawn by appropriately considering the hierarchy, sequence and precedence of one rule over the other whenever conflicting inferences are possible.

One simple example of conflicting answers is, violation of "registration rule" by a student "under the purview of ACB," as the "prescribed course package by ACB" clause takes precedence over the "registration rule" clause of the Academic Regulations. In this case the messages are only given as a warning that the "registration rule" is violated by an ACB student. This acts as warning signal for the ACB to make sure that it is as per the intentions of the ACB to exercise clauses of Academic Regulations which permit ACB to deviate from normal situations, when it made the student's course package.

The software design for registration validation is presented in Figures 6.13 through 6.20. Figure 6.13 identifies the processes to be performed, by partitioning the problem. The

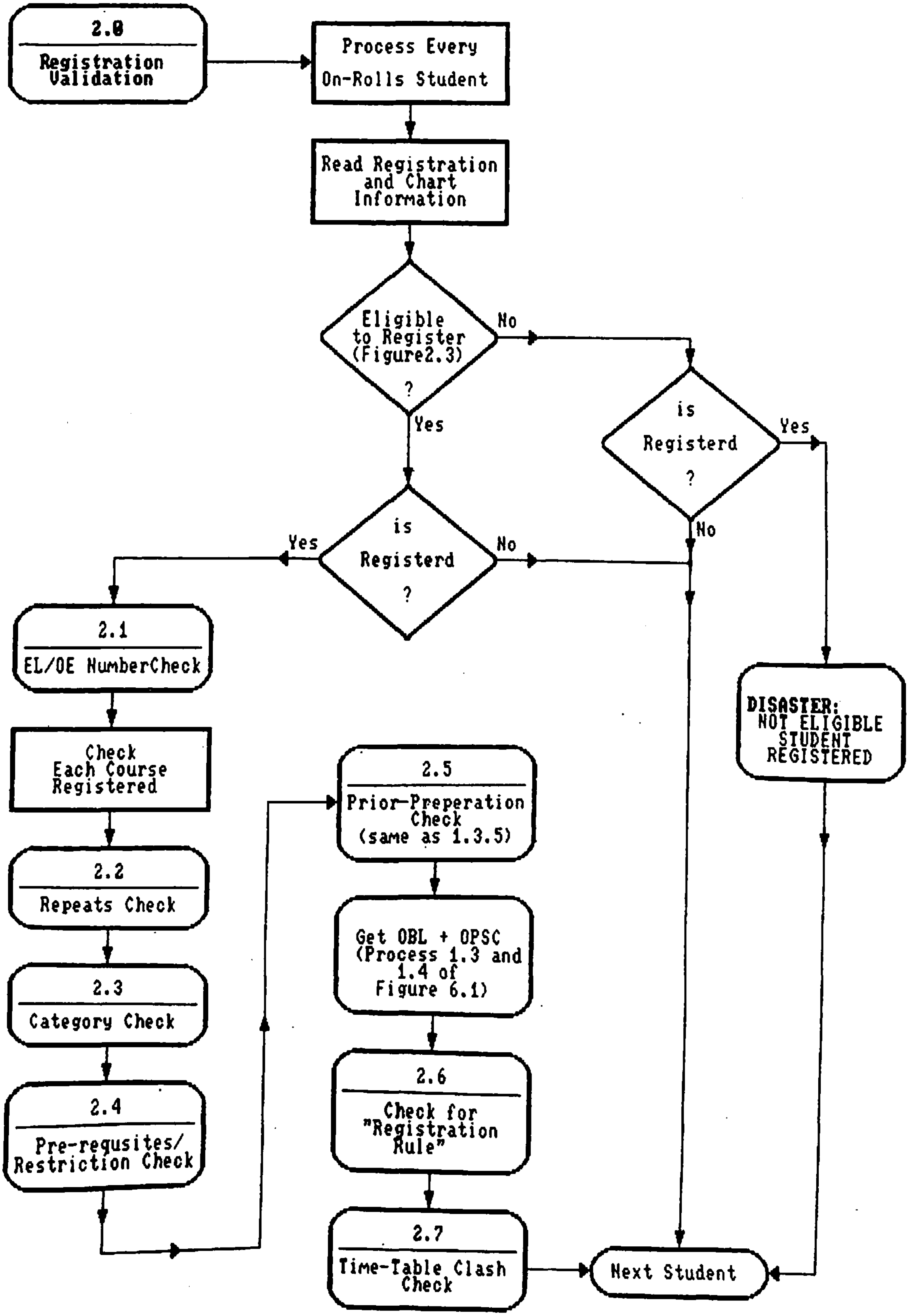


Figure 6.13 - Registration Validation - Process of Post-Registration Checks. (Process 2 of Figure 3.1)

process of checking and validating the registration in electives (EL) and optional electives (OE), in terms on numbers, is explained in Figure 6.14. Similarly, Figure 6.15 gives the applications of the rules for checking and validating the registration in courses being repeated by the student.

Any registered course that is not a part of the students' current semesterwise pattern, must have a valid category. This checking is described by the process Figure 6.16 as validation check on course's category. The availability of courses outside the students' chart, that is, whether the student is allowed to take the course under any category, is also performed simultaneously.

The checking of prerequisites, restrictions and prior-preparations, is one of the most complex processes to be implemented. Figures 6.17 and 6.18 describe the design of the software for the process of prerequisites and restrictions checking and validations. Prerequisites of diverse types, as explained in Section 6.3 require different processes for checking as explained in Figure 6.17. The restrictions on courses' are similar to prerequisites and impose atypical constraints on the registration of students other than for whom the course in normally meant, that is, in their semesterwise chart. The verification of the registration, of every student, in such courses is accomplished by checking whether the restriction conditions are fulfilled by the student or not, as explained in Figure 6.18, which is a continuation of Figure 6.17.

For every student departing from normal load as prescribed by the semesterwise pattern, the "registration rule" sets the hierarchy in terms of what is the first charge, what is the second charge etc. The checking for violations of "registration rule" is described in Figure 6.19, which gives the design of the software for the same.

All the errors detected, as violations of Academic Regulations, are flashed on the screen and printed-out as report for further actions. A sample of some of the registration

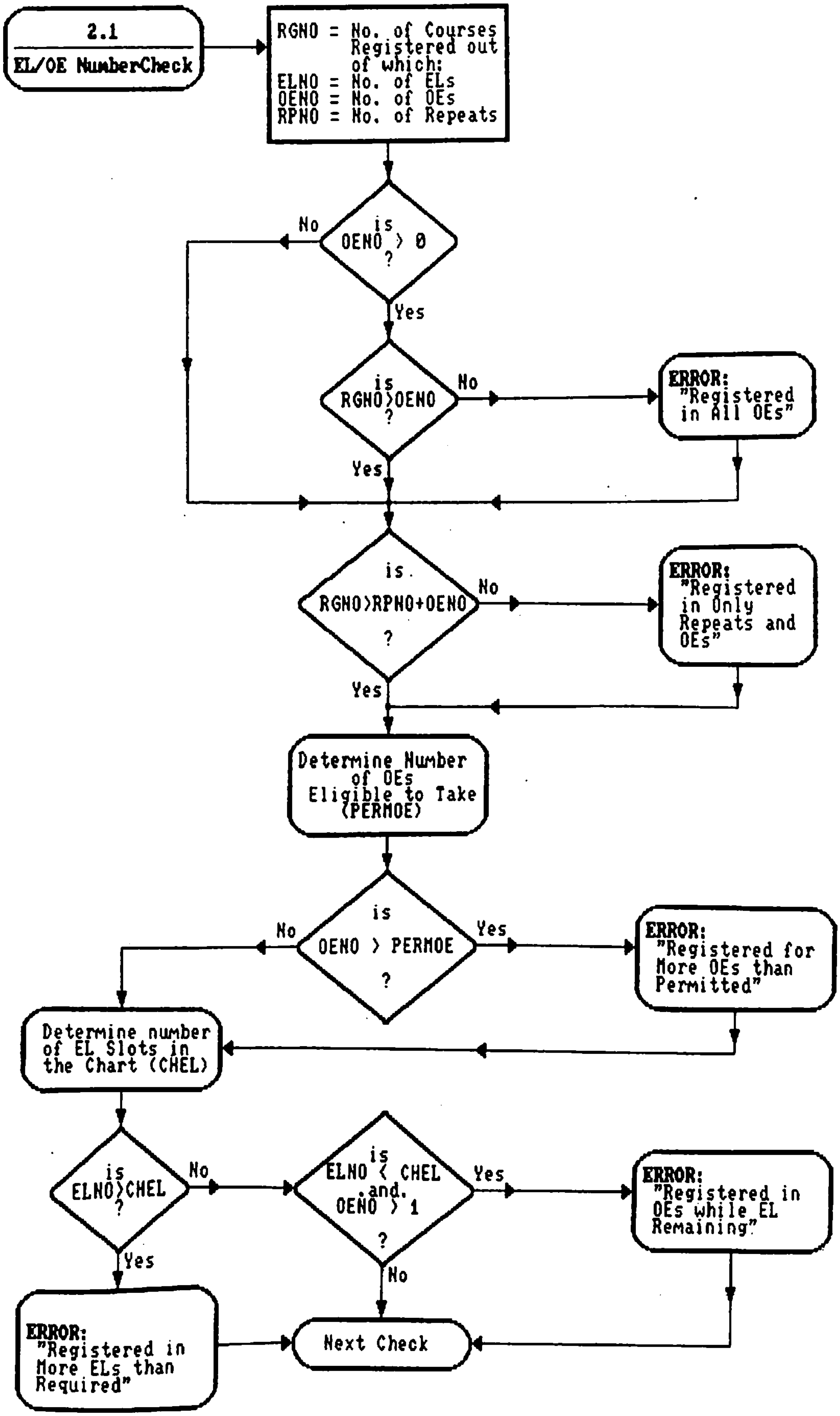


Figure 6.14 - EL/OE Number Registration Validation. (Process 2.1 of Figure 6.13)

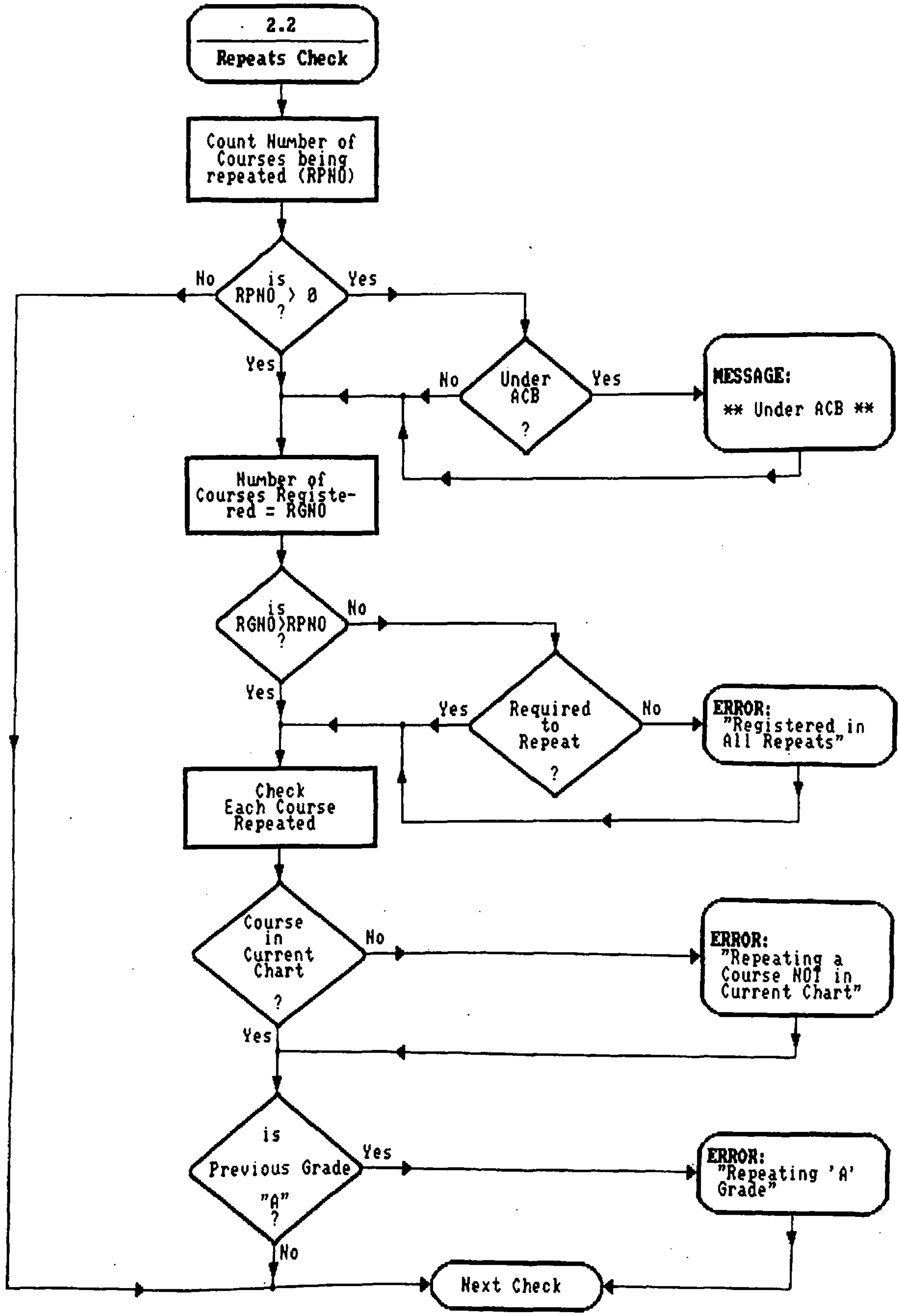


Figure 6.15 - Process of Registration Validation in Courses Being Repeated. (Process 2.2 of Figure 6.13)

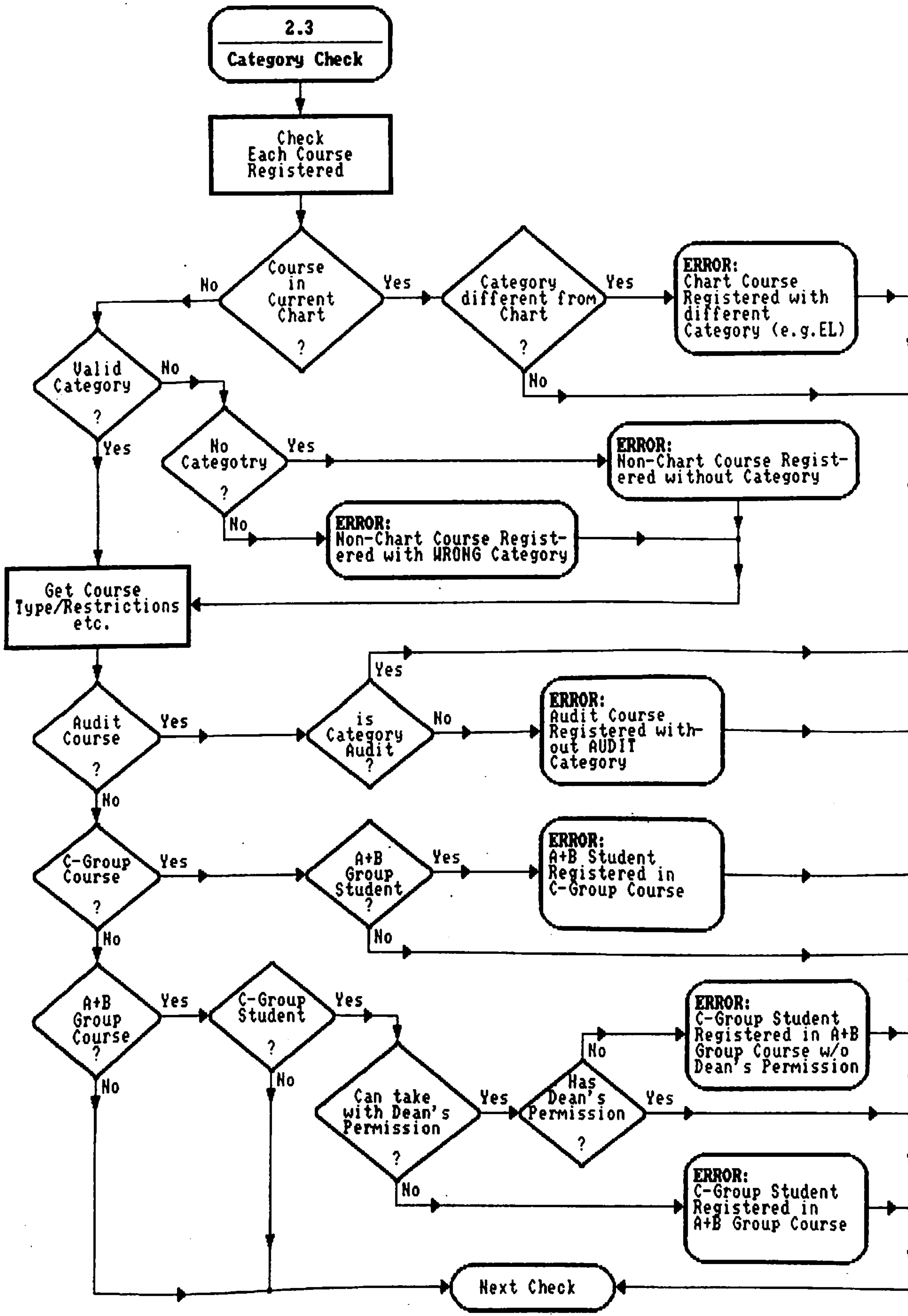


Figure 6.16 - Process of Registration Validation for Course's Category and Availability. (Process 2.3 of Figure 6.13)

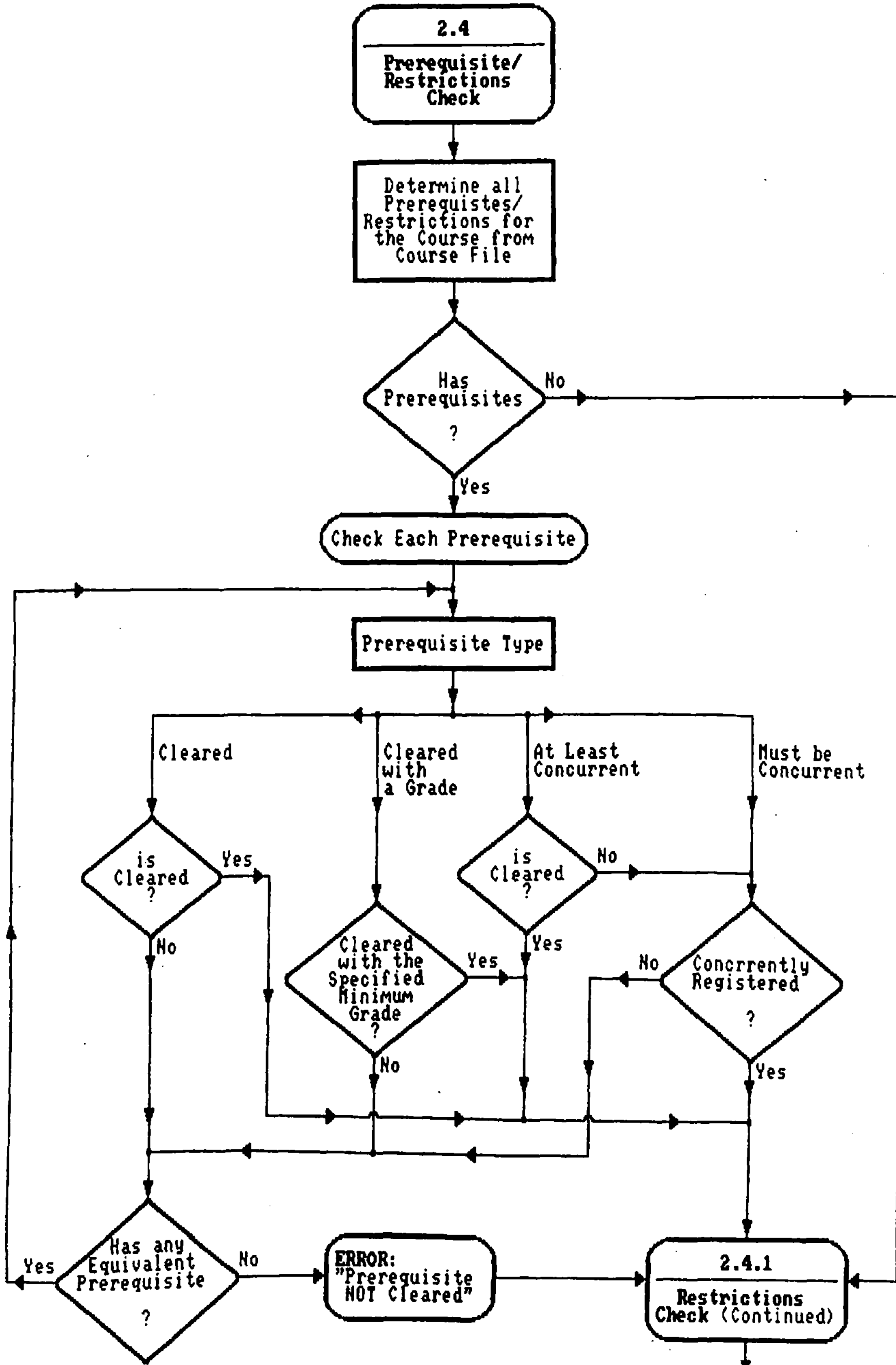


Figure 6.17 - Process of Checking of Prerequisites/Restrictions. (Process 2.4 of Figure 6.13)

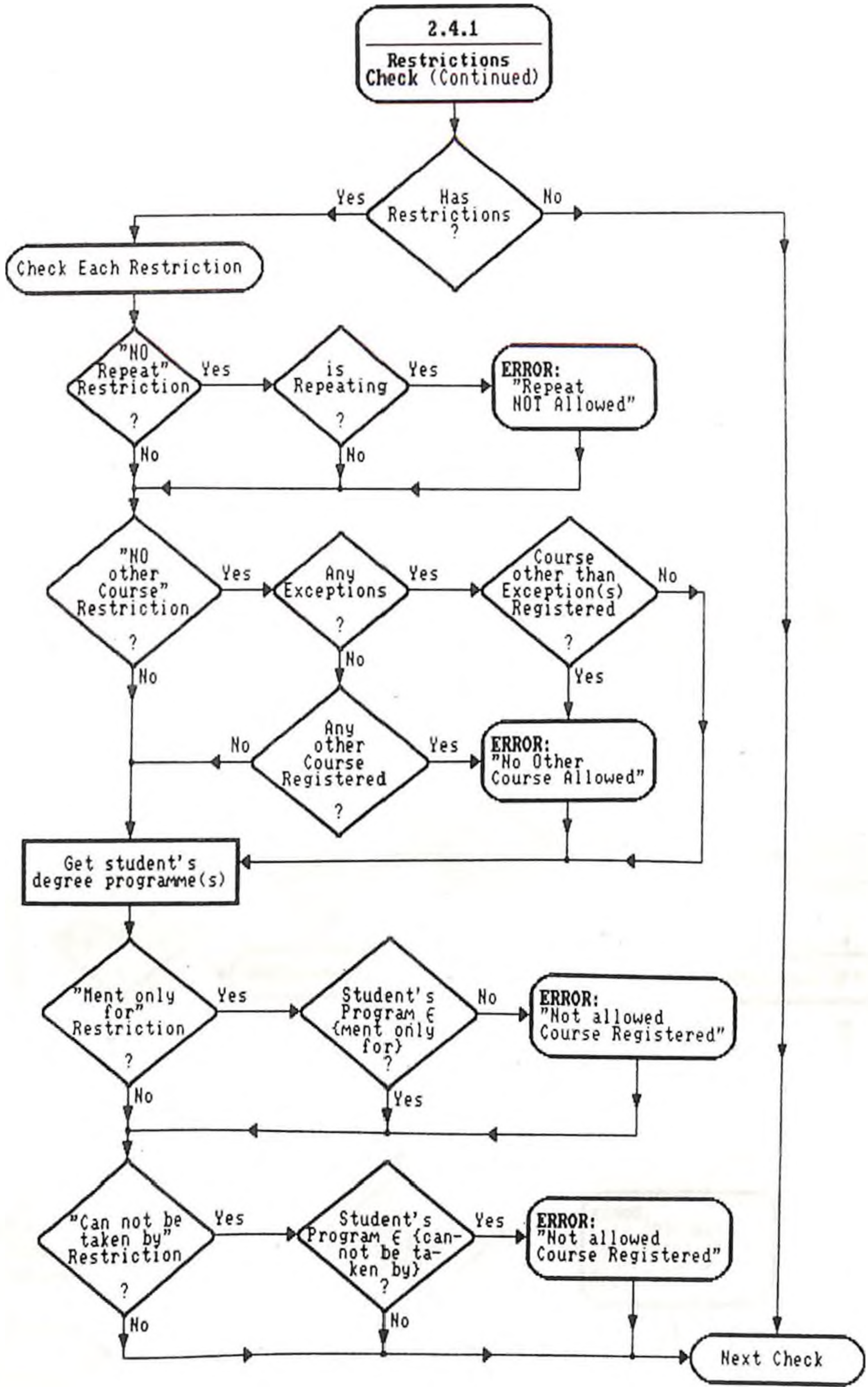


Figure 6.18 - Process of Chacking for Restrictions. (Process 2.4.1 of Figure 6.17)

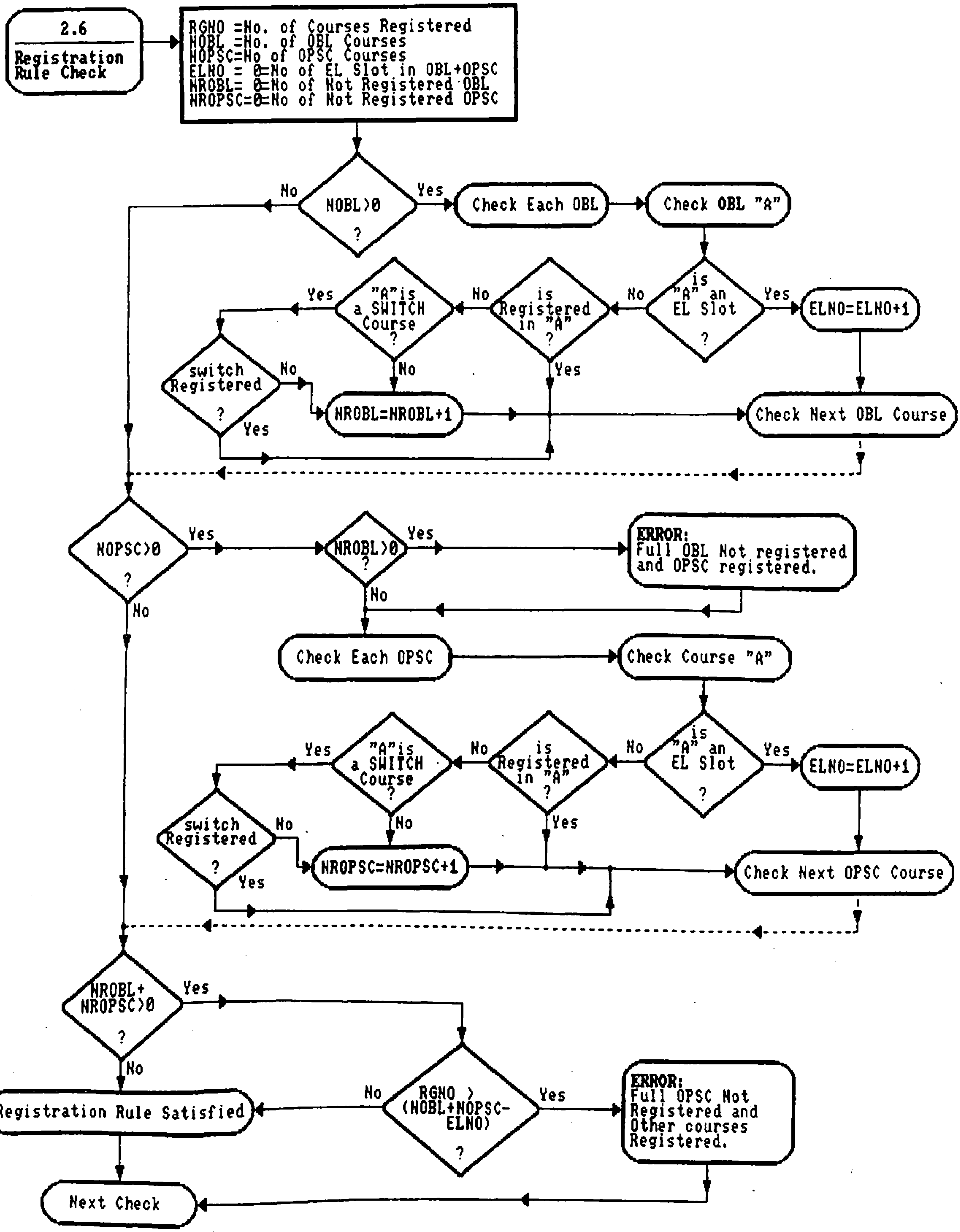


Figure 6.19 - Checking of Registration Rule for OBL/OPSC/HL-Repeat/etc. for "Current" Semester's Registration. (Process 2.6 of Figure 6.13)

violations and errors detected by the registration validation process is included in Appendix A.4. The violations and errors detected are only reported and no action is taken by the system or the software either to correct them or to take punitive actions as prescribed by the Academic Regulations. All decision making and action taking is left to the prescribed academic administrators.

The last part of the registration validation process is time-table clash check, Figure 6.13, process 2.7. Time-table for the courses' registered by the student has to be free from clashes of all kinds. The verification of time-table of all students, after the registration, was a humanly formidable mission until the same was computerized. The time-table of each registered student, for all courses registered, is checked for clashes in common/tutorial hour(s), lecture/practical hour(s), comprehensive examinations and for "no lunch hour." Figure 6.20 gives the detailed software design for applying the time-table clash checks and Appendix A.4.2 gives a sample of the report generated whenever a time-table clash is detected. The report includes the details of identified clashes and a map of the time-table of the registered courses, physically showing the clashes in the time-table, a 9 X 6 matrix, for easy readability, identification and working on the same to remove the clash(es), if possible. Once again the alterations or actions required, in students' registrations, to resolve detected time-table clashes are left to the academic administrator.

6.4.3 Course Lists and Registration Statistics

The registration information is student related and is input and stored in the files studentwise, as explained in Chapter Four, design of information content, while the teaching and evaluation is required to be done coursewise. The registration information is, therefore, transformed from student-wise to coursewise. The process of this transformation of registration information is called making course lists.

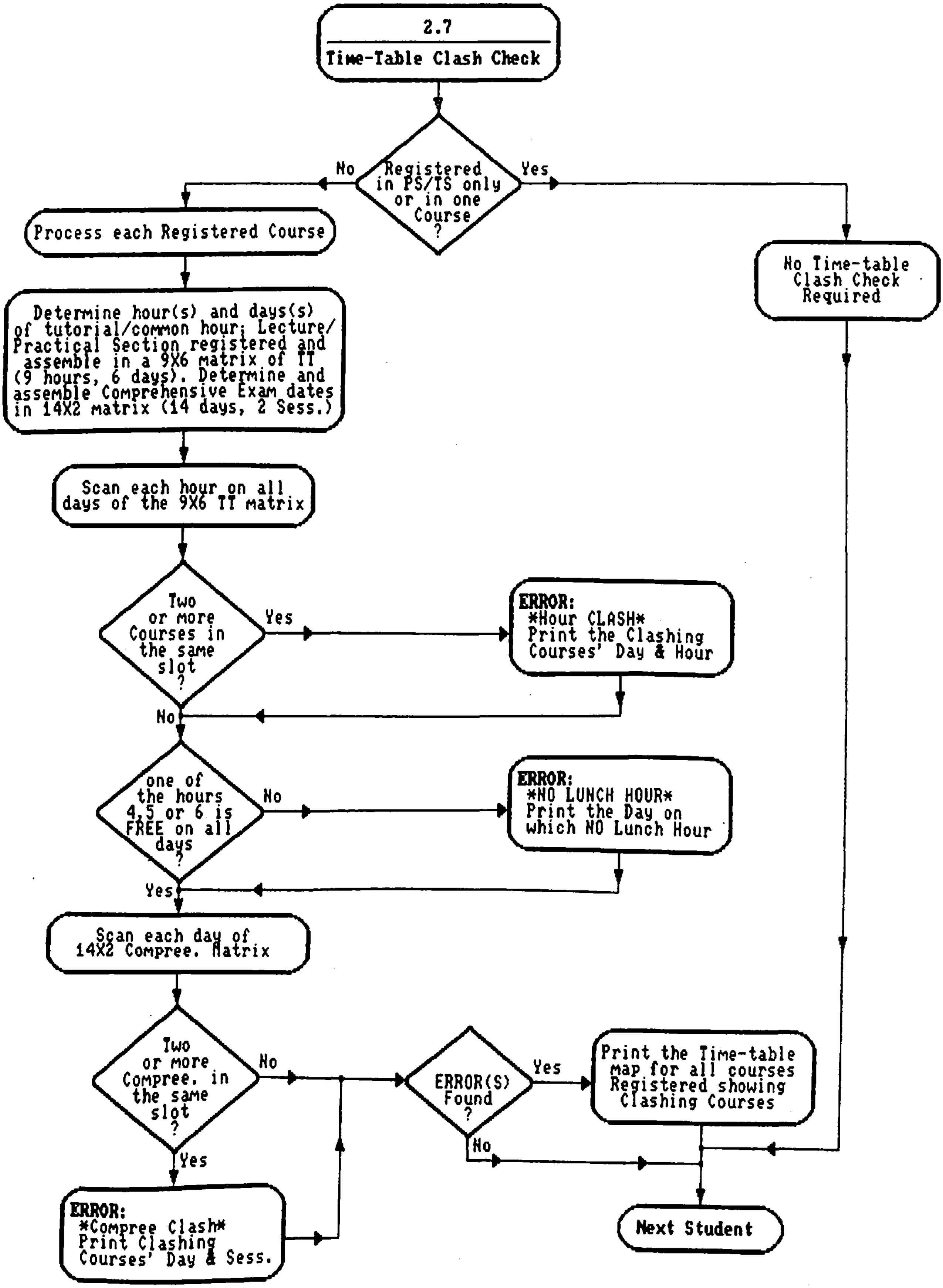


Figure 6.20 - Process of Checking of Time-Table Clashes. (Process 2.7 of Figure 6.13)

The software design of this process, which does not produce any visible hard-copy output, is described in Figure 6.21. The software design for this information processing is an amalgamation of intensive interaction of information content, information structure and information transformation. The design optimizes the use of computer resources in terms of processing time and memory. The whole process is completed in a short time of approximately fifteen minutes.

Once the course lists are made, the coursewise registration information becomes readily available. The first report generated from the coursewise registration information is statistics on number of students registered in each course and in each lecture/practical section of the course, for multi-section courses. A sample page of this report is given in Appendix A.5.

The second report that is generated from the coursewise information, at this stage, are course lists for each course offered in the semester. Course list for the instructor-in-charge is called coursewise list (also called "Merged Course List") and sectionwise lists for the instructor(s). The software design, for printing of these lists, is described in Figure 6.22 with all procedural details to convert the design into code. One sample each of "Coursewise List" and "Sectionwise List" is included in Appendix A.6. These lists serve the dual purpose of attendance register and record of marks for each course/section.

6.5 MID-SEMESTER PROCESSES

The mid-semester information processing is of two kinds. First is update of information contents as a result of corrective actions on the registration. The registration amendments or revisions may arise from administrative actions on registrations errors, which violated Academic Regulations or rules of operation, as detected by "Registration Validation" process or due to other administrative reasons or get initiated from students desirous of altering their registration.

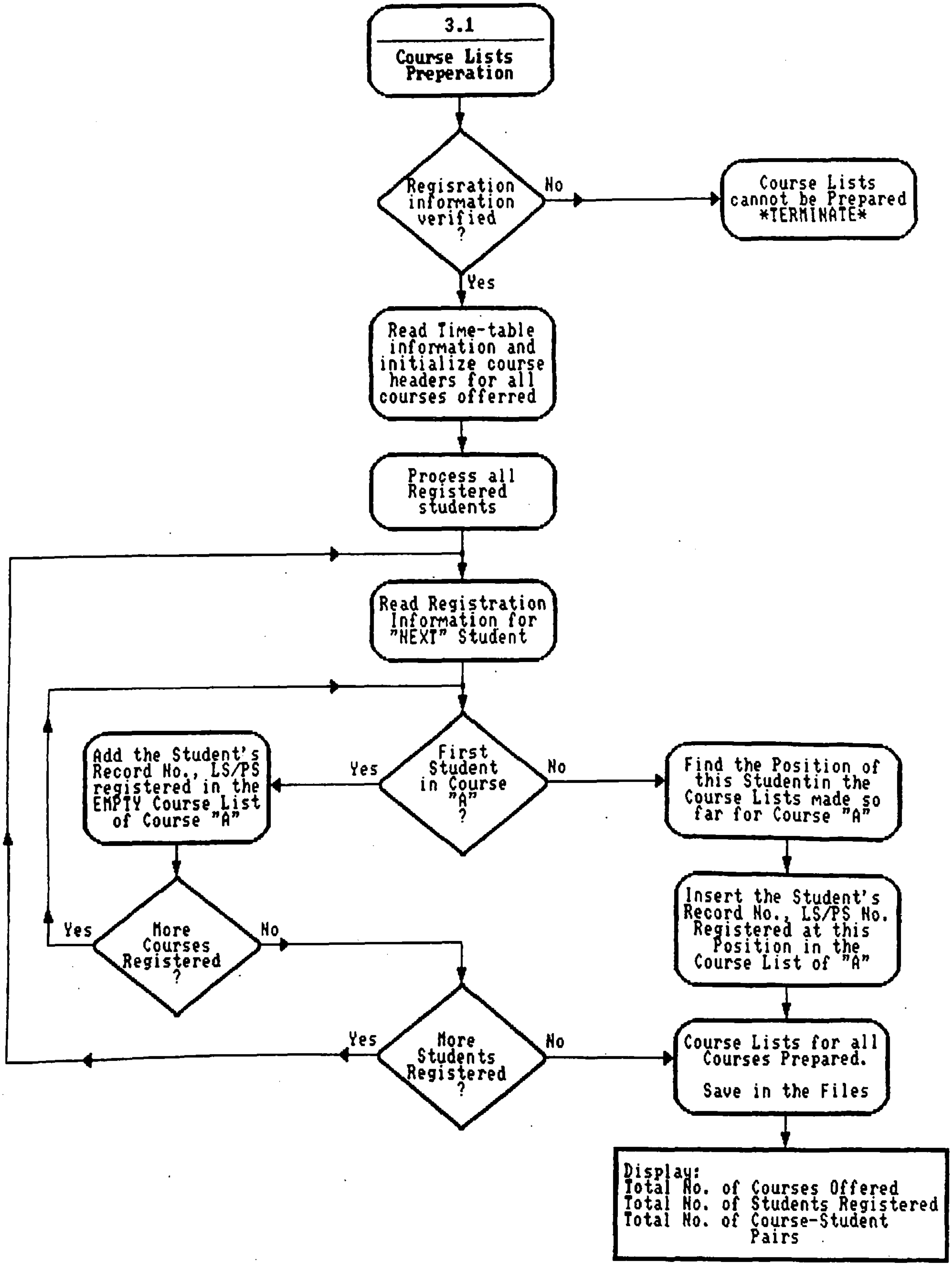


Figure 6.21 - Process of Making Course Lists from the Registration Information for all Courses Offered in the Semester.

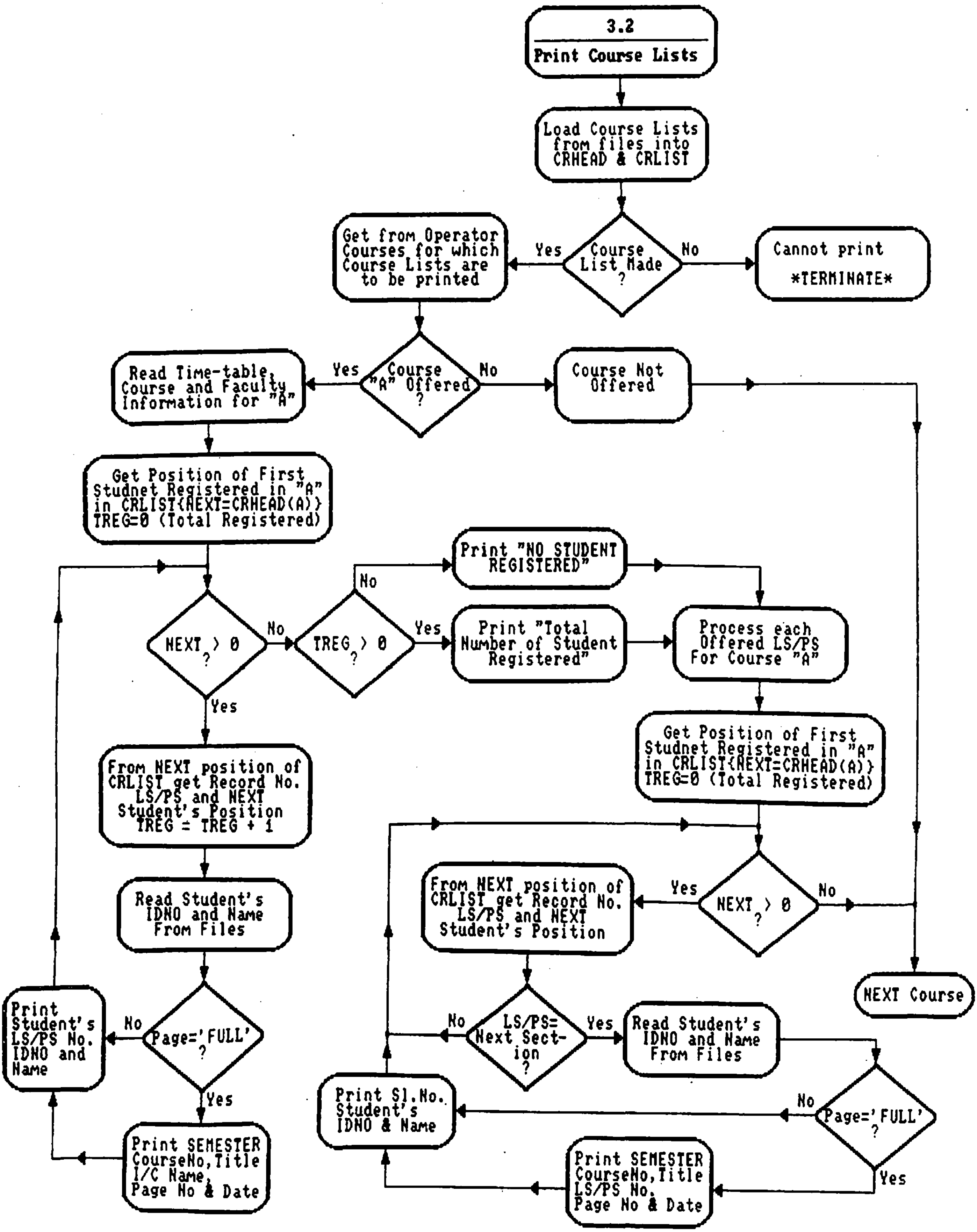


Figure 6.22 - Process of Printing Merged and Sectionwise Course Lists.

Second is processing of information for future, that is, planning and preparation for end of semester, next semester and next academic year as a whole. Various types of likely eligibilities are worked-out to identify populations of students for each kind of planning activity. Software design of these information processing activities is described in this section.

6.5.1 Likely Eligibilities

The approach for determining the likely eligibility, to identify population of students' for a particular objective, is almost same for all "likely eligible ..." processes, but the likely eligibility criterion is different for different answers. Therefore, in order to determine a likely student population for an objective, the required eligibility criterion is first determined from the Academic Regulations or rules governing the operations. This criterion is translated into software to enable system to apply it to the information on students available in the system.

To apply the eligibility criterion, an assumption is made that all registered courses of the current semester and prescribed courses, as per the semesterwise pattern, of required future semesters will be cleared by the student. All students who fulfill the eligibility criterion, under this assumption, are picked-up as the likely population. Appendix A.7 and Appendix A.8 include some of the likely eligible population lists.

6.5.2 Practice School II Profile

Processing of information for Practice School profiles is unique in terms of its requirements and information content. The information content of the profile is a mixture of student's academic and personal information. The academic component is culled-out from the stored up-to-date academic information and the other component is input from the terminal for the sole purpose of printing it on the profile. This mixture of information is formatted and assembled on a page. A sample of Practice School II profile is given in Appendix A.9.

6.5.3 Grade Lists

One of the key report for the completion of current semester's academic tasks is the Grade List. This document is required at the end of semester to turn-in the grades and reports for all courses offered in the semester. The significance, role and design of the Grade List was unraveled in the previous Chapter in section on "Design for Information Collection."

The software design for processing information to generate Grade Lists is described here. From the updated registration information and information contained in the system, the coursewise information is generated as described in Section 6.4.3 and Figure 6.21. From this coursewise information, which also contains all administratively awarded reports (like W/DP/RC), the Grade List for each course is printed out. The software design for Grade Lists is given in Figure 6.23, which gives the details of numerous checks and validations performed by the software before printing to ensure correct and complete up-to-date information. Each Grade List is followed by a one page Analysis Sheet. The samples of Grade List and Analysis Sheet are incorporated in Appendix A.10.

6.5.4 Examination Committee Analysis (EC Analysis)

The next crucial and confidential report for the monitoring of academic process is the "Examination Committee Analysis" for each course offered in the semester. This EC analysis contains certain academic indices based on the past academic performance of the set of students who are registered for a course. The software procedural design of information processing required for EC Analysis is described in Figure 6.24 and a sample page of EC analysis is included in Appendix A.12.

6.6 SEMESTER END PROCESSES

The end of semester is the point of reckoning for completion of educational tasks of the semester. Coursewise grades/reports awarded by the instructor-in-charge and approved by the

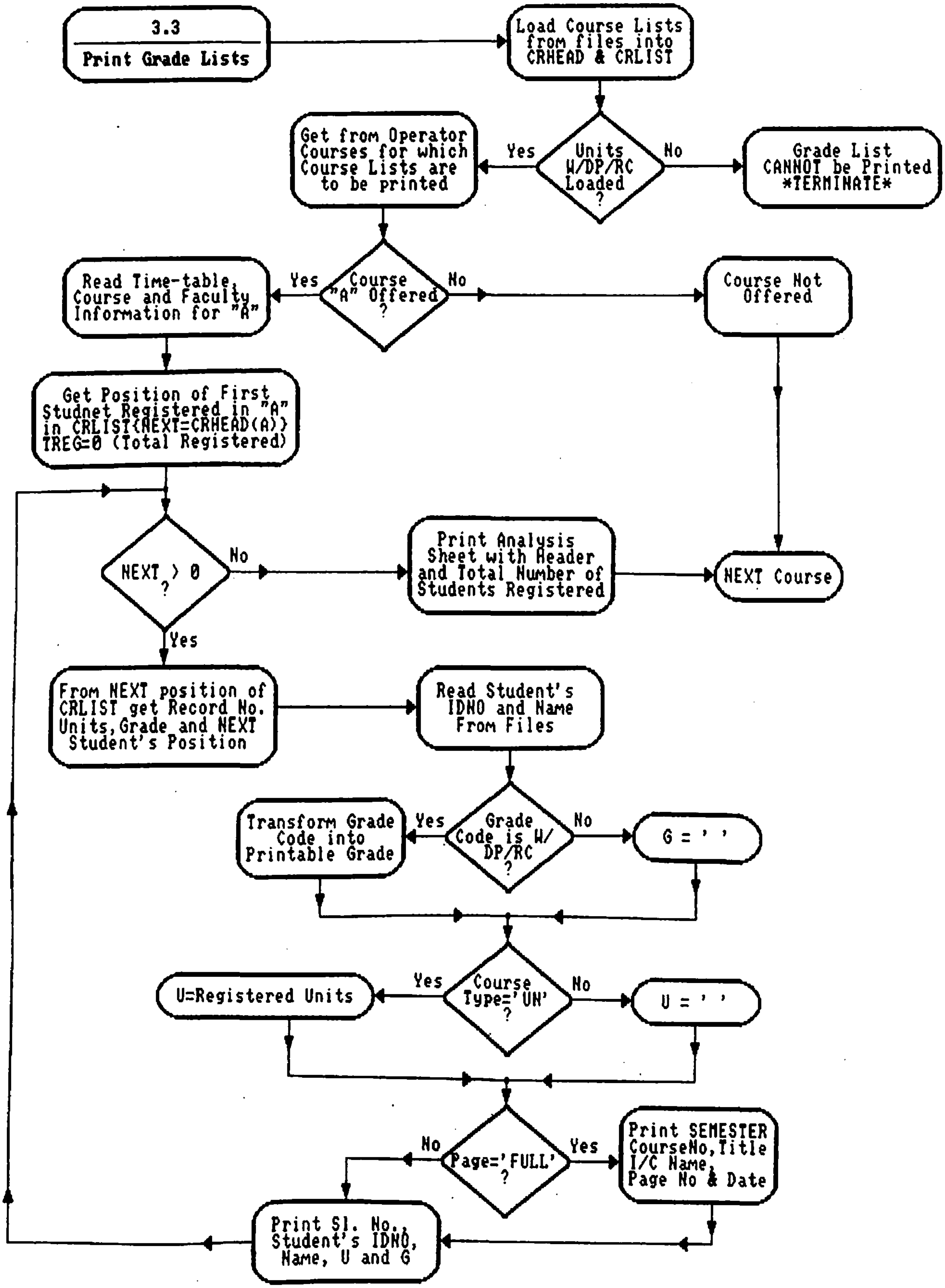


Figure 6.23 - Process of Printing Grade Lists for "Current" Semester.

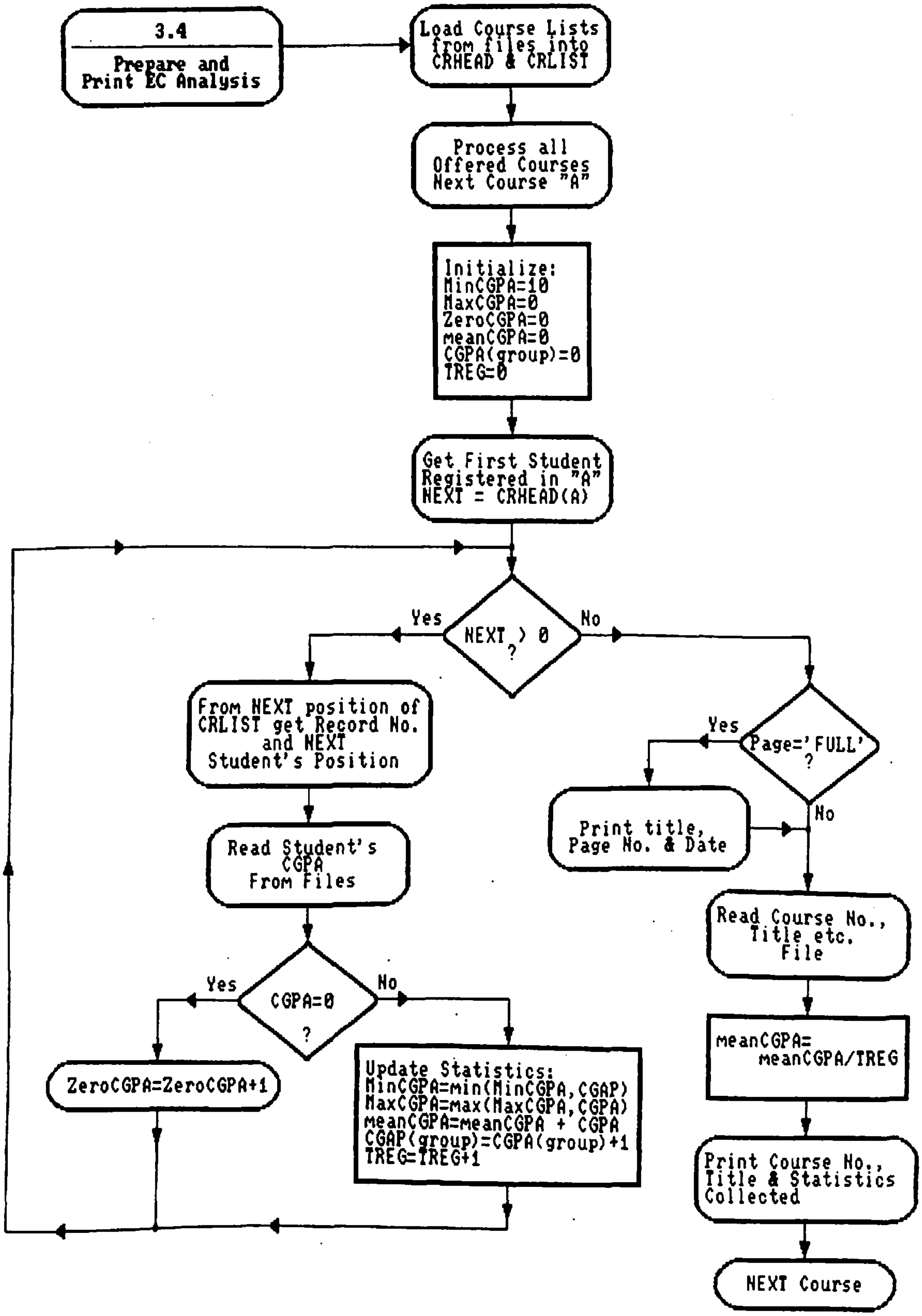


Figure 6.24 - Process of Preapring and Printing EC Analysis for a Semester.

examination committee mark the beginning of semester end processes for the computerized monitoring and management of academic records. Processes involved at this and subsequent stages of Monitoring and decisions and post-processing are identified in the information flow diagram given in Figure 6.25.

6.6.1 Grade Loading and Posting

The first process, as semester end process, is the input of these coursewise grades/reports to the system. This process of input and its verification, called Grade Loading, data design and software design for the same was described in detail, in previous Chapters. After the input is completed and verified, the coursewise information of grades/reports for all students is transformed into studentwise grades/reports. This process is called Grade Posting.

For every registered student, grades/reports in all courses registered by the student are collected and written at appropriate locations in the files. Figure 6.26 is the detailed software design for the process of grade posting. The process of grade posting is similar in nature, but inverse of process of making course lists, Figure 6.21. This process requires more checks to be performed and updates information in more than one file.

6.6.2 CGPA Update

Cumulative Grade Point Average (CGPA), the measure used for overall academic performance, is computed after the grade/report for all registered courses are available for a student. The formula for computing CGPA, defined in Academic Regulations and presented in Section 2.4(j), Chapter Two, is translated into software as described by Figure 6.27, with details of all permissible variations in CGPA computing. The updated CGPA and performance in all registered courses is the beginning of information processing activities that are termed as eligibility update, monitoring and decisions and post-processing.

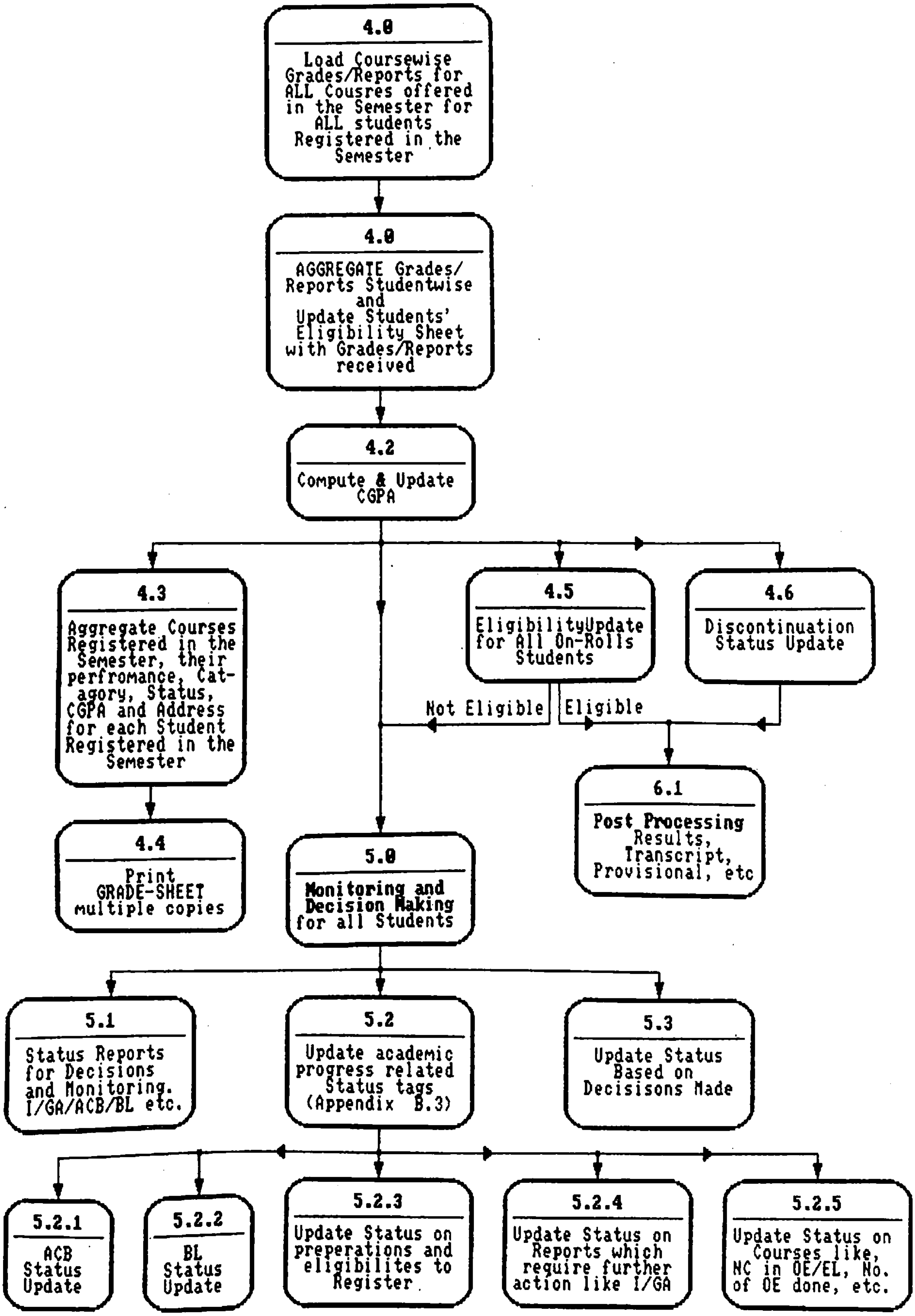


Figure 6.25 - Identification of Information Processing Processes for End of Semester, Monitoring and Decisions and Post-Processing.

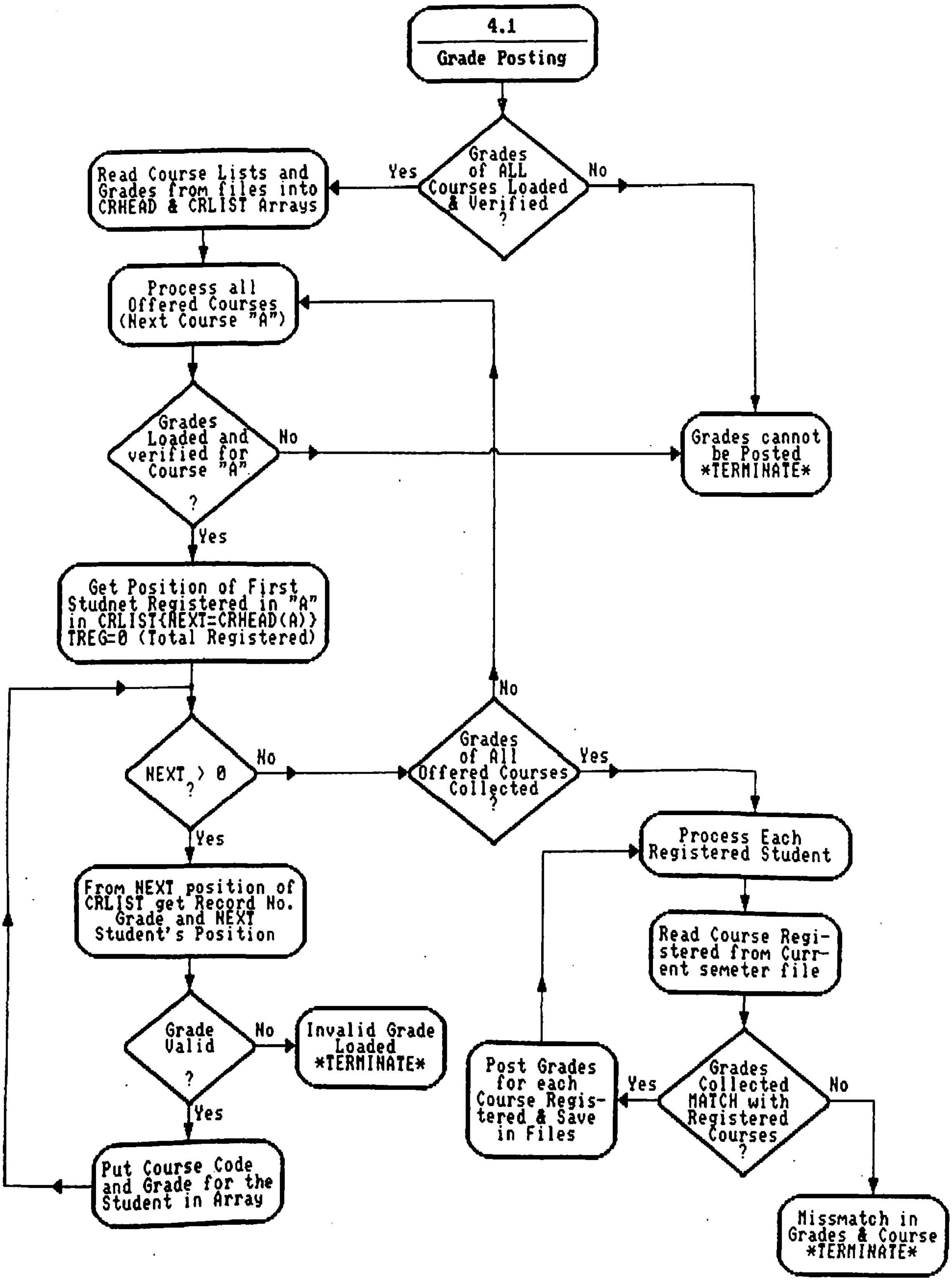


Figure 6.26 - Process of Posting Coursewise Grades to Individual students as per the Registration for all Courses Offered in the Semester.

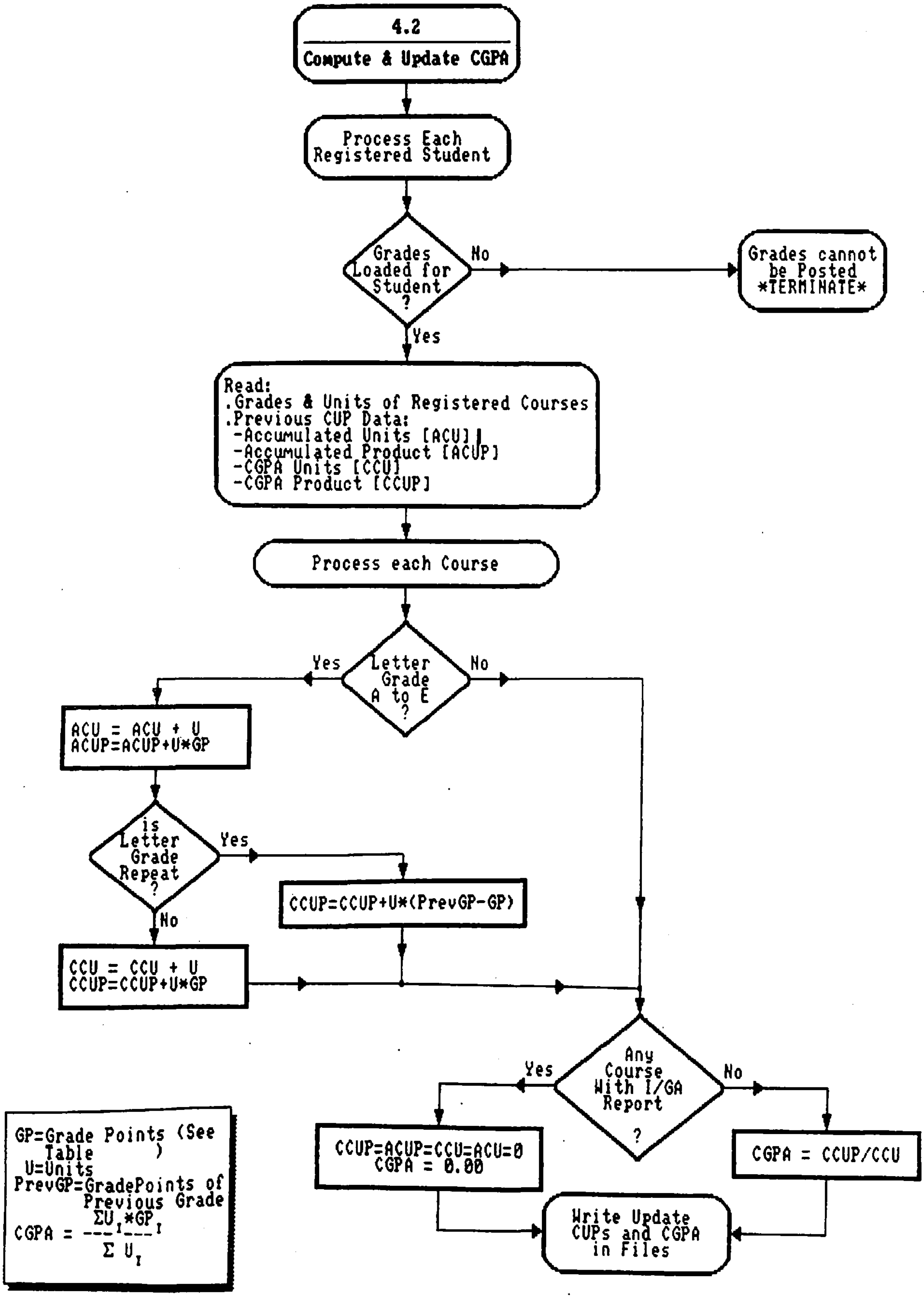


Figure 6.27 - Process of CGPA and CUPs Update for a Semester.

6.6.3 Grade Sheets

The hard copy report of the students' performance for the semester and up-to-date cumulative performance, that is CGPA, for the student and for the academic file of the student is called Grade Sheet or Grade Card. This report is generated by processing stored information on student's IDNO, Name, Address, Semester, courses registered, their category, repeat status, grade/report received and up-to-date CGPA. The collected information is assembled in the prescribed format and desired number of copies of the Grade Sheet are printed out. A sample of the Grade Sheet is included in Appendix A.13.

6.6.4 Eligibility Update

The process of eligibility update is processing of information, after the semester end tasks are completed, to determine and confirm the eligible population from the corresponding likely eligible population identified in the mid-semester processing, Section 6.5.1.

For example "likely graduate" population is checked to identify, who clear all the registered courses and other graduation requirements and become eligible for the award of the degree(s) and who remain short of eligibility. The software design for this checking and eligibility update is given in Figures 6.24 and 6.28. The eligible population's status is updated and it is subjected to post-processing, while not eligible population remains in the main stream, that is status of likely graduate is removed and it becomes continuing.

Similar checks are applied for each category of likely eligible population. Status update is done only when no further information has been generated on the likely eligible population through a process of academic decision making.

6.7 MONITORING AND DECISIONS

The monitoring and decisions processes are of three categories. The first are those in which, the monitoring and decision making is done, based on the stored information, by the software. In second category, processed information is made available to the academic administrator for monitoring and decision making. The third category is of input of academic decisions which, influence and control further processes and processing of information.

6.7.1 Status Update

All processes dealing with updating of academic status of every continuing student, fall in the first category. The academic progress based status tags are updated by processing the up-to-date academic information and inferring through a logical process based on the Academic Regulations and rules governing the operations. The academic progress based status tags were discussed in Chapter Four and are listed in Appendix B.3.

Figure 6.28 gives software design for updating student's under ACB status. The application and translation of rules of the Academic Regulations for determining whether a student is under ACB or not is explained through Figure 6.28. Software for all other academic progress based status tags, which need to be updated after the end of semester, is designed in the similar manner. Most of these status tags form a part of the "Eligibility Sheet" whose design was described in Section 6.1.

6.7.2 Status Reports and other Monitoring and Decision Making Aids

In the second category, processed information is provided by the system to the academic administrator for monitoring and decision making. For example, a list of students' for whom the final performance in a course is yet not available and the report is "Incomplete" (I) or "GA" (Grade Awaited). A sample page for each of these is included in Appendix A.15. This kind of information can be easily extracted from the updated status of the students.

A more complex processing is required for determining a tentative course package for ACB or BL students. The information is processed to identify OBL and OPSC for such students and through a set of guidelines, determine a tentative course is done, based on the stored information, by the software. In second category, processed information is made available to the academic administrator for monitoring and decision making. The third category is of input of academic decisions which, influence and control further processes and processing of information.

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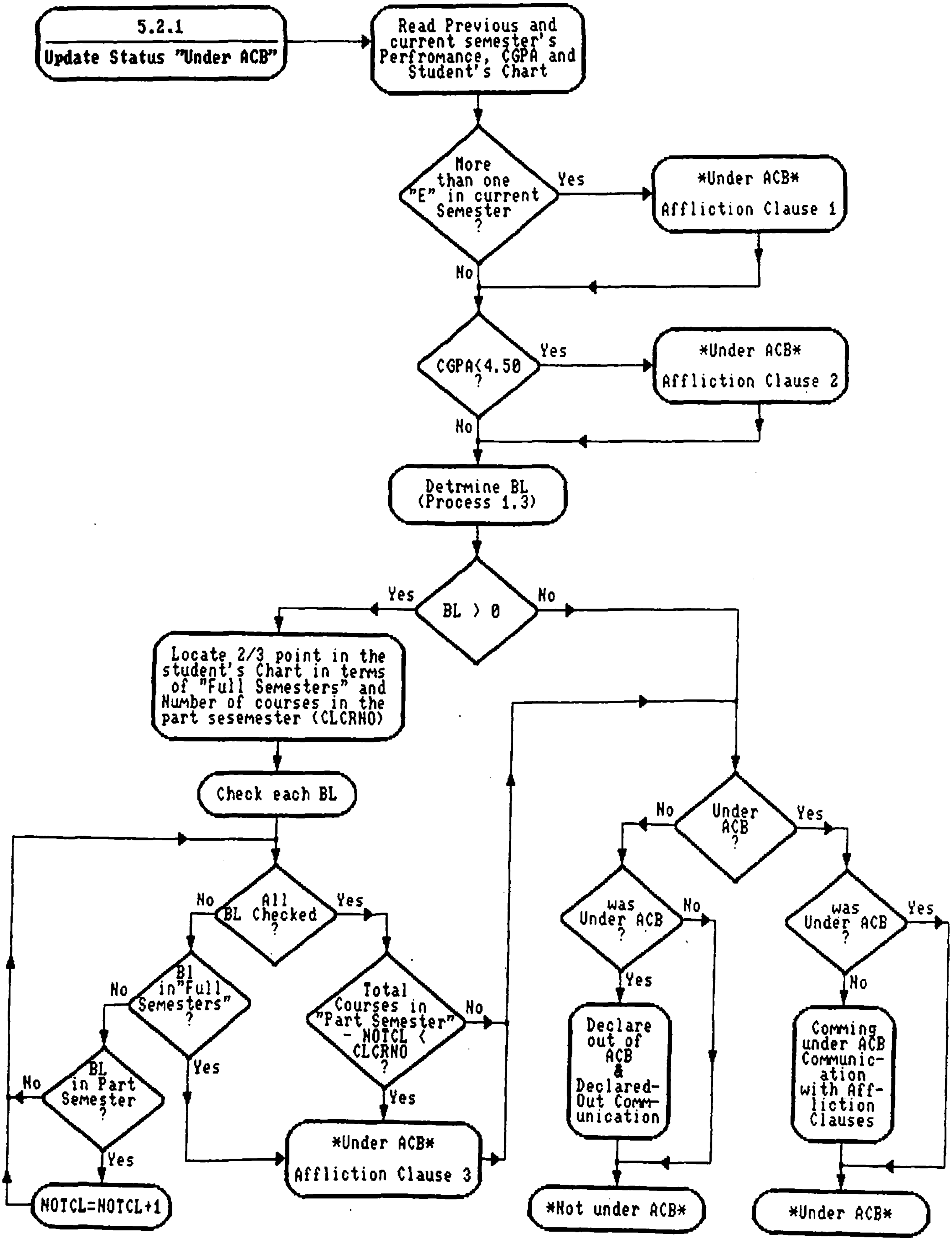

Figure 6.28 - Under ACB Status Update and Communications.

package. A map of all courses in the tentative package is also prepared by the system whenever, the package has a mixture of OBL and OPSC, to identify clashes among the courses. These serve as aids for decision making. Samples of tentative course packages and time-table map are included in Appendix A.17.

The third category, of monitoring and decisions processes, comes under the input design and was discussed in Chapter Five. With the monitoring and update processes, the information of continuing students is ready for processing for next semester. This, supplemented with the information on new admissions, begins the cyclic process of academic monitoring and management of academic records.

6.8 POST PROCESSING

Processing of academic information for those students who complete the requirements of the award of the degree or discontinue programme falls under post-processing. The processes under this head begin after the semester end processes are completed, that is, the grades are loaded, verified, posted, CGPA updated and eligibility update completed to identify eligible population, as explained above in Section 6.6.4. The processes that are carried out are detailed in the information flow diagram in Figure 6.29, which is a refinement of Process 6 of Figure 3.1, Chapter Three.

6.8.1 Results for EC/Senate/Board

The result and summary analysis of results of all students who complete the requirements of graduation is prepared in the prescribed format (Appendix A.16.1) for the Examination Committee's approval. Certain aspects of final eligibility as per the Academic Regulations like clearing of dues, etc. are verified manually before the release of documents such as transcript and provisional degree certificates to the individual defaulting student. Similarly, results and summary analysis of results are prepared for the Senate by cumulating all the results approved by the Examination Committee, since the last Senate meeting.

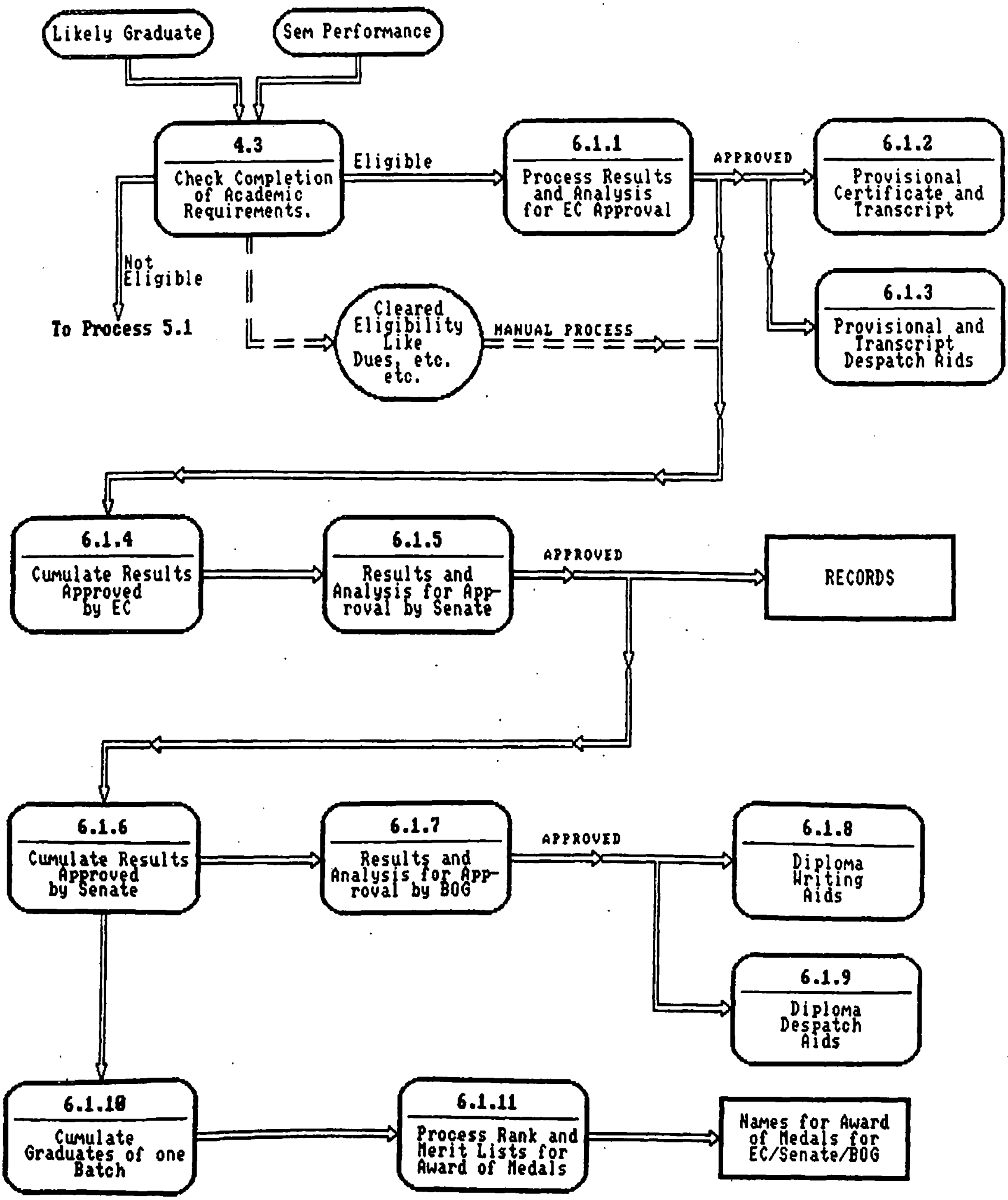

Figure 6.29 - Post Processing: Processing of Information for Graduating and Grduated Students.

The results approved by the Senate, in it's different meetings, for the award of degree to the students are consolidated for the Board of Governors for conferment of degrees to the students. Process 6.1.1, and 6.1.4 to 6.1.7 in Figure 6.29 describes the processing activity at each stage of preparation of results.

Another consolidation of graduating students, whose results have been approved by the Examination Committee and the Senate, are done in order to prepare rank lists and to identify the prospective medal awardees'. Figure 6.29, processes 6.1.10 to 6.1.11 describe the software procedure for this.

6.8.2 Transcript and Provisional

The transcript is prepared for all graduating students whose results are passed by the Examination Committee and for those students who discontinue the programme without completing the degree. In the transcript, student's entire academic record, right from the admissions until graduation or discontinuation, is presented. All admission-oriented and academic flexibilities used by the students are also summarized. Student's final academic standing in terms of CGPA, degree(s) admitted to and degree(s) completed, and division wherever applicable, are given in the Transcript.

For continuing students, who are yet to graduate, an intermediate transcript is produced by the system. This intermediate transcript is an extension of the concept of final transcript for graduating students, as described above. It contains the up-to-date record of student's academic performance and flexibilities used.

The provisional certificate is also printed out by the computer for all graduating students. The processing and printing of provisional certificate and transcript by the computerized students' academic records management and monitoring system has resulted in tremendous savings in time and manual labor. Samples of Transcript and provisional certificate printed by the computer are included in Appendix A.19.

6.8.3 Dispatch and Diploma Writing Aids

The system also provides several aids, which are not so academic in nature, for smooth operations and control of manual processes. Some examples are dispatch register for provisional certificate and Transcript, dispatch register for final diploma certificate, list of students for diploma writing, etc. These processes are also covered in Figure 6.29, process 6.1.3, process 6.1.8 and process 6.1.9.

6.9 SUMMARY

The design of software for the information processing intensive processes, which transform students' academic information from one form to other, has been described in this Chapter. This is the last phase of the software design for computerization of academic records for educational administration, management and monitoring, as was described in Figure 3.4, Chapter Three.

Software design has been carried by identifying the main processing activity, portioning the main activity into identifiable processes and designing the detailed software structure for each of the processes. This results in a modular software where each module satisfies all the five design guidelines specified in the beginning of the Chapter and minimizes design effort as any module used in more than one process is designed only once. The technique used to describe the software design includes detailed information flow diagrams and structures flow charts. The software design of each module is detailed down to the procedural level of design so that it can be coded directly in software code.

CHAPTER SEVEN

CONCLUSIONS

7.1 CONCLUSIONS

The process of educational administration, management and monitoring in an institution of higher education with academic freedom, like BITS, is continuously subjected to minute scrutiny, innovations and modernization in all aspects of operation. Ever increasing demands for information are made by the administrator, faculty, students and others in increasing complexities.

This dissertation is a record of the design and implementation of software for computerization of students' academic records, their maintenance and processing for educational administration, management and monitoring in an educational institution like BITS. Various aspects of Software Engineering have been considered while designing the system. Nature and character of academic information, from the source to preparation for input, its processing and utilization have been discussed in the light of required information, not only for educational administration, monitoring and decision making but also for continued educational innovations and reforms. The decision processes and the rules of processing information for the specified tasks have been examined and discussed at length as the quality of information affects the decision and the decision process while being accountable.

By its very nature the academic information is confidential and vulnerable, hence, requires stringent control and security during input, processing and storage. The information has to be accurate, reliable and tractable from its source through its use. These aspects have been discussed and considered in the software design for input, storage and processing to ensure security and accuracy of the stored information and information in transition during processing.

The software design that is developed as a part of this Thesis, has been implemented successfully at BITS using HP-1000 computer system. Software packages developed, on this design, have been in operation and use for over five years, while the new changes have been incorporated continuously.

Actually, the task was much more than just a design of software. The software packages developed were put in service straightaway. The operators developed familiarity and began their use. This strategy of manpower development along with the computerization effort, therefore, ensured that the manpower was free from suspicion and anxiety, that any computerization would layoff people from jobs. In other words, computerization of academic records at BITS, was a totally integrated process in which each individual human it touched was subjected to cultural transformation and developed new habits of handling information.

This was an unusual culture burdened on the design, which was addressed to this Thesis. Indeed, investigations had to go far in the field to design formats of proforma for information input, handling and update. Proforma designs for entering information to be input to computer or for updating of information and, most importantly, the formats of the computer printouts in which processed information or conclusions are presented for the clientele, be it an educational administrator or a student have been carried out. In short, thesis has addressed itself to the task, decided on the operational logic and then went ahead to work out the software logic.

Original objectives have been more than fulfilled. The perception was to go for a flexible design to accommodate as much as possible rather than a rigid design for a limited task. No design can be final but a design, which has adaptability and flexibility in its structure, goes a longer distance than a design which is perfect but rigid and immovable.

At BITS, several changes have come in the educational structure, its administration and monitoring, and many educational reforms have been brought-in, over the past five years. New degree programmes and new disciplines have been added, new courses have been introduced, programmes have been restructured and Academic Regulations and rules governing the operations have changed. The fact that the designed software has been able to incorporate all these without undergoing a redesign or becoming non-operational even for a day, proves the flexibility and adaptability of the design.

Some of the other accomplished objectives are:

(a) The system design focused on the need to ensure minimum human error in entering information into the computer and processing of the same.

(b) One information is input only once and is thoroughly verified and validated by the computer before being put to use.

(c) For updating of information in the system, which has to be done by manual keyboarding, only piece of information that has changed, is required to be input.

(d) The information to be input, is always in a performa, which is either computer dictated or computer printed. This proforma includes the peripheral information relationships for intelligent generation of new or update information and input of same. For many situations the pre-printed proforma is used and the information is printed by the computer indicating what to enter or update, where and by whom. The information is captured at the point of generation.

(e) Maximum processing of information is done by the computer without operator interventions and it is this ambition which increasingly burdened the system with complexities.

(f) The design optimizes the reliability, accuracy, consistency and timeliness of information and minimizes the input time with on-line capability of the hardware. Thus, providing a quick, reliable and efficient service to both management and other clientele.

The successful computerization of students' academic records at BITS for educational administration, management and monitoring, and role played by it in educational innovations and reforms carried-out at BITS, have set an example for the other similar Universities for higher education. For successful computerization, it must meet goals which have to be clearly defined. At the same time the user has to acquire the art of living with the change. In a time variant system one event follows another on a scale of time. Almost invariably the second event takes over only at the completion of the first. There are situations where such a pair of events becomes critical and system collapses because time target for the first event could not be completed and the second event takes over at the scheduled time. Unless all these factors are properly accounted for in the computerization in University environment, it will not be successful.

7.2 SCOPE FOR FURTHER WORK

Scope for further work is two dimensional. One is vertical growth of the existing system to take it to a higher level of sophistication, which can provide still better and more services to the clientele. Second is horizontal expansion, that is, utilization of the experience gained to computerize many more activities of administration in an educational institution, both academic and non-academic.

The enhancement of the existing system of maintenance and processing of students' academic records can to be taken to a higher level of sophistication in terms of operations and facilities. The academic administrators and decision makers should directly interact with and have access to central information store, minimizing paper, verbal information exchange, eliminating delays in transmission of information from one office to other and more indicators will be available to the academic them for monitoring and decision making. This will improve the efficiency of the system and will avoid long undue delays and interdependences. The task will require an approach similar to this Thesis in addition to hardware upgrade.

Another developmental activity is the computerization of the Registration process, whereby, a student registers directly on the computer terminal. Apart from other peripheral benefits, this process will provide a natural interaction point between the student and the computer. Student will no longer wander from place to place, searching for courses or advisors, and whole registration can be completed in one step at one terminal.

The horizontal expansion and growth of the existing system needs investigations and research in the peripheral processes which directly or indirectly are connected to educational system and the students. Admissions, students' personal accounts and fees, and time-table making are some of the processes that interact with the academic records monitoring system at the battery limits.

Apart from the students' academic records, system recognizes the requirements of other aspects of the student life, particularly the financial aspect as another operation, which interfaces but maintains its own distinctive character with the academic aspects. While students' personal accounts have also been computerized at BITS, it remains an endeavor for another thesis for further investigations, interlinking with Institute accounts and academic aspects, and upgrading.

Similarly, the admissions are completed through a computerized process and a set of students are delivered at the first battery limit to the students' academic information processing system (SAIPS). Incoming students' background, interests, goals, and other factors have great significance in indicating potential success of a student in University and in professional world beyond University. A study can be conducted to define such factors and determine correlations, if any, between academic quality of students admitted and their performance at BITS, and similar other related parameters.

The process of making time-table, that is, scheduling of classes, examinations and other instruction associated activities with optimization of resource like, faculty, classrooms, registerability of students' in multisection courses, is another activity closely associated with the academic information processing. This multi-constrained, multidimensional assignment problem is topic of another thesis.

For many other activities related to administration, management and monitoring of an educational system, the nature and character of decision making process is related to and dependent upon an information system, which is no different from the students' academic records management and processing system described in this dissertation. From the experience gained through this Thesis, it is clear that for any process related to management of information in an educational institution that is need based, time bound, information driven, and postaudit accountable, a computer based information processing system can be developed to aid in decision making, records management and monitoring.

In an institution of higher education, introduction of similar computerized systems is possible in following activities:

(a) Management and monitoring of accounts and other resources,
(b) Optimized resource allocation models,
(c) Educational hardware stock, allocation, utilization and control, across the Institute,
(d) System of instruction monitoring, and
(e) many other specialized, Institution specific activities like Practice School allotment, monitoring, etc.

Each of the above is a research topic/project requiring to evolve a design for the computerized system that can fulfill the information needs of the decision makers and the administrators. Many of these topics are part of completed and ongoing research at BITS. An outgrowth of all these is design and development of an integrated, comprehensive information plan for the institute, which will provide for an institutional information base rather than an individual activity information base, with information stored in a readily retrievable form.

A third dimension possible for further research involves studies in contemporary issues of Software Engineering practice; database engineering, security, integrity, and operations; software reliability, testing and quality assurance, and of user interfaces, user interactions and user friendliness. The investigations in these fields, at BITS, will be tremendously benefited with the live reference points of a large information base, operating software and software code of over a million lines, where several of the above have been put to practical applications.

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* This publication can be obtained from Registrar, BITS, Pilani.
$ This document can be obtained from BITS COOP, BITS, Pilani.

APPENDIX - A

SAMPLES OF THE REPORTS, OUTPUT AND COMPUTER GENERATED FORMS FOR INFORMATION COLLECTION AND INPUT

CONTENTS

REGISTRATION CARD — BITS,PILANI — SECOND SEMESTER 1990 - 91

REC NO 1800 88A6PS429 R SAMPATHKUMAR — PRNO 655 — STUDENT STATUS NORMAL

ORIGINAL REGISTRATION								AMENDED/REVISED REGISTRATION						
ARCD	CODE	LS	PS	TYPE	SIGN	COURSE NO	COURSE TITLE	ADD	SUBSD	SUBSD BY	W	RC	DP	SIGN
	117			OPSC		MGTS C352	PERSONNEL MANAGEMENT							
	112			OPSC		MGTS C322	MARKETING I							
	116			OPSC		MGTS C332	GOVERNMENT & BUSINESS							
	119			OPSC		MGTS C342	PRODUCTION MANAGEMENT							
	597			OPSC		AAOC C312	OPERATIONS RESEARCH							
				OPSC/EL										

SIGN DATE SIGN STUDENT SIGN REG ADV SIGN DEAN SIGN ARCD SIGN DEAN

INSTRUCTIONS

1. Any courses printed out are assigned by the Computer on the basis of permissibility of Academic Regulations
2. Under the column TYPE enter only EL/OE/AU categories
3. For ACB/EL any departure from the printed package as above, can be done only with Dean's prior approval and signature

BITS , PILANI
FOR REGISTRATION IN: I SEM, 1991-92
ELIGIBILITY SHEET(VIDE A.B. 3.21)

REC NO:1276 88A6PS429 R SAMPATHKUMAR CGPA 8.15 PATTERN CODE 1804 ADMISSION. I SEM 1988-89

YEAR		I SEM CODE COURSE NO		COURSE TITLE	UNITS	GRADES		II SEM CODE COURSE NO		COURSE TITLE	UNITS	GRADES	
I		518 MATH	B131	CALCULUS	2	A		469 BIO	C111	GENERAL BIOLOGY	3	C	
		312 SCI	B141	PHYSICAL SCIENCE	2	B		471 CHEM	C112	INORGANIC CHEMISTRY	3	B	
		483 CHEM	C111	ORGANIC CHEMISTRY	3	C		527 PHY	C112	ELECTRICITY & MAGNETISM	3	A	
		489 PHY	C111	MODERN PHYSICS	3	A		525 MATH	C112	HIGHER CALCULUS	3	B	
		485 MATH	C111	LINEAR ALGEBRA	5	A		897 TA	C132	WORKSHOP PRACTICE	4	C	
		194 TA	C111	ENGINEERING GRAPHICS	4	A		515 AAOC	C111	PROB & STAT	3	B	
II		476 ES	C112	THERMODYNAMICS	3	B		575 AAOC	C212	SOCIAL ENGINEERING II	3	B	
		528 PHY	C211	OPTICS & WAVE MOTION	3	C		531 TA	C122	COMPUTATION TECHNIQUES	3	B	
		389 MATH	C211	COMPLEX VARIABLES	3	C		566 MATH	C212	DIFF EQN & FOURIER SER	3	B	
		373 TA	C211	MEASUREMENT TECHNIQUES I	2	B		902 TA	C222	MEASUREMENT TECH II	4	B	
		329 ES	C211	CIRCUIT THEORY I	3	B		560 ES	C212	ELECTRONICS I	3	C	
		381 AAOC	C211	SOCIAL ENGINEERING I	3	A		563 ES	C242	STRUC & PROP OF MAT	3	B	
		491 PSY	C211	INTRODUCTORY PSYCHOLOGY	3	C		599 AAOC	C222	OPTIMISATION	3	A	
SUMMER	#	600 BITS	C221	PRACTICE SCHOOL I	5	A							
III		114 MGTS	C341	ECON ENVIR OF BUSINESS	3	A	CDC1	117 MGTS	C352	PERSONNEL MANAGEMENT	3	B %	CDC1
		115 MGTS	C351	ORG BEHAVIOUR	3	A	CDC1	112 MGTS	C322	MARKETING	3	A %	CDC1
		121 MGTS	C361	ACCOUNTING AND FINANCE	3	A	CDC1	116 MGTS	C332	GOVERNMENT & BUSINESS	3	C %	CDC1
		395 TA	C311	REPORT WRITING	3	B		119 MGTS	C342	PRODUCTION MANAGEMENT	3	A %	CDC1
		316 AAOC	C311	DATA PROCESSING	3	B		597 AAOC	C312	OPERATIONS RESEARCH	3	A %	
		836 BITS	C331	COMPUTER PROJECTS	3	D	EL	598 AAOC	C322	SYSTEMS	3	C	
IV	||	487 PHIL	C221	SYMBOLIC LOGIC	3	B %	EL	354 BITS	C412	PRACTICE SCHOOL II	20		
	|| $	.....		.....			EL						
	|| $	.....		.....			EL						
	|| $	.....		.....			EL						
	|| $	.....		.....			EL						
	|| $	.....		.....			EL						

STATUS TAGS

1. STAFF .... NO
2. CLAUSE 10 .... NO
3. ADMIT SEMESTER 1
4. ADM STANDING .... NO
5. MARGINAL DIF .... NO
6. NOT TO REGISTER .... NO
7. GW .... NO
8. PENDING I .... NO
9. PENDING GA .... NO
10. ACB(5.02: 1 .... NO
11. NC IN EL .... NO
12. NC IN OI .... NO
13. DE DONE 0
14. OVERREACHED .... NO
15. PS I ADVANCED .... NO
16. PS II SEM: II
17. TS DECOUPLED .... NA
18. DP IN PS .... NO
19. ELIGIBLE FOR PS I .... NO
20. ELIGIBLE FOR CDC1 .... YES
21. CDC1 TOUCHED .... YES
22. ELIGIBLE FOR CDC2 .... NA
23. CDC2 TOUCHED .... NA
24. ELIGIBLE FOR PSII/TS .... YES
25. OVERSTAYING .... NO
26. DISCONTINUED .... NO
27. LIKELY GRADUATE .... NO
28. CLEARED 9.01 .... NO
29. GRADUATED .... NO
30. ....

LEGEND: * - BACKLOG $ - OPSC || - CURRENT SEM % - PREV SEM PERFORMANCE + - EXEMPTED @ - DEBARRED TO REGISTER

ACC CGP:1010 CGPA CGP:1010 ACC UNITS: 124 CGPA UNITS: 124

UNACCOUNTED COURSE(S) 582 AAOC C341 NUMERICAL ANALYSIS 3 W

A.3.1 NOT Registered Students' List

BITS, PILANI FIRST SEMESTER 1991 - 92 PAGE 1
LIST OF NOT REGISTERED STUDENTS 27 AUG., 1991
WHO WERE IN THE DUES LIST OF 6 JUNE, 1991

ID NO.	NAME	HOSTEL CODE	DU LS S.NO.
88A3PS106	SUDESH KUMAR	RP	943
88A4PS175	CHERUKURI ARAVIND	BG	985
88PHXF808	K V MURALIDHARAN	DS	1395
89A3PS099	PANKAJ RAJ SARAOGI	VK	1592
89A5PS956	B SRINIVASA RAO	RM	1693
89C3PS853	ALOK SRIVASTAVA	DS	1973
89PHXF012	DINESH KUMAR GUPTA	DS	2134
89PHXF405	C SRIHARI RAO	DS	2143
89PHXP407	CHANDRA CHARU TRIPATHI	DS	2150
89PHXP408	DEEP CHANDRA DUMKA	DS	2151
90A2PS384	RANJIT THOMAS JOSEPH	SK	2271
90A2PS907	MANOJ PAPPEN	SK	2284
90A5PS646	K RAJESH KUMAR	VY	2448
90A6PS418	DIVYA RAMANATHAN	MR	2471
90A6PS464	ANUGU MALINI DEVI	MR	2478
90A8PS905	SURENDRA KUMAR	KR	2564
90B1PS295	SANJAY SHUKLA	GN	2566
90B2A2456	PRASAD CRG	VY	2601
90B4PS911	UDAYSINGH DHONDIRAM B	KR	2681
90H107464	S SAI SATHEESH	DS	2914
90H108089	AJIT SURI	DS	2927
90H108090	P PRABHU	DS	2928

BITS, PILANI FIRST SEMESTER 1991 - 92 PAGE 1
LIST OF NOT REGISTERED STUDENTS 27 AUG., 1991
WHO WERE IN THE DUES LIST OF 6 JUNE, 1991

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89A3PS099	PANKAJ RAJ SARAOGI	VK	1592
89A5PS956	B SRINIVASA RAO	RM	1693
89C3PS853	ALOK SRIVASTAVA	DS	1973
89PHXF012	DINESH KUMAR GUPTA	DS	2134
89PHXF405	C SRIHARI RAO	DS	2143
89PHXP407	CHANDRA CHARU TRIPATHI	DS	2150
89PHXP408	DEEP CHANDRA DUMKA	DS	2151
90A2PS384	RANJIT THOMAS JOSEPH	SK	2271
90A2PS907	MANOJ PAPPEN	SK	2284
90A5PS646	K RAJESH KUMAR	VY	2448
90A6PS418	DIVYA RAMANATHAN	MR	2471
90A6PS464	ANUGU MALINI DEVI	MR	2478
90A8PS905	SURENDRA KUMAR	KR	2564
90B1PS295	SANJAY SHUKLA	GN	2566
90B2A2456	PRASAD CRG	VY	2601
90B4PS911	UDAYSINGH DHONDIRAM B	KR	2681
90H107464	S SAI SATHEESH	DS	2914
90H108089	AJIT SURI	DS	2927
90H108090	P PRABHU	DS	2928

A.3.2 NOT Registered Students' Communication

RETAIN FOR REFERENCE
ARC DIVISION, BITS, PILANI FIRST SEMESTER 1991 - 92

88A3PS106 27 AUG , 1991
SUDESH KUMAR

You have failed to register in the current semester and have not acted as per Clause 1.18 of the Academic Regulations. Before acting as per Clause 1.21 you are given an opportunity to respond through the attached proforma.

IN ANY CASE CLEAR OUTSTANDING DUES. CONSULT DUES SLIP ALREADY SENT TO YOU.

DEAN ARC

88A3PS106
SUDESH KUMAR
32/7 RISHI NAGAR
SANOLI RD
PANIPAT-132103(HAR)

RETAIN FOR REFERENCE
ARC DIVISION, BITS, PILANI FIRST SEMESTER 1991 - 92

88A4PS175 27 AUG., 1991
CHERUKURI ARAVIND

You have failed to register in the current semester and have not acted as per Clause 1.18 of the Academic Regulations. Before acting as per Clause 1.21 you are given an opportunity to respond through the attached proforma.

IN ANY CASE CLEAR OUTSTANDING DUES. CONSULT DUES SLIP ALREADY SENT TO YOU.

DEAN ARC

88A4PS175
CHERUKURI ARAVIND
C V REDDY SASTRY
A9 NIN STAFF QTRS
NATIONAL INSTITUTE OF NUTRITION
HYDERABAD-500007

- -

DETACH AND RETURN

ARC DIVISION, BITS, PILANI FIRST SEMESTER 1991 - 92

88A3PS106 Date ______________

SUDESH KUMAR

I could not register in the current Semester for the following reasons:

I may be permitted to drop the current semester.

OR

I may be permitted to Discontinue from the Programme.

____

Signature

Instructions:

Strike off the portion not applicable.

Send this to reach latest by 15.08.1991.

- -

DETACH AND RETURN

ARC DIVISION, BITS, PILANI FIRST SEMESTER 1991 - 92

88A4PS175 Date ______________

CHERUKURI ARAVIND

I could not register in the current Semester for the following reasons:

I may be permitted to drop the current semester

OR

I may be permitted to Discontinue from the Programme.

____

Signature

Instructions:

Strike off the portion not applicable.

Send this to reach latest by 15.08.1991.

- -

A.4 REGISTRATION VALIDATION ERRORS

A.4.1 Registration Errors

BITS, PILANI   REGISTRATION CHECKS   25 AUG., 1991   Page 1

335 86B3A7945 INDRAGANTI V B RAMESH   ** Under ACB **

** DCOC-CDC Concurrent - Deans Permission Required for 84 CS C453 OE

874 87A8PS901 SURINDER GUPTA

** Registered in Colisted Course, Old course cleared 932 INSTR C341

895 87B1A4922 ANIL KUMAR SINGH

** Registered with WRONG Category in Course 908 BITS C323 OE

849 87C4PS621 MOPAL PRAVEEN REDDY   ** Under ACB **

** Requires Deans permission for course 516 AAOC C311

1164 88A2PS281 TRINATHA VENUGOPAL CH

** Prior Preperation (Own CDC) NOT CLEARED for 178 CE C411 EL

1199 88A2PS324 KARRI SREEDHAR   ** Under ACB **

** own CDC registered as EL 432 CE C361

998 88A3PS089 G K SURESH

** Registered in OE (s) while Electives remaining

** Registered w/o Category in course 497 EEE C432

1068 88A4PS168 INDEEVAR SHYAM L   ** Under ACB **

** Registered in 6 EL, while ONLY 5 EL required

1391 88A5PS597 S ANAND   ** Under ACB **

** Registered in C - Group course 544 ENGL C251

1202 88A6PS328 PRASAD N V S S R

** Repeating "A" Grade in 856 BITS C331

** Registered in OE (s) while Electives remaining

1289 88A6PS447 S SRIRAM

** Registered in others CDC - PRIOR PREPERATION NOT DONE for 663 ECON C311 EL

** Registered in others CDC - PRIOR PREPERATION NOT DONE for 664 ECON C321 OE

1344 88B1A3524 S SHYAM SUNDAR

** PREREQUSITE NOT CLEARED for Course 843 EEE C461

##PREREQUSITE course is 670 EEE C331

or PREREQUSITE course is 89 INSTR C331

1781 89A1PS313 KANWARDEEP SINGH ** Under ACB **

** NOT REGISTERED IN OBL course 531 TA C122

** INVALID OPSC REGISTRATION :FULL OBL NOT REGISTERED

1670 89A3A7127 GOKHALE SWAPNA SUDHIR

** NOT REGISTERED IN OPSC course 924 EEE C341

** FULL OBL + OPSC NOT REGISTERED - extra course 496 EEE C381

1590 89A3PS021 MEHRA UNEEK UMESHCHANDRA

** NOT REGISTERED IN OBL course 531 TA C122

** INVALID OPSC REGISTRATION :FULL OBL NOT REGISTERED

** FULL OBL+ OPSC NOT REGISTERED - extra course 528 PHY C211

1653 89A3PS107 MARRI RAMA KRISHNA ** Under ACB **

** NOT REGISTERED IN OPSC course 599 AAOC C222

1663 89A3PS118 DEEP BASU

** PRIOR PREPERATION Not Done for Course 496 EEE C381

** PRIOR PREPRATION NOT DONE for Course 445 EA C411 EL

2124 89A8PS911 MS SANGAL RUBY PRAKASH

** PREREQUSITE NOT CLEARED for Course 642 AAOC C321

##PREREQUSITE course is 524 ES C211

or PREREQUSITE course is 509 ES C231

##PREREQUSITE course is 589 MATH C211

2091 89C3PS613 ANJALI SHARMA

** Prior Preperation (Own CDC) NOT CLEARED for 896 STD C481 EL

2099 89C3PS647 RAJESH SHARMA

** Registered in A & B Group course 509 ES C231

A.4.2 Time-Table Clash and Map

BITS, PILANI FIRST SEMESTER 1991 - 92

13 AUG., 1991

TIME TABLE CLASH CHECK FOR: 1276 8886PS429 B SAMPATHKUMAR

CLASHES:

DAY	HOUR	CLASHING COURSES			
MONDAY	7	AAOC C341	L 2	MGTS C431	L 1
WEDNESDAY	7	AAOC C341	L 2	MGTS C431	L 1
THURSDAY	2	AAOC C341	TUT	HIST C112	L 1
FRIDAY	7	AAOC C341	L 2	MGTS C431	L 1
SATURDAY	2	HIST C112	L 1	MATH C131	TUT

COMPRE CLASHES:

DATE	TIME	COURSES	
7.12.91	FN	AAOC C341	HIST C112

THURSDAY : NO LUNCH HOUR **

DAY	HOUR 1	HOUR 2	HOUR 3	HOUR 4	HOUR 5	HOUR 6	HOUR 7	HOUR 8	HOUR 9	HOUR10	HOUR11
MONDAY						MATH C151 L 5	AAOC C341 L 2 MGTS C431 L 1	MGTS C481 L 1			
TUESDAY		HIST C112 L 1		AAOC C211 L 5	MGTS C413 L 1						
WEDNESDAY						MATH C151 L 5	AAOC C341 L 2 MGTS C431 L 1	MGTS C481 L 1			
THURSDAY		AAOC C341 TUT HIST C112 L 1		AAOC C211 L 5	MGTS C413 L 1	MATH C151 L 5					
FRIDAY						MATH C151 L 5	AAOC C341 L 2 MGTS C431 L 1	MGTS C481 L 1			
SATURDAY	AAOC C211 TUT	HIST C112 L 1 MATH C131 TUT		AAOC C211 L 5	MGTS C413 L 1						

COMPREE SCHEDULE

TIME \Dates>	30.11.91	2.12.91	3.12.91	4.12.91	5.12.91	6.12.91	7.12.91	9.12.91	10.12.91	11.12.91	12.12.91	13.12.91	14.12.91
FN						AAOC C211	AAOC C341 HIST C112						MATH C131
AN				MGTS C431	MGTS C413	MGTS C481							

A.5 REGISTRATION STATISTICS

581 AAOC C211 SOCIAL ENGINEERING I SK Jain

L 1: 66 L 2 78 L 3: 67 L 4: 70 L 5: 63

TOTAL NO OF STUDENTS REGISTERED 344

401 AAOC C221 GRAPHS AND NETWORKS MV Tamhankar

L 1: 12

TOTAL NO OF STUDENTS REGISTERED 12

599 AAOC C222 OPTIMISATION Satya Prakash

L 1 62 p L 2: 55 L 3: 59 L 4: 61 L 5: 57

TOTAL NO OF STUDENTS REGISTERED 294

516 AAOC C311 DATA PROCESSING GS Rao

L 1: 52 L 2: 55 L 3: 1 59

TOTAL NO OF STUDENTS REGISTERED 166

597 AAOC C312 OPERATIONS RESEARCH B Singh

L 1: 76 L 2: 81

TOTAL NO OF STUDENTS REGISTERED 157

642 AAOC C321 CONTROL SYSTEMS KE Raman

L 1: 48 L 2: 53 L 3: 56 L 4: 49

TOTAL NO OF STUDENTS REGISTERED 206

598 AAOC C322 SYSTEMS Kusum Lata

L 1: 59 L 2: 61 L 3: 63

TOTAL NO OF STUDENTS REGISTERED 183

582 AAOC C341 NUMERICAL ANALYSIS MS Radhakrishnan

L 1 64 L 2: 62 L 3: 63 L 4: 58 L 5: 68 L 6: 54 L 7: 60

TOTAL NO OF STUDENTS REGISTERED 429

467 EEE C361 DIGITAL ELECTRONICS G Raghurama

L 1 50 L 2 56

P 1 20 P 2: 18 P 3: 21 P 4: 24 P 5: 23

TOTAL NO OF STUDENTS REGISTERED 106

A.7 LIKELY GRADUATE STUDENTS' LIST

BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI 14 OCT., 1991 PAGE 1
FIRST SEMESTER 1991 - 92

** LIKELY TO GRADUATE **

SL NO	REC NO	IDNO	NAME
1	112	85B2A1928	REDDY KUMAR ANIL
2	306	86A1PS912	LALIT AJMERA
3	311	86A2PS918	RAJ KUMAR SHARMA
4	314	86A2PS921	VIJAY KUMAR SHARMA
5	351	86A5PS962	A K SRIKANTH
6	140	86A7PS087	KOVVURI RAMALINGAVARA PRASAD
7	281	86B1A4566	LOKESH SETH
8	171	86B3PS339	RAVULA VENKATAKRISHNA
9	176	86B5A3348	BHASKAR KUMAR BULUSU
10	194	86B5A4385	ARVIND GOPALAKRISHNAN
11	294	86C3PS629	S SUNDARA RAJAN
12	283	86PHXF001	B V PRASAD
13	481	87A1PS143	MS MULAMALLA AHALYA REDDY
14	595	87A1PS284	GANESH V
15	599	87A1PS288	JEYESSOMNATH C N
16	615	87A2PS307	SUDHIR
17	802	87A2PS554	SIVAKUMAR R
18	883	87A2PS910	VIVEK KUMAR
19	888	87A2PS915	MS T LAKSHMI
20	891	87A2PS918	RAMESH CHANDRA SWAIN
21	475	87A3PS135	A R ANAND
22	518	87A4PS190	VINEET SHARMA
23	525	87A4PS201	BALASUBRAMANIAM S
24	878	87A4PS905	MS S SRIPRIYA
25	880	87A4PS907	V PETHA PERUMAL

A.8 LIKELY THESIS (TS) AND PRACTICE SCHOOL (PS)

A.8.1 Likely Thesis Students' List

BITS, PILANI FIRST SEMESTER 1991 - 92 25 OCT., 1991 PAGE 1

LIST OF STUDENTS ELIGIBLE TO DO THESIS IN SECOND SEMESTER 1991 - 92

S NO	REC NO	ID NO	NAME	CGPA	PSII SEM.	TS DEGREE
1	347	86B1A1958	S CHANDRA SHEKHAR REDDY	7.29	I	FD
2	334	86B2A1943	MS S ANITHA	5.72	I	FD
3	340	86B2A2951	N VENKATRAMAN	5.32	I	FD
4	326	86B2A3935	SUNIL KUMAR GOYAL	7.25	I	FD
5	336	86B2A4946	D RADHA KRISHNA BABU	6.86	I	FD
6	254	86B2A5505	YARLAGADDA SAI SRINIVASA RAO	4.84	I	FD
7	333	86B2A7942	CHILUVURI MURALI DHARA VARMA	6.44	I	FD
8	249	86B3A2497	DINESH CHAND	6.40	I	FD
9	341	86B3A3952	RAYMOND GERARD MIRANDA	6.68	I	FD
10	346	86B3A3957	AVINASH BHATT	7.71	I	FD
11	339	86B3A4950	UPENDRA PRATAP SINGH	6.36	I	FD
12	263	86B3A7525	K VENKATA RAGHAVA RAM	6.16	I	FD
13	328	86B3A7937	PUNEET SHARMA	6.82	I	FD
14	323	86B4A1932	NAMBURI VENKATRAMAYYA	6.54	I	FD
15	319	86B4A2927	PADIRAJU RAMESH	5.97	I	FD
16	322	86B4A3931	PREM CHAND YADAV	7.26	I	FD
17	327	86B4A7936	PANKAJ SHARMA	7.80	I	FD
18	329	86B4A7938	S N KUMAR	8.21	I	FD
19	330	86B4A7939	DEEPAK SHARMA	8.57	I	FD
20	178	86B5A2350	BABBURI CHANDRA SEKHARA RAO	6.21	I	FD
21	356	86B5A3973	VIJAY KUMAR JAIN	6.92	I	FD
22	318	86B5A7926	V S KRISHNAN	6.68	I	FD
23	721	87B1A1441	JAMMULAPATI SRIKANTH	5.98	I	FD
24	775	87B1A1513	MS ANNA JESIL CHERIYAN	6.35	I	FD
25	712	87B1A2429	NAVIN DUREJA	5.84	I	FD

A.8.2 Likely Practice School Students' List

List of Likely PS II Students BITS, PILANI SECOND SEMESTER 1990 - 91 14 MAR., 1991 PAGE 1

S NO	REC NO	ID NO	NAME	CGPA	IS ELIGIBLE FOR I SEM?	IS ELIGIBLE FOR II SEM?	DEAN ARC RECO	DEAN ID RECO	SEMESTER ALLOTTED	PS DEGREE TAG
1	103	85B1A1953	SIVA SUBRAMANIA PILLAI M	3.99	YES	--				
2	295	86A3A7901	KUNAL KUNDU	9.41	YES	--				
3	282	86B1A1569	AMITABH KUNDU	7.31	YES	YES				
4	325	86B1A3934	SAURABH AGARWAL	7.67	YES	--				
5	342	86B1A7953	MS SEEMA	5.98	??	YES				
6	348	86B1A7959	VIVEK GUPTA	6.15	YES	--				
7	337	86B2A2948	AMIT JAIN	5.82	YES	--				
8	243	86B2A5489	GOBBURU VENKATA SITARAM JOGARAO	4.31	??	??				
9	262	86B3A2524	S VENKATA RAMANA REDDY	6.17	YES	--				
10	185	86B3A3364	S R SUBRAMANIAN	7.98	YES	--				
11	343	86B3A3954	S VENKATESHWARAN	8.75	YES	YES				
12	335	86B3A7945	INDRAGANTI V B RAMESH	4.64	NO	NO				
13	187	86B5A2367	VINAY KUMAR	6.16	YES	--				
14	310	86B5A3917	GHIYA KINNAR KIRITBHAI	7.62	YES	--				
15	321	86B5A3930	THAKUR LALTA PRASAD SINGH	6.48	NO	NO				
16	393	87A1B2040	R JAYAKUMAR	9.53	YES	YES				
17	385	87A3A7032	MS RADHAI THANDAPANI	9.98	YES	YES				
18	443	87A6A7099	ALOK KHANDELWAL	9.61	YES	--				
19	875	87A6PS902	MS SEEMA	4.30	NO	YES				
20	368	87A7B1015	V BHASKAR	9.69	YES	YES				
21	416	87A7B4069	PHILIP JOSEPH LYNN	8.69	YES	YES				
22	424	87A7PS078	BHUPENDER DABAS	4.21	NO	??				
23	874	87A8PS901	SURINDER GUPTA	6.42	YES	--				
24	781	87B1A1521	SIVA S MURTHY	6.84	YES	YES				
25	894	87B1A1921	A RAJESH	4.99	NO	YES				

A.9 PRACTICE SCHOOL II PROFILES (PS PROFILES)

AJAY MALHOTRA --88A1PS201, (CHEMICAL), (02.06.69/89.50),(7.27, 7.28), ENGLISH, HINDI. ADDR: YD MALHOTRA, A68 PRIYADARSHNI VIHAR,INDRAPRASTHA EXTENSION,DELHI-110092.
SCI(1A/4B/7C),TA(2A/1B/3C),ES(3B/3C/1D),AAOC(1A/1B/5C),CHE(1A/2B/4C),GRAPHIC ART(A), PS-I(A) at NISTADS, Delhi.
PROF INTEREST-PIPING & INSTRU, CHEMICAL PROCESS TECH, POLYMERS & PLASTICS. EXTRA CURR ACTIVITIES-HOCKEY, CRICKET, MUSIC,DANCE,DEBATING.

ALOK TEWARI --88A1PS216, (CHEMICAL), (08.06.70/81.00), (5.39, 5.63), ENGLISH, HINDI. ADDR: SATISH CHANDRA TIWARI, DEPARTMENT OF VETERINARY MICROBIOLOGY,H A U,HISAR-125004(HARYANA).
SCI(1B/4C/6D/1E), TA(1B/4C/1D),ES(3C/3D/1E),AAOC(3B/2C/2D),CHE(2B/4C/1D), PS-I(A) at RBI, Lucknow.
PROF INTEREST-BIO CHEMICAL, PETROCHEMICAL,POLYMERS. EXTRA CURR ACTIVITIES-PROCESSIONAL ASSISTANT(RBI), ATHELETICS, SINGING, SWIMMING.

AMITABH KUNDU --86B1A1569, (CHEMICAL & BIO SCIENCES), (14.01.69/85.75), (6.58, 7.31), ENGLISH, HINDI, BENGALI. ADDR: C/O SURG COMMANDER K K KUNDU, ROHINI-22, SENIOR NAVAL OFFICERS FLATS,COLABA, BOMBAY-400005.
SCI(3B/11C), TA(2B/4C),ES(1B/6C),AAOC(1A/4B/3C),BIO(3A/4B),CHE(2A/2B/3C), MICROPROCESSORS(C), COMPUTER PROJECTS(A), GENETIC ENGINEERING(B),BIOCHEMICAL ENGG(C),SELECTED CHEM ENGG OPER(C), PS-I(A) at The Gen Elec Co India Ltd, Calcutta.
PROF INTEREST-PROCESS DESIGN, PROCESS CONTROL, SOFTWARE PROGRAMMING. EXTRA CURR ACTIVITIES-GROUP WORK, ORGANISING, READING,GAMES,PROGRAMMING.

ANUPAM MISRA --88A1PS244, (CHEMICAL), (24.02.72/81.20), (5.48, 5.65), ENGLISH,HINDI,SANSKRIT. ADDR: T C MISRA,JOINT DIRECTOR, RICE MILLING,C S A UNIV OF AGRI & TECH,KANPUR-208002.
SCI(1B/5C/6D),TA(2A/1B/1C/2D),ES(1B/1C/5D),AAOC(3C/4D),CHE(2B/2C/3D),PUBLIC ADMINISTRATION(B), PS-I(A) at CDRI, Lucknow.
PROF INTEREST-CHEMICAL THERMODYNAMICS, MARKETING. EXTRA CURR ACTIVITIES-DEBATE,SINGING,ACTING,SEC(PRESS CLUB).

ARIMANDA V M REDDY --88A1PS160, (CHEMICAL), (21.05.71/87.90), (6.49, 6.92), ENGLISH, HINDI,TELUGU. ADDR: ARIMANDA YELLA REDDY,OPP TO LIBRARY STAMBHALAGARUVU,GUNTUR-522006.
SCI(1B/9C/2D), TA(3B/3C), ES(2B/5C), AAOC(1A/2B/4C), CHE(7B), PS-I(A) at The Sirpur Paper Mills, Kaghaznagar.
PROF INTEREST-RESEARCH, TEACHING. EXTRA CURR ACTIVITIES-PAPER PRESENTATION, CHEMICAL ASSOC WORK, TABLE TENNIS, CRICKET, BADMINTON.

A.10 COURSEWISE GRADE LIST AND ANALYSIS SHEET

A.10.1 Grade List for a Course

BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI — 25 NOV., 1991 — PAGE 1
FIRST SEMESTER 1991 - 92

COMP CODE:614 COURSE NO HIST C112 UNITS: 3 MAIN TRENDS IN IND HIST INSTRUCTOR INCHARGE: SN Prasad

SRNO	IDNO	NAME	STATUS	GRADE
1	88A2PS338	AMARDEEP DAHIYA		--
2	88A4PS157	B MADHUSUDAN REDDY		--
3	88A4PS168	INDEEVAR SHYAM L		RC
4	88A4PS184	SANJAY KUMAR SHARAWAT		W
5	88B1A1471	JAYANTH SRIDHAR		--
6	88B1A2503	LAV KANT		--
7	88C2PS930	S RAJESH KUMAR		--
8	88C2PS933	R P KIRAN KUMAR		--
9	88C3PS667	BIPIN KUMAR		--
10	88D2PS676	MUKUL AGOCHIYA		--
11	88D3PS673	ANAND SHARMA		--
12	89A5PS745	GANESH BALAKRISHNA		--
13	89A5PS957	PARVEEN KUMAR		W
14	89A5PS958	MERUGU KIRAN REDDY		--
15	89A5PS962	C RAJESH BABU		--
16	89A6PS468	PONNU KAILASAM P		--
17	89A6PS919	ASEEM RAJA		W
18	89B2A3944	H ARUN		--
19	89C2PS576	MANEPALLI SURYAMANIKYAM		--
20	89C2PS618	ANAND EKAMBARAM		--
21	89D2PS657	SHAILJA SINGHDEV		--
22	89D2PS665	ANIL SHARMA		--
23	90A2PS327	KUCHIMANCHI JAI KRISHNA		--

SIGNATURE OF THE INSTRUCTOR INCHARGE

A.10.2 Analysis Sheet for Grade List

BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI   25 NOV., 1991   PAGE 2
FIRST SEMESTER 1991 - 92

COMP CODE:614 COURSE NO: HIST C112   UNITS: 3 MAIN TRENDS IN IND HIST   INSTRUCTOR INCHARGE: SN Prasad
ANALYSIS OF GRADES   TOTAL NO OF STUDENTS 23

1. LETTER GRADES	NO OF A GRADES ___	
	B GRADES ___	
	C GRADES ___	
	D GRADES ___	
	E GRADES ___	MEAN GRADE POINT VALUE FOR THE COURSE __.____
2 SEMINAR AND INDEPENDENT STUDY	NO OF GOOD GRADES ___	
	POOR GRADES ___	
3. FIRST DEGREE THESIS-FINAL GRADES	NO OF EXCEL GRADES ___	
	GOOD GRADES ___	
	POOR GRADES ___	
4. INTERNSHIP	NO OF OUTSTANDING GRADES ___	
	VERY GOOD GRADES ___	
	GOOD GRADES ___	
	AVERAGE GRADES ___	
	POOR GRADES ___	
5. TEACHING PRACTICE	NO OF ABOVE AVG GRADES ___	
	AVERAGE GRADES ___	
	BELOW AVG GRADES ___	
6. AUDIT BASIS, PHD THESIS-INTERIM GRADES	NO OF S GRADES ___	
	U GRADES ___	
7. PHD THESIS - FINAL GRADES	NO OF EXCEL GRADES ___	
	GOOD GRADES ___	
	UNACC GRADES ___	
8. REPORTS OTHER THAN GRADES	NO OF W ___ RC ___ DP ___	
	I ___ GA ___	
	RRA ___ NC ___	

SIGNATURE OF THE INSTRUCTOR INCHARGE

84B5A3386 (REC 17)
NARESH CHOUDHRY
C/O SH MOHINDER SINGH
1/6318 GALI NO-4
EAST ROHTASH NAGAR
DELHI-110032

84B5A8933 (REC 28)
SANGEETH UMASHANKAR
C/O SH R. UMASANKAR
M43/18, T.N.H.B. FLATS
WEST AVENUE, THIRUVANMIYUR
MADRAS-600 041 (TAMIL NADU)

84PHXF401 (REC 30)
ARJUN BADLANI
C/O LATE SH N R BADLANI
I-115 ASHOK VIHAR
PHASE-1
DELHI-110052

85A1PS223 (REC 31)
L JEYAKUMAR
C/O SH S LAKSHMINARASIMHAN
NO 16, "SHENBAG"
STATE BANK OFFICER'S COLONY
MAHARAJANAGAR, TIRUNELVELI-627011

85A1PS904 (REC 79)
MS D USHA
C/O MRS D SHANTA RAO
6-2-977/1, II FLOOR
KHAIRATABAD
HYDERABAD-500004

85A1PS906 (REC 80)
ABDUL RAUF ANSARI
S/O SMT KANEEZ FATIMA
MOHALLA-KAITHY TOLA
BISWAN DISTT SITAPUR
UP-261201

85A2PS252 (REC 32)
ERLA NARENDRA REDDI
C/O SH ERLA SUBBARAMI REDDI
190-E
KOTAKOMMALA STREET
TIRUPATI-517501(AP)

85A2PS253 (REC 33)
P NAGESH
C/O SH P M SHASTRY ADVOCATE
16-11-405/4, MOOSARAM BAGH
HYDERABAD-36

85A2PS287 (REC 34)
K VIKRAM
C/O SH A D KUMARASWAMY
E-7 AMBEDKAR ROAD
BLOCK-13
NEYVELI-607803(TN)

85A2PS313 (REC 35)
MANOJ ARAVIND
C/O SH P ARAVIND
NO.16, 2ND MAIN ROAD
JAGANNATHAPURAM, VELACHERY
MADRAS-600042

85A2PS910 (REC 81)
PITTA HANUMANTHARAO
C/O SH PITTA NARASIMHAM
GUMMALAMPADU (PO),)VIA) S N PADU(SO)
PRAKASAM(DI)
ANDHRA PRADESH-523225

85A3PS130 (REC 36)
K SIOVA SANKAR KUMAR
C/O SH K SIVA SANKAR
DOOR NO. 217/218, STREET-22
NANDYAL-518501
KURNOOL(DT)(AP)

85A3PS901 (REC 82)
MS NIVEDITA PADHY
C/O DR K CK PADHY
ASST PROFESSOR OPTHALMOLOGY
S C B MEDICAL COLLEGE
CUTTACK-753007(ORISSA)

85A3PS902 (REC 83)
SOMALA SUBBA REDDY
C/O SH SOMALA NARAYANA REDDY
G VEERAPURAMU(VII),GUVVALAKUNTLA(POST)
ATMAKUR(TQ), KURNOOL(DT) ANDI
ANDHRA PRADESH-518422

85A4PS045 (REC 37)
VARANSI SHIVA SHANKAR
C/O SH V SHIVARAM
Q/O III-2,DBK-RAILWAY AUARTERS
SECTOR-I
VISAKHAPATNAM-530004

85A4PS169 (REC 38)
VADLAMANI VENUMADHAV
C/O SMT VISALAKSHI
2-112
GANGARAM
HYDERABAD-500133(AP)

85A4PS204 (REC 39)
U V V SESHA SYAMA SUNDAR
C/O SH U R K P SUBBARAO
KAPILESWARA PURAM
KAPILESWARAPURA, MANDAL
EAST GODWARI-533309(AP)

85A4PS524 (REC 40)
S K MADHAVAN
C/O SH S RAJAGOPAL
192, BAZAAR STREET
NAMAKKAL(SALEMAT)
TAMILNADU-637001

85A5PS419 (REC 41)
GHANTA VENKATA VENU GOPAL
C/O SH N SUBBA RAO
RETIRED HINDI PUNDIT
ITHANAGHAR TENALI
GUNTUR(DT)-522201(AP)

85A5PS459 (REC 42)
K KRISHNA REDDY
C/O SH K NARSA REDDY
H NO 6-5-128 SUBHASH NAGAR
NIZAMABAD-503002(AP)

85A5PS553 (REC 43)
S R SREENIVASA REDDY
C/O SH S GBUL REDDY
KAPU STREET, PGRUMAMILLA
CUDDAPAH(DT)-5161193(AP)

85A5PS918 (REC 84)
MS SUDHA PAMIDI
C/O SH P NAGAMALLESWARA RAO
4-5-31/3, VIDYA NAGAR
RING ROAD
GUNTUR-522007(AP)

85A5PS921 (REC 85)
PRAVIN KUMAR TRIPATHI
C/O SH SHYAM SUDHAKAR
JUNIOR ENGINEER (CIVIL)
O/O S S PO'S OFFICE NATI IMALI
VARANASI

85A5PS938 (REC 86)
V KARTHIKEYAN
C/O SH G VENKATACHALAM
6/32, SRIVILLIPUTHUR ROAD
NEAR POLICE COLONY
SIVAKASI-626124

A.12 EXAMINATION COMMITTEE ANALYSIS (EC ANALYSIS)

A.12.1 EC Analysis before Semester's Performances

* EC ANALYSIS * BITS, PILANI FIRST SEMESTER 1991 - 92 25 NOV., 1991 PAGE

SL NO	COURSE	TITLE	NO OF STUDENTS TOTAL	CGPA=0	REST	AUDIT	INPUT-CGPA ANALYSIS LESS 4.50	4.50 5.49	5.50 6.99	7.00 8.99	9.00 ABOVE	MIN	MAX	MEAN
1	AAOC C211	SOCIAL ENGINEERING I	344	1	343	0	44	63	126	86	24	2.81	10.00	6.30
2	AAOC C221	GRAPHS AND NETWORKS	12	0	12	0	0	0	0	10.	2	7.14	9.52	8.20
3	AAOC C222	OPTIMISATION	294	0	294	0	15	31	93	117	38	3.20	10.00	7.12
4	AAOC C311	DATA PROCESSING	166	0	166	0	10	24	66	64	2	4.02	9.91	6.60
5	AAOC C312	OPERATIONS RESEARCH	157	0	157	0	4	23	67	56	7	3.82	10.00	6.77
6	AAOC C321	CONTROL SYSTEMS	206	0	206	0	3	17	68	89	29	3.93	9.95	7.34
7	AAOC C322	SYSTEMS	183	0	183	0	7	27	67	71	11	3.85	9.63	6.89
8	AAOC C341	NUMERICAL ANALYSIS	429	0	429	0	12	48	147	179	43	3.93	9.91	7.11
9	AAOC C351	INSTRU METHODS OF ANAL	77	0	77	0	3	17	30	23	4	4.21	9.71	6.55
10	BIO C211	BIOLOGICAL CHEMISTRY	91	0	91	0	18	23	29	17	4	3.20	9.42	5.87
11	BIO C311	MICROBIOLOGY	24	0	24	0	1	7	9	6	1	4.40	9.71	6.45
12	BIO C321	CELL BIOLOGY	25	0	25	0	1	7	10	6	1	4.40	9.71	6.45
13	BIO C331	BIOPHYSICS	24	0	24	0	1	7	9	6	1	4.40	9.71	6.45
14	BIO C421	ENZYMOLOGY	11	0	11	0	0	1	9	1	0	5.34	7.41	6.39
15	BIO C461	RECOMBINANT DNA TECH	12	0	12	0	0	2	9	1	0	5.34	8.12	6.40
16	BIO C491	SPECIAL PROJECTS	1	0	1	0	0	0	1	0	0	6.75	6.75	6.75
17	BITS C313	LAB ORIENTED PROJECT	10	0	10	0	0	2	4	4	0	5.34	8.33	6.94
18	BITS C323	STUDY ORIENTED PROJECT	99	0	99	0	3	19	43	25	9	4.07	9.80	6.60
19	BITS C331	COMPUTER PROJECTS	64	0	64	0	1	7	25	26	5	4.43	9.84	7.07
20	BITS C333	PROJ ON ORGANIZ ASPECTS	29	0	29	0	0	8	5	12	4	4.68	9.81	7.02
21	BITS C341	SELECTED COMP LANGUAGES	51	0	51	0	0	3	18	26	4	5.12	9.71	7.30

A.12.2 Grand EC Analysis (After Semester's Performance)

GRAND ANALYSIS OF GRADES BITS, PILANI FIRST SEMESTER 1990 - 91 15 JAN., 1991 PAGE 1

SL NO	COURSE	TITLE	NO OF STUDENTS TOTAL	CGPA=0	REST	AUDIT	LATEST-CGPA ANALYSIS LESS 4.50	4.50 5.49	5.50 6.99	7.00 8.99	9.00 ABOVE	MIN	MAX	MEAN
1	AAOC C211	SOCIAL ENGINEERING I	301	0	301	0	26	50	106	109	10	3.31	9.87	6.55

A 25 | B 66 | C 99 | D 76 | E 31 | NC 0 | RRA 0 | I 0 | GA 0 | W 3 | DP 1 |

%A 8.31 | %B 21.93 | %C 32.89 | %D 25.25 | %E 10.30 | %NC 0.00 | %RRA 0.00 | %I 0.00 | %GA 0.00 | %W 1.00 | %DP 0.33 |

RC 0 |

%RC 0.00 |

Mean Grade Point Average: 5.85

SL NO	COURSE	TITLE	TOTAL	CGPA=0	REST	AUDIT	LESS 4.50	4.50 5.49	5.50 6.99	7.00 8.99	9.00 ABOVE	MIN	MAX	MEAN
2	AAOC C222	OPTIMISATION	321	2	319	0	9	36	102	128	44	3.76	10.00	7.19

A 84 | B 97 | C 98 | D 22 | E 3 | NC 1 | RRA 0 | I 1 | GA 0 | W 14 | DP 0 |

%A 26.17 | %B 30.22 | %C 30.53 | %D 6.85 | %E 0.93 | %NC 0.31 | %RRA 0.00 | %I 0.31 | %GA 0.00 | %W 4.36 | %DP 0.00 |

RC 1 |

%RC 0.31 |

Mean Grade Point Average: 7.56

SL NO	COURSE	TITLE	TOTAL	CGPA=0	REST	AUDIT	LESS 4.50	4.50 5.49	5.50 6.99	7.00 8.99	9.00 ABOVE	MIN	MAX	MEAN
3	AAOC C311	DATA PROCESSING	208	9	199	0	5	22	92	69	11	4.00	9.96	6.76

A 52 | B 51 | C 63 | D 19 | E 7 | NC 0 | RRA 0 | I 0 | GA 0 | W 13 | DP 1 |

%A 25.00 | %B 24.52 | %C 30.29 | %D 9.13 | %E 3.37 | %NC 0.00 | %RRA 0.00 | %I 0.00 | %GA 0.00 | %W 6.25 | %DP 0.48 |

RC 2 |

%RC 0.96 |

Mean Grade Point Average: 7.27

SL NO	COURSE	TITLE	TOTAL	CGPA=0	REST	AUDIT	LESS 4.50	4.50 5.49	5.50 6.99	7.00 8.99	9.00 ABOVE	MIN	MAX	MEAN
4	AAOC C312	OPERATIONS RESEARCH	165	3	162	0	9	18	56	64	15	3.81	9.95	6.95

A 35 | B 30 | C 40 | D 31 | E 7 | NC 0 | RRA 0 | I 0 | GA 0 | W 21 | DP 0 |

%A 21.21 | %B 18.18 | %C 24.24 | %D 18.79 | %E 4.24 | %NC 0.00 | %RRA 0.00 | %I 0.00 | %GA 0.00 | %W 12.73 | %DP 0.00 |

RC 1 |

%RC 0.61 |

Mean Grade Point Average: 6.77

BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE
PILANI, RAJASTHAN

TAP SECOND SEMESTER 1990-91

ID NO 88A6PS429

NAME R SAMPATHKUMAR
ADDR R RAJAGOPALAN
13 CHAKRAPANI STREET
WEST MAMBALAM
MADRAS-600033

COURSE NO		COURSE TITLE	UNITS	GRADE	
MGTS	C352	PERSONNEL MANAGEMENT	3	B	
MGTS	C322	MARKETING	3	A	
MGTS	C332	GOVERNMENT & BUSINESS	3	C	
MGTS	C342	PRODUCTION MANAGEMENT	3	A	
AAOC	C312	OPERATIONS RESEARCH	3	A	
PHIL	C221	SYMBOLIC LOGIC	3	B	EL

CGPA CUP 1010 ACCU CUP 1010

ACCUMULATED UNITS 124
UNITS USED IN CALCULATING CGPA 124
REGISTRAR CGPA 8.15

BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE
PILANI, RAJASTHAN

TAP SECOND SEMESTER 1990-91

ID NO 88A6PS429

NAME R SAMPATHKUMAR
ADDR R RAJAGOPALAN
13 CHAKRAPANI STREET
WEST MAMBALAM
MADRAS-600033

COURSE NO		COURSE TITLE	UNITS	GRADE	
MGTS	C352	PERSONNEL MANAGEMENT	3	B	
MGTS	C322	MARKETING	3	A	
MGTS	C332	GOVERNMENT & BUSINESS	3	C	
MGTS	C342	PRODUCTION MANAGEMENT	3	A	
AAOC	C312	OPERATIONS RESEARCH	3	A	
PHIL	C221	SYMBOLIC LOGIC	3	B	EL

ACCUMULATED UNITS 124
UNITS USED IN CALCULATING CGPA 124
REGISTRAR CGPA 8.15

BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE
PILANI, RAJASTHAN

TAP SECOND SEMESTER 1990-91

ID NO 88A6PS429

NAME R SAMPATHKUMAR
ADDR R RAJAGOPALAN
13 CHAKRAPANI STREET
WEST MAMBALAM
MADRAS-600033

COURSE NO		COURSE TITLE	UNITS	GRADE	
MGTS	C352	PERSONNEL MANAGEMENT	3	B	
MGTS	C322	MARKETING	3	A	
MGTS	C332	GOVERNMENT & BUSINESS	3	C	
MGTS	C342	PRODUCTION MANAGEMENT	3	A	
AAOC	C312	OPERATIONS RESEARCH	3	A	
PHIL	C221	SYMBOLIC LOGIC	3	B	EL

CGPA CUP 1010 ACCU CUP 1010

ACCUMULATED UNITS 124
UNITS USED IN CALCULATING CGPA 124
REGISTRAR CGPA 8.15

BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE
PILANI, RAJASTHAN

TAP SECOND SEMESTER 1990-91

ID NO 88A6PS429

NAME R SAMPATHKUMAR
ADDR R RAJAGOPALAN
13 CHAKRAPANI STREET
WEST MAMBALAM
MADRAS-600033

COURSE NO		COURSE TITLE	UNITS	GRADE	
MGTS	C352	PERSONNEL MANAGEMENT	3	B	
MGTS	C322	MARKETING	3	A	
MGTS	C332	GOVERNMENT & BUSINESS	3	C	
MGTS	C342	PRODUCTION MANAGEMENT	3	A	
AAOC	C312	OPERATIONS RESEARCH	3	A	
PHIL	C221	SYMBOLIC LOGIC	3	B	EL

ACCUMULATED UNITS 124
UNITS USED IN CALCULATING CGPA 124
REGISTRAR CGPA 8.15

A.14 LIST OF STUDENTS WHO HAVE CLEARED ACADEMIC REQUIREMENTS FOR GRADUATION

BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI 14 DEC., 1991 PAGE 1

SECOND SEMESTER 1990 - 91

** 9.01 CLEARED **

SL NO	REC NO	IDNO	NAME	
1	8	82PHXF001	K R VENKATASUBRAMANIAN	90,2
2	26	84A2PS915	BRAJESH RATHI	90,2
3	28	84B5A8933	SANGEETH UMASHANKAR	90,2
4	45	85A6PS358	GURURAJ K	90,2
5	105	85B1A1957	MARLA BHASKAR	90,2
6	102	85B1A2952	RAJENDRAN S	90,2
7	107	85B1A2960	SODEM SRIDHAR	90,2
8	101	85B1A3951	B UDAYA RAVI SHANKAR	90,2
9	104	85B1A3954	JAGVIR SINGH DESHWAL	90,2
10	108	85B1A3963	RAJIV GUPTA	90,2
11	100	85B1A5949	NAKIRIKANTI SRINIVASA RAO	90,2
12	99	85B1A7945	TARUN KUMAR	90,2
13	106	85B1PS958	JALADI S CHAKRAVARTHY	90,2
14	61	85B2A1471	SURESH S	90,2
15	113	85B2A1929	PRASAD S	90,2
16	111	85B2A2925	RAM KARAN SINGH	90,2
17	114	85B2A2930	R V RAMANA	90,2
18	115	85B2A2934	SANJAYA SINGH GAUR	90,2
19	110	85B2A3923	N K SRINIVASAN	90,2
20	109	85B2PS919	D VENKATESWARA PRASAD	90,2
21	62	85B3A1477	MS CLARA GLADYS	90,2
22	116	85B3A3937	ALOK GUPTA	90,2
23	117	85B3A4939	ANIL MURJANI	90,2
24	118	85B4A3912	MAYANK MITTAL	90,2
25	[illegible]	85B4A3915	RAJEEV JAIN	90,2

A.15 STATUS REPORTS

A.15.1 List of Students Under ACB with Affliction Clauses

List of ACB Students BITS, PILANI SECOND SEMESTER 1990 - 91 15 JUN., 1991 PAGE 1

S NO	REC NO	ID NO	NAME	TWO OR MORE E"S	CGPA LESS THAN 4.5	NOT CLEARED 2/3RD COURSES	
1	747	87A5PS477	RANJAN MAGAZINE	--	YES	--	OFF CAMPUS REGISTERED
2	765	87A5PS498	VIJAI SINGH SOMBANSI	YES	YES	--	OFF CAMPUS REGISTERED
3	898	87A5PS925	PARAMESHWARAN RAMMOHAN	YES	--	--	OFF CAMPUS REGISTERED
4	900	87A5PS927	K NARAYANAN	YES	--	--	OFF CAMPUS REGISTERED
5	688	87A6PS400	ROMIN FAROOQ BUTT	YES	YES	--	OFF CAMPUS REGISTERED
6	875	87A6PS902	MS SEEMA	YES	YES	YES	
7	424	87A7PS078	BHUPENDER DABAS	--	YES	--	
8	776	87B1A5514	SURESH SUBRAMANIAN	YES	--	--	
9	772	87B3A2508	M SWAMINATHAN	YES	--	--	
10	664	87B4A2369	NARASIMHAN R	YES	--	--	
11	672	87B4A3381	R SURESH KRISHNAN	YES	--	--	OFF CAMPUS REGISTERED
12	749	87B4A6479	AJOY KUMAR MISHRA	YES	YES	--	
13	849	87C4PS621	MOPAL PRAVEEN REDDY	--	YES	YES	
14	1124	88A1PS230	SWAMINATHAN N	--	YES	--	
15	1359	88A1PS541	V ANIL KUMAR	--	YES	--	
16	1172	88A2PS291	KRISHNA MOHAN T	YES	YES	--	
17	1199	88A2PS324	KARRI SREEDHAR	--	YES	--	
18	1226	88A2PS359	ARVIND KUMAR KUSHWAHA	YES	--	--	OFF CAMPUS REGISTERED
19	1237	88A2PS372	MS PARVEEN VIMAL	YES	YES	--	
20	1476	88A2PS917	HARISH CHANDER SHARMA	--	--	YES	

TOTAL NO OF STUDENTS WITH TWO OR MORE E"S IS 109

TOTAL NO OF STUDENTS WITH CGPA LESS THAN 4 5 IS 124

TOTAL NO OF STUDENTS WHO HAVE NOT CLEARED 2/3RD COURSES IS 25

TOTAL NO OF STUDENTS UNDER THE PURVIEW OF ACB AT THE END OF SECOND SEMESTER 1990 - 91 IS 184

A.15.2 List of Backlog (BL) Students

List of Backlog Students BITS, PILANI

S NO	REC NO	ID NO	NAME
1	103	85B1A1953	SIVA SUBRAMANIA PILLAI M
2	335	86B3A7945	INDRAGANTI V B RAMESH
3	171	86B3PS339	RAVULA VENKATAKRISHNA
4	475	87A3PS135	A R ANAND
5	879	87A4TS906	RANJIT SINGH
6	875	87A6PS902	MS SEEMA
7	424	87A7PS078	BHUPENDER DABAS

CGPA	ACB		BACKLOG	COURSE(S)		
3.99	YES	1	554	BITS	C412	
		2	638	BITS	C422T	
		3	639	BITS	C442T	
4.64	YES	1	660	CS	C311	
		2	661	CS	C321	
		3	662	CS	C331	
		4	863	CS	C352	
		5	565	CS	C362	
		6	59	CS	C332	
		7	64	CS	C342	
5.46	--	1	486	PHIL	C211	EL
8.84	--	1		ELECTIVE		
		2		ELECTIVE		
		3		ELECTIVE		
		4		ELECTIVE		
		5		ELECTIVE		
5.46	--	1	685	ME	C311	
		2	142	ME	C312	
		3	687	ME	C331	
		4	582	AAOC	C341	
		5	592	ME	C392	
		6	146	ME	C332	
		7	147	ME	C342	
		8	411	ME	C382	
4.30	YES	1	114	MGTS	C341	
		2	115	MGTS	C351	
		3	557	MGTS	C381	
		4		ELECTIVE		
		5		ELECTIVE		
		6	117	MGTS	C352	
		7		ELECTIVE		
		8		ELECTIVE		
4.21	YES	1	59	CS	C332	
		2	64	CS	C342	
		3	554	BITS	C412	

A.15.3 List of Students with Pending "I" Report

BITS, PILANI   SECOND SEMESTER 1990 - 91

LIST OF STUDENTS WITH "I" PENDING

S NO	REC NO	ID NO	NAME
1	1885	89B1A2498	R RAJAGOPAL
2	1810	89B1A7359	NIRMAL KUMAR BHAGABATI
3	2768	90A4PS595	MANISH TAYAL
4	2394	90A7PS108	HIMANHU
5	2484	90A8PS207	SANJEEV KUMAR
6	2919	90D2PS918	ANURAG PANT

18 JUL., 1991 PAGE 1

	CODE	COURSE(S)
1	599	AAOC C222
2	560	ES C212
3	563	ES C242
4	589	MATH C211
5	569	PHY C212
6	531	TA C122
7	902	TA C222
1	599	AAOC C222
2	560	ES C222
3	563	ES C242
4	566	MATH C212
5	569	PHY C212
6	531	TA C122
7	902	TA C222
1	515	AAOC C111
1	515	AAOC C111
2	469	BIO C111
3	525	MATH C112
1	515	AAOC C111
1	490	POL C 212

A.15.4 Grade Awaited (GA) Students' List

BITS, PILANI SECOND SEMESTER 1990 - 91

LIST OF STUDENTS WITH "GA" REPORT

S NO	REC NO	ID NO	NAME
1	26	84A2PS915	BRAJESH RATHI
2	107	85B1A2960	SODEM SRIDHAR
3	139	86A3A7073	BINDU MADHAVAN
4	364	87A3PS010	MS SHIKHA AGARWAL
5	457	87A3PS114	ARVIND LAMBA
6	1142	88B5A5254	T C MANOJ KUMAR
7	1863	89A2PS464	SATVIR SINGH
8	2151	89A6PS941	PEEYUSH DAYAL
9	2486	90A1PS210	DEVESH KUMAR VARSHNEY
10	2217	90H291068	AMITAVA DAS
11	2229	90H292083	ARULALAN R B

	CODE	COURSE(S)
1	554	BITS C412
1	638	BITS C422T
1	639	BITS C442T
1	554	BITS C412
1	554	BITS C412
1	554	BITS C412
1	575	AAOC C212
1	560	ES C212
1	560	ES C212
1	515	AAOC C111
1	533	BITS C512
2	534	BITS C522
3	535	BITS C532
4	536	BITS C542
1	537	BITS C552
1	538	BITS C562

A.16 RESULTS

A.16.1 Results for Examination Committee and Senate

BITS, PILANI 6- 6-1991 Page 1

LIST OF CANDIDATES WHO HAVE FULFILLED THE REQUIREMENTS OF GRADUATION FOR AN INTEGRATED FIRST DEGREE (SINGLE OR DUAL) OR A HIGHER DEGREE PROGRAMME AND WHO HAVE BECOME ELIGIBLE FOR THE DEGREE AT THE END OF SECOND SEMESTER 1990 - 91.

SL NO	ID NO	NAME	Thesis Grade	CGPA	Division
A. Integrated First Degree Programmes					
(i) Students who qualify for Single Degree only and First Degree under Dual Degree Scheme					
B.E.(Hons)(Chemical) (With Practice School)					
1.	87A1PS154	V.C.JAIPRAKASH	-	8.25	FIRST
2.	87A1PS171	SANJAY BHAN	-	6.26	SECOND
B.E.(Hons.)(Civil) (With Practice School)					
20.	87A2PS165	SUDERSHAN KUMAR	-	6.10	SECOND
M.Sc.(Tech.)(Computer Science)					
95.	86A7TS045	SHANKER SINGH RATHORE	GOOD	4.87	SECOND
M.Sc.(Tech.)(Computer Science) (With Practice School)					
96.	87A7PS002	VINOD KUMAR JAIN	-	7.09	FIRST
M.Sc.(Hons.)(Chemistry)					
132.	85B2A2925	RAM KARAN SINGH	EXCELLENT	6.29	SECOND
(ii) Students who qualify for the Second Degree under Dual Degree Scheme					
B.E.(Hons.)(Chemical) (With Practice School)					
185	85B3A1477	CLARA GLADYS	-	6.25	SECOND
B. Higher Degree Programmes					
M.E.(Chemical)					
247	90H101001	ALOK SINGHAL		5.75	

BITS, PILANI 6- 6-1991 Page 1

ANALYSIS OF THE EXAMINATION RESULTS OF CANDIDATES WHO HAVE FULFILLED THE REQUIREMENTS OF GRADUATION FOR AN INTEGRATED FIRST DEGREE (SINGLE OR DUAL) OR A HIGHER DEGREE PROGRAMME AND WHO HAVE BECOME ELIGIBLE FOR THE DEGREE AT THE END OF SECOND SEMESTER 1990 - 91.

Programme	No of Degrees	Distinction	First	Second
B.E.(Hons.)(Chemical) (With Practice School)	29	0	11	18
B.E.(Hons.)(Civil) (With Practice School)	23	0	9	14
B.E.(Hons.)(Electrical and Electronics) (With Practice School)	46	7	30	9
B.E.(Hons.)(Mechanical) (With Practice School)	29	3	16	10
B.Pharm.(Hons.) (With Practice School)	1	0	1	0
Master of Management Studies (With Practice School)	20	0	5	15
M.Sc.(Tech.)(Computer Science)	1	0	0	1
M.Sc.(Tech.)(Computer Science) (With Practice School)	17	5	11	1
M.Sc.(Tech.)(Instrumentation) (With Practice School)	12	0	6	6
TOTAL	246	17	117	112

Programme	No of Degrees
M.E.(Chemical)	1
M.E.(Civil)	6
M.E.(Computer)	12
M.E.(Electronics & Control)	10
M.E.(Mechanical)	12
M.E (Systems & Information)	14
M.Pharm.	12
M.E.(Microelectronics)	8
TOTAL	321

A.16.2 Result for the Board of Governors

Appendix " ":Senate agenda item No. ________
Appendix " ":BOG agenda item No. ________
(______ Pages)

CONSOLIDATED LIST OF STUDENTS FOR CONSIDERATION AND RECOMMENDATION BY THE SENATE TO THE BOARD OF GOVERNORS FOR CONFERMENT OF VARIOUS DEGREES, SINCE THE LAST BOARD MEETING

SL NO	ID NO	NAME	Thesis Grade	CGPA	Division
A. Integrated First Degree Programmes					
(i) Students who qualify for Single Degree only and First Degree under Dual Degree Scheme					
B.E.(Hons.)(Chemical) (With Practice School)					
1.	87A1PS151	NANDINI DUTT	-	8.82	FIRST
2.	87A1PS154	V.C.JAIPRAKASH	-	8.25	FIRST
3	87A1PS171	SANJAY BHAN	-	6.26	SECOND
B.E.(Hons.)(Civil) (With Practice School)					
38.	84A2PS915	BRAJESH RATHI	-	5.64	SECOND
41.	87A2PS189	S RAMESH	-	8.51	FIRST
M.Sc.(Tech.)(Computer Science)					
241	86A7A3011	RAMENDRA SINGH BAONI	EXCELLENT	9.19	DISTINCTION
M.Sc.(Tech.)(Computer Science) (With Practice School)					
244.	87A7PS001	DHRUBAJYOTI BORTHAKUR	-	9.88	DISTINCTION
(ii) Students who qualify for the Second Degree under Dual Degree Scheme					
B.E.(Hons.)(Chemical) (With Practice School)					
471.	85B1A1957	M BHASKAR	-	5.41	SECOND
B. Higher Degree Programmes					
M.E.(Chemical)					
510.	89H101090	NAIR CHANDRASEKHAR BHASKARAN		8.50	

BITS, PILANI

Appendix " ":Senate agenda item No. ________
Appendix " ":BOG agenda item No. ________
(______ Pages)

CONSOLIDATED LIST OF STUDENTS FOR CONSIDERATION AND RECOMMENDATION BY THE SENATE TO THE BOARD OF GOVERNORS FOR CONFERMENT OF VARIOUS DEGREES, SINCE THE LAST BOARD MEETING (IN ABSTRACT)

Programme	No of Degrees	Distinction	First	Second
B.E.(Hons.)(Chemical) (With Practice School)	57	3	25	29
B.E.(Hons.)(Civil) (With Practice School)	53	0	15	38
B.E.(Hons.)(Electrical and Electronics)	2	2	0	0
B.E.(Hons.)(Electrical and Electronics) (With Practice School)	113	22	66	25
B.E.(Hons.)(Mechanical) (With Practice School)	59	6	26	27
B.Pharm.(Hons.) (With Practice School)	16	0	9	7
Master of Management Studies (With Practice School)	54	0	25	29
M.Sc.(Tech.)(Computer Science)	3	2	0	1
M.Sc.(Tech.)(Computer Science) (With Practice School)	51	17	27	7
M.Sc.(Tech.)(Instrumentation) (With Practice School)	28	0	15	13
M.Sc.(Hons.)(Biological Sciences)	28	3	12	13
M.Sc.(Hons.)(Biological Sciences) (With Practice School)	6	0	2	4
TOTAL	609	59	280	270
M.E.(Chemical)	2			
M.E.(Civil)	6			
M.E.(Computer)	12			
M.E.(Electronics & Control)	11			
M.E.(Mechanical)	12			
M.E.(Collaborative)(Industrial Production)	1			
TOTAL	704			

BITS, PILANI

Appendix " ":Senate agenda item No ________
Appendix " ":BOG agenda item No ________
(_______ Pages)

CONSOLIDATED LIST OF STUDENTS FOR CONSIDERATION AND RECOMMENDATION BY THE SENATE TO THE BOARD OF GOVERNORS FOR CONFERMENT OF VARIOUS DEGREES, SINCE THE LAST BOARD MEETING
(IN ABSTRACT)

Programme	No of Degrees	Distinction	First	Second
B.E.(Hons.)(Chemical) (With Practice School)	57	3	25	29
B.E.(Hons.)(Civil) (With Practice School)	53	0	15	38
B.E (Hons.)(Electrical and Electronics)	2	2	0	0
B.E.(Hons.)(Electrical and Electronics) (With Practice School)	113	22	66	25
B.E.(Hons.)(Mechanical) (With Practice School)	59	6	26	27
B.Pharm.(Hons.) (With Practice School)	16	0	9	7
Master of Management Studies (With Practice School)	54	0	25	29
M.Sc.(Tech.)(Computer Science)	3	2	0	1
M.Sc.(Tech.)(Computer Science) (With Practice School)	51	17	27	7
M.Sc.(Tech.)(Instrumentation) (With Practice School)	28	0	15	13
M.Sc (Hons.)(Biological Sciences)	28	3	12	13
M.Sc.(Hons.)(Biological Sciences) (With Practice School)	6	0	2	4
. . . .				
TOTAL	609	59	280	270
M.E.(Chemical)	2			
M.E.(Civil)	6			
M.E.(Computer)	12			
M.E.(Electronics & Control)	11			
M.E.(Mechanical)	12			
. . . .				
M.E.(Collaborative)(Industrial Production)	1			
TOTAL	704			

A.17 TENTATIVE COURSE PACKAGE AND TIME-TABLE MAP

A.17.1 Course Package for ACB Students

ACB COURSE PACKAGE BITS, PILANI FIRST SEMESTER 1991 - 92 22 JULY, 1991 PAGE 1

1 1476 88A2PS917 HARISH CHANDER SHARMA CGPA = 5.51 PSC = 6
OBL 531 581 595 599 967 597 967
OPSC : 582 642 967
There is no operative "E" course
Basis of Allotment: OBL + OPSC <= PSC

1	OBL	531	TA	C122
2	OBL	595	TA	C311
3	OBL	599	AAOC	C222
4	OBL	597	AAOC	C312
5	OPSC	582	AAOC	C341
6	OPSC	642	AAOC	C321

---

2 1724 89B5A3223 KOLPEKWAR ABHIJEET SHANKARRAO CGPA = 8.28 PSC = 7
OBL : 476 573 509 551 531 566
OPSC : 595 597 582 561
There is no operative "E" course
Basis of Allotment: OBL + OPSC <= PSC

1	OBL	476	ES	C112
2	OBL	573	TA	C211
3	OBL	509	ES	C231
4	OBL	551	BIO	C211
5	OBL	531	TA	C122
6	OBL	566	MATH	C212
7	OPSC	582	AAOC	C341

---

3 1820 89A6PS373 ARJUN BALACHANDRAN CGPA = 4.05 PSC = 6
OBL 566 599
OPSC 516 967
Operative "E" courses : 589 528 476
Basis of Allotment: OBL + OPSC <= PSC

1	OBL	566	MATH	C212
2	OBL	599	AAOC	C222
3	OPSC	516	AAOC	C311
4	OPSC	967	ELECTIVE	
5	HL	967	ELECTIVE	
6	HL	967	ELECTIVE	

A.17.2 Course Package for BL Students

BITS, PILANI
FIRST SEMESTER 1991 - 92
PRESCRIBED PACKAGE OF COURSES FOR BL STUDENTS

1590 89A3PS021 MEHRA UNEEK UMESHCHANDRA

1	OBL	581	AAOC	C211
2	OBL	561	ES	C221
3	OBL	531	TA	C122
4	OBL	566	MATH	C212
5	OPSC	595	TA	C311
6	OPSC	642	AAOC	C321
7	OPSC	582	AAOC	C341
8	OPSC	599	AAOC	C222

- -

BITS, PILANI
FIRST SEMESTER 1991 - 92
PRESCRIBED PACKAGE OF COURSES FOR BL STUDENTS

1863 89A2PS464 SATVIR SINGH

1	OBL	581	AAOC	C211
2	OBL	561	ES	C221
3	OBL	531	TA	C122
4	OBL	566	MATH	C212
5	OPSC	598	AAOC	C322
6	OPSC	582	AAOC	C341
7	OPSC	599	AAOC	C222

- -

BITS, PILANI
FIRST SEMESTER 1991 - 92
PRESCRIBED PACKAGE OF COURSES FOR BL STUDENTS

2522 90A1PS251 SATISH PAUL

1	OBL	526	MATH	C141
2	OPSC	476	ES	C112
3	OPSC	528	PHY	C211
4	OPSC	573	TA	C211
5	OPSC	509	ES	C231
6	OPSC	531	TA	C122
7	OPSC	561	ES	C221

- -

A.17.3 Time-Table Map for OBL+OPSC

BITS,PILANI FIRST SEMESTER 1991 - 92

TIME TABLE MAP FOR:: 1476 88A2PS917 HARISH CHANDER SHARMA

22 JULY, 1991

DAY	HOUR 1	HOUR 2	HOUR 3	HOUR 4	HOUR 5	HOUR 6	HOUR 7	HOUR 8	HOUR 9	HOUR10	HOUR11
MONDAY		TA C311 L 2	AAOC C211 L 1	TA C122 L 1	TA C122 L 2 TA C311 L 1 AAOC C321 L 1 AAOC C341 L 1	AAOC C211 L 2	TA C122 L 3 AAOC C312 L 1 AAOC C321 L 2 AAOC C341 L 2	TA C311 L 3 AAOC C211 L 3 AAOC C321 L 3 AAOC C341 L 3	TA C311 L 4 AAOC C341 L 4		
TUESDAY			TA C311 L 5 AAOC C211 L 4 AAOC C321 L 4 AAOC C341 L 5	TA C122 L 4 AAOC C211 L 5 AAOC C341 L 6	TA C122 L 5 TA C311 L 6 AAOC C312 L 2 AAOC C341 L 7				TA C311 L 7		
WEDNESDAY	AAOC C321 TUT	TA C311 L 2	AAOC C211 L 1	TA C122 L 1	TA C122 L 2 TA C311 L 1 AAOC C321 L 1 AAOC C341 L 1	AAOC C211 L 2	TA C122 L 3 AAOC C312 L 1 AAOC C321 L 2 AAOC C341 L 2	TA C311 L 3 AAOC C211 L 3 AAOC C321 L 3 AAOC C341 L 3	TA C311 L 4 AAOC C341 L 4		
THURSDAY		AAOC C341 TUT	TA C311 L 5 AAOC C211 L 4 AAOC C321 L 4 AAOC C341 L 5	TA C122 L 4 AAOC C211 L 5 AAOC C341 L 6	TA C122 L 5 AAOC C312 L 2 AAOC C341 L 7				TA C311 L 7		
FRIDAY		TA C311 TUT	AAOC C211 L 1	TA C122 L 1	TA C122 L 2 AAOC C321 L 1 AAOC C341 L 1	AAOC C211 L 2	TA C122 L 3 AAOC C312 L 1 AAOC C321 L 2 AAOC C341 L 2	AAOC C211 L 3 AAOC C321 L 3 AAOC C341 L 3	AAOC C341 L 4		
SATURDAY	TA C122 TUT AAOC C211 TUT AAOC C312 TUT		AAOC C211 L 4 AAOC C321 L 4 AAOC C341 L 5	TA C122 L 4 AAOC C211 L 5 AAOC C341 L 6	TA C122 L 5 TA C311 L 6 AAOC C312 L 2 AAOC C341 L 7						

COMPREE SCEDULE

TIME \Dates>	30.11.91	2.12.91	3.12.91	4.12.91	5.12.91	6.12.91	7.12.91	9.12.91	10.12.91	11.12.91	12.12.91	13.12.91	14.12.91
FN			AAOC C321	TA C311		TA C122 AAOC C211 AAOC C312	AAOC C341						
AN													

LIST OF OBL + OPSC COURSES :

OBL : TA C122 TA C311 AAOC C211 AAOC C312

OPSC: AAOC C321 AAOC C341

A.18 DUAL DEGREE ALLOTMENT

A.18.1 Dual Degree Allotment List

DUAL DEGREE ALLOTMENT LIST BITS, PILANI SECOND SEMESTER 1990 - 91 15 DEC , 1991 PAGE 1

S NO	ID NO	NAME	PBI	A1	A2	A3	A4	A5	A6	A7	A8	Dual Degree Allotted
1	90B5PS201	SRINJOY DAS	372	4	6	#1	5	8	7	3	2	A3
2	90B1PS521	C D BASKAR RAJ	358	4	7	#1	5	8	6	3	2	A3
3	90B1PS559	THOMAS B SEBASTIAN	358	5	8	#1	4	6	7	2	3	A3
4	90B1PS459	KARTHIK VENKATAKRISHNAN	350	2	7	6	4	#1	3	8	5	A5
5	90B2PS461	ROHIT CHHAPOLIA	346	4	7	#1	3	8	6	2	5	A3
6	90B4PS244	GAYATHRI CHITTIAPPA	346	6	7	2	4	8	5	#1	3	A7
7	90B5PS223	SURESH S	344	X	X	X	X	X	X	X	X	-
8	90B4PS421	RAJESH JALAN	332	5	8	2	4	7	6	#1	3	A7
9	90B3PS548	K SUBRAHMANYAM	330	5	7	2	6	8	4	#1	3	A7
10	90B2PS432	MUNJAL S CHHEDA	328	7	6	4	#1	8	3	2	5	A4
11	90B4PS444	VASU DEVA SRINIVAS GADDAE	328	5	6	3	4	8	7	#1	2	A7
12	90B5PS399	JAMBHORKAR NITIN SUDHAKAR	326	5	8	#1	4	6	7	2	3	A3
13	90B4PS319	P V SATYANARAYANA RAJU	324	4	8	2	5	7	6	#1	3	A7
14	90B4PS412	VENKATRAMANI B	320	5	6	2	3	8	7	#1	4	A7
15	90B5PS235	ANIL KUMAR KODALI	318	5	7	#1	3	8	6	2	4	A3
16	90B5PS382	GAURAV NAGPAUL	318	5	7	#1	4	8	6	2	3	A3
17	90B3PS546	D VIJAY	317	2	7	#1	6	8	3	5	4	A3
18	90B5PS373	ANAND N	314	3	7	#1	5	8	6	4	2	A3
19	90B3PS489	RAJAN SANJEEV KRISHNA	310	3	7	2	6	8	5	#1	4	A7
20	90B3PS526	GUNJAN SINHA	306	3	#1	2	4	8	7	5	6	A2
21	90B5PS380	K RAJU	306	3	8	#1	5	7	6	4	2	A3
22	90B5PS398	BADWE ASHUTOSH MANOHAR	306	5	6	2	4	8	7	#1	3	A7
23	90B4PS323	GOPAL N	304	5	7	2	4	8	6	#1	3	A7
24	90B3PS294	VINAY BHATIA	298	5	7	2	3	8	6	#1	4	A7
25	90B1PS557	P CHANDRA SHEKHAR REDDY	296	6	5	#2	4	7	8	1	3	A3

A 19.2 Dual Degree Allotment Letter

BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE
PILANI (RAJ.) 333 031

Admissions & Placement

DUAL DEGREE - 1991

10 JUL, 1991

90B5A3201
SRINJOY DAS

I am glad to inform you, subject to conditions given below, that you are permitted to work concurrently for two first degrees under the Dual Degree Scheme

Your Second Degree is -
B.E.(Hons.)(Electrical and Electronics)

CONGRATULATIONS

ADMISSIONS OFFICER

90B5A3201
SRINJOY DAS
15C, GARFA 4TH LANE
CALCUTTA
WEST BENGAL-700075

:CONDITIONS:

1. If you are under the purview of ACB, your pursuit of Dual Degree Program will be governed by the Claus 7.02 of the Academic Regulations.

2. If you accept this offer of dual degree, you should send Rs. 6000/- as admisson fee to the Dual Degree Scheme latest by 10th July, 1991. This amount should be sent by Demand Draft drawn on UCo Bank, Vidya Vihar, Pilani OR State Bank of Bikaner & Jaipur, Pilani in favour of Birla Institute of Technology and Science.

3. You should send your acceptence of the above offer in the proforma given below by the due date along with the Demand Draft for Rs. 6000/-

4. The Dual Degree Assignment has been done on your present grades. However, any subsequent change in the grades may warrant modification of your dual degree assignment

---

(This proforma duly filled in along with the Demand Draft should reach the Admissions Office latest by 10th July, 1991.)

From
SRINJOY DAS
90B5A3201

Dear Sir,

With reference to the offer of Dual Degree, I accept the Dual Degree in

B.E.(Hons.)(Electrical and Electronics)

I also accept the rules and regulations under which this offer is made

I am enclosing a Demand Draft No ______________ dated __________ for Rs. 6000

PLACE ______________

____
SIGNATURE

DATE ______

A.19 TRANSCRIPT AND PROVISIONAL

A.19.1 Transcript

BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI (RAJASTHAN)

TRANSCRIPT

ID NO 87A3TS096

NAME SHOBHA B
ADDR C/O COMMODORE BALASUBRAMANIAM (RETD)
VSM (IN), C-10 VIVEKANANDPURI
LUCKNOW-226007

Degree(s) Completed
B E (Hons)(Electrical and Electronics)
CGPA . 7.09 Division : FIRST

	COURSE NO		COURSE TITLE	UNITS	GRADE	
FIRST SEMESTER 1987-88	MATH	D131	CALCULUS	2	D	
	SCI	D131	PHYSICS & CHEMISTRY	2	D	
	CHEM	C111	ORGANIC CHEMISTRY	3	B	
	PHY	C111	MODERN PHYSICS	3	D	
	MATH	C111	LINEAR ALGEBRA	5	B	
	TA	C112	WORKSHOP PRACTICE	4	C	
					CGPA...	6.11
SECOND SEMESTER 1987-88	BIO	C111	GENERAL BIOLOGY	3	B	
	CHEM	C112	INORGANIC CHEMISTRY	3	C	
	MATH	C112	HIGHER CALCULUS	3	D	
	PHY	C112	ELECTRICITY & MAGNETISM	3	C	
	TA	C111	ENGINEERING GRAPHICS	4	A	
	AAOC	C111	PROB & STAT	3	C	
					CGPA...	6.47
FIRST SEMESTER 1988-89	ES	C112	THERMODYNAMICS	3	B	
	PHY	C211	OPTICS & WAVE MOTION	3	C	
	MATH	C212	DIFF EQN & FOURIER SER	3	C	
	TA	C211	MEASUREMENT TECHNIQUES I	2	A	
	ES	C211	CIRCUIT THEORY I	3	B	
	TA	C122	COMPUTATION TECHNIQUES	3	C	
	ES	C221	MECHANICS OF SOLIDS	3	C	
					CGPA...	6.66
SECOND SEMESTER 1988-89	AAOC	C211	SOCIAL ENGINEERING I	3	C	
	MATH	C211	COMPLEX VARIABLES	3	D	
	TA	C222	MEASUREMENT TECH II	4	A	
	ES	C212	ELECTRONICS I	3	B	
	ES	C242	STRUC & PROP OF MAT	3	B	
	ES	C222	ENERGY CONVERSION	3	B	
	ES	C232	TRANSPORT PHENOMENA I	3	C	
					CGPA...	6.83

(Continued)

REGISTRAR

BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI (RAJASTHAN)

TRANSCRIPT

ID NO 87A3TS096 Page 2
NAME SHOBHA B

FIRST SEMESTER 1989-90	EEE	C341	ANALOG ELECTRONICS LAB	3	C	
	EEE	C351	ELECTRONICS II	3	D	
	EEE	C331	E M ENERGY CONVERSION I	4	C	
	AAOC	C321	CONTROL SYSTEMS	3	C	
	AAOC	C341	NUMERICAL ANALYSIS	3	C	
	AAOC	C222	OPTIMISATION	3	C	
					CGPA...	6.61
	COURSE NO		COURSE TITLE	UNITS	GRADE	
SECOND SEMESTER 1989-90	EEE	C352	DIGITAL ELECTRONICS LAB	3	B	
	EEE	C362	ELECTRONICS III	3	B	
	EEE	C332	POWER SYSTEMS I	3	C	
	EEE	C372	CIRCUITS AND SIGNALS	3	C	
	AAOC	C312	OPERATIONS RESEARCH	3	B	
	AAOC	C322	SYSTEMS	3	A	
	TA	C311	REPORT WRITING	3	A	
					CGPA...	6.85
FIRST SEMESTER 1990-91	AAOC	C311	DATA PROCESSING	3	C	EL
	EA	C311	MICROPROCESSORS	3	B	EL
	MGTS	C433	ADVERT AND SALES PROMO	3	B	EL
	HUM	C342	GRAPHIC ART	3	A	EL
	EEE	C491	SPECIAL PROJECTS	3	A	EL
	EA	C381	ARTIFICIAL INTELLIGENCE	3	A	OE
					CGPA...	7.09
SECOND SEMESTER 1990-91	BITS	C422T	THESIS	15	EXCELLENT	
	BITS	C442T	SEMINAR	1	GOOD	
					CGPA...	7.09

SUMMARY

Admitted in: FIRST SEMESTER 1987-88
To: B.E.(Hons.)(Electrical and Electronics)(With Practice School)

Transferred in: FIRST SEMESTER 1989-90
To: B.E.(Hons.)(Electrical and Electronics)

Units Used in CGPA 138
(This includes only courses with letter grades, excluding repetitions)
CGPA 7.09

Degree(s) Completed:
B.E.(Hons.)(Electrical and Electronics)

Fulfilled the academic requirements of graduation and became eligible for the award of the degree at the end of SECOND SEMESTER 1990-91

Division : FIRST

Date of Issue REGISTRAR

A.19.2 Provional

PC/ID NO
87A3TS096

BIRLA INSTITUTE OF TECHNOLOGY & SCIENCE

PILANI (RAJASTHAN) INDIA

PROVISIONAL CERTIFICATE

This is to certify that

SHOBHA B

has fulfilled the requirements of graduation and has become eligible for the award of the degree

B.E.(Hons.)(Electrical and Electronics)
at the end of SECOND SEMESTER 1990-91

and has been placed in FIRST Division.

PILANI

Dated________________ **REGISTRAR**

A P P E N D I X - B

DETAILED FILE STRUCTURES FOR STUDENTS' ACADEMIC INFORMATION PROCESSING SYSTEM

CONTENTS

B.1 SUMMARY OF FILES

SL. NO.	DESCRIPTION		FILE NAME	RECORD SIZE Bytes	NUMBER OF RECORDS	FILE SIZE IN BLOCKS	FILE SIZE IN KILO-BYTES	PAGE NO.
1.	Mailing address		ADRESS	128	4500	2250	576	B-6
2.	Semesterwise charts		BSPROG	192	2000	1500	384	B-7
3.	Course information	a.	CRINFO	64	960	240	62	B-8
		b.	CRSORT	2	960	8	2	
4.	Current semester course lists	a.	CRLIST	6	16000	375	96	B-10
		b.	CRHEAD	2	960	8	2	
5.	Teaching faculty	a.	FACLTY	64	960	240	62	B-11
		b.	FACSOR	1920	1	8	2	
6.	Student's Master	a.	IDNAME	128	4500	2250	576	B-12
		b.	IDSORT	9000	1	36	9	
		c.	IDS1RT	2	4500	36	9	
		d.	RECPOS	2	4500	36	9	
7.	Miscellaneous		MSCFIL	256	1	1		B-15
8.	Cumulative Semesterwise performance information		OLDDAT	448	4500	7875	2016	B-16
9.	Semesterwise program chart with performance		PRFORM	512	4500	9000	2304	B-17
10.	Current semester courses' registration & performance		REGDAT	64	4500	1125	288	B-18
11.	Time-Table	a.	TTINFO	16	960	60	16	B-19
		b.	TTEXPF	16	960	60	16	
		c.	TTPNTR	2	960	8	2	
	TOTAL					25113	6431	

1 block (blk) = 256 bytes
1 word = 2 bytes
1 kilo byte (kb) = 1000 bytes

B.3 STUDENT STATUS TAGS

Sl. No.	Description	Location in "IDNAME" File [Word,Bit(s)]

B.3.1 Admission and Continuity Tags

1.	On Rolls	30,0
2.	Admit Semester {00=I Sem,01=II Sem, 10=Summer}	60,0-1
3.	Staff	60,2
4.	Advanced Standing Admission	60,3
5.	Marginal Deficiency Admission	60,4
6.	Transfer Case	60,5
7.	Dual Degree Admission	60,6
8.	Pattern(chart) {0 => Pattern 1; 1 = >Pattern 2}	60,7
9.	Admission Under Clause 10	60,8
10.	PS II is with First Degree	60,9
11.	Notional Placement - Semester - Year offset	60,11-12 60,13-15
12.	Discontinued (Left)	64,0
13.	Graduated (AR[3], Cl 9.03)	64,9
14.	Left in Current Semester	64,13

B.3.2 Academic Progress Tags

1.	PS I Likely	61,9
2.	SEMNA	61,15
3.	NC in OE	62,0
4.	Eligible for PS I	62,3
5.	Eligible for PS II	62,4
6.	Over Stayed	62,6
7.	Fulfilled Academic Requirements of Graduation {C19.01}	62,7
8.	DP in PS I/PS II	62,8
9.	Registration done by computer	62,9
10.	NC in Thesis	62,10
11.	Number of OE Available	62,11-13
12.	Under Purview of Academic Counseling Board {ACB}	63,0
13.	ACB Affliction Clause - 2 or more "E" {Cl 5.02 (i)}	63,1
14.	ACB Affliction Clause - CGPA < 4.50 {Cl 5.02 (ii)}	63,2
15.	ACB Affliction Clause - More than 50% extra time {Cl 5.02 (iii)}	63,3
16.	Pending I	63,4

(Cont. ..)

B.3 STUDENT STATUS TAGS (Continued)

Sl. No.	Description	Location in "IDNAME" File [Word,Bit(s)]
17.	Pending GA	63,5
18.	NC in Elective	63,6
19.	Having Operative Back Log {OBL}	63,7
20.	Having Back Log {BL}	63,8
21.	Eligible for CDC 1	63,11
22.	CDC 1 Touched	63,12
23.	Eligible for CDC 2	63,13
24.	CDC 2 Touched	63,14
25.	Likely graduate	64,1
26.	Likely graduate Brought Forward	64,11

B.3.3 Allotment/Permission Tags

1	Permitted CDC 1	61,0
2	Permitted to delay PS I	61,1
3	Permitted CDC 2	61,2
4	Thesis/Seminar de-coupled	61,3
5	Grade Card Withheld {GW 1}	61,4
6	Grade Awaited {GA 1}	61,5
7	Debarred to Register	61,6
8	Provisional PS II First Half	61,7
9	Provisional PS II Second Half	61,8
10	Not to Register	64,10
11	PBI Condonation Flag for Ist Year {00-None, 01-I Sem, 10-II Sem, 11-Both Semesters Condoned}	64,15-14

B.3.4 Processing Tags

1	Current Semester Registered	30,8
2	Off Campus	64,2
3	Current Semester Grades Loaded	64,3
4	Chart Loaded	64,4
5	Previous Semester Registered	64,5
6	Previous Semester ACB	64,6
7	Provisional Admission	64,8
8	Left in Current Semester	64,13

B.4 FILE STRUCTURES

B.4.1 Mailing Address File

Word	1	2 ...				....
	NUMBER OF CHARACTERS IN ADDRESS INCLUDING $	LINE 1 OF ADDRESS	$	LINE 2 OF ADDRESS	$	

...				... 61
LINE 3 OF ADDRESS	$	LINE 4 OF ADDRESS	$	

Word	62	
Bit	15 1	0
	EXTENSION NUMBER	PP CALL TAG

63 64
32 0
PHONE NUMBER (32 BITS) INTEGER (DOUBLE)

Notes: 1. Each line is of variable length (40 Characters maximum) with a "$" as end-of-line mark.
2. Address can have a maximum of 120 characters including "$".
3. Address can have maximum 4 lines.

```
File name          = ADRESS
Number of Records  = 4500
Records size       = 128 bytes [64 words]
File size          = 4500 * 128 = 576 kb [2250 blk]
```

B.4.2 Semesterwise Charts File

Word	1 2	3	4 9
	CHART CODE (2A2)	PATTERN (1 or 2)	SEMESTER COUNTS #1

Word	10		11		...	96	
Bit	15 6	5 0	15 6	5 0		15 6	5 0
	COURSE CODE	CATEGORY #2	COURSE CODE	CATEGORY		COURSE CODE	CATEGORY

#1 Words 4–9: Semesterwise number of courses

Word	4				5 ...			... 9
Bit	15 12	11 8	7 4	3 0	15 12		...	3 0
	NUMBER OF COURSES IN							
	1ST YEAR I SEM Sem 1	II SEM Sem 2	SUMMER Sem 3	2ND YEAR I SEM Sem 4	II SEM Sem 5	SUMMER	...	Sem 24

#2 Course Categories – Same as "PRFORM" file.

Notes: 1. There can be at most 2000 Distinct Bulletin Charts.
2. Each Chart can Have upto 87 Courses Spread over 24 Semesters.
3. Maximum Course Code can be 960.

File name = BSPROG
Number of Records = 2000
Records size = 192 bytes [96 words]
File size = 2000 * 192 = 384 kb [1500 blk]

B.4.3 Course Information File

(a) Course Master File

Word	1 6	7				8	9 20
Bit	COURSE NUMBER (6A2)	15 13	12 10	9 6	5 0	TYPE	COURSE TITLE (12A2)
		Free	L	P	U		
		#1				#2	

Word	21	22 23	24 31	32
	FREE	RESTRICTIONS	PREREQUISITES / NO OTHERS COURSE	STATUS
		#3	#4	#5

#1 Lecture/Practical/Units:
L => Lecture Hours; P => Practical Hours; U => Units.

#2 Word 8 - Course Type:

BIT	TYPE
0	AU
1	UG
2	PG
3	ME(C)
4	ME
5	MPhil
6	MPhil(A)
7	PhD

BIT	TYPE
8	MVS
9	BS
10	MS
11	-
12	-
13	Having Equivalent(s)
14	Having Restriction(s)
15	Having Prerequisite(s)

(Note: Only 1 of the bits 0 to 10 can be set at a time.)

#3 Word 22-23 - Restrictions:

Word 22: Bit 0 - Preparation of CDC of required
5-1- Discipline of CDC Prior preparation
6 - For own CDCs
7 - No other course
8 - ONLY For
9 - CAN NOT BY
10 - No repeat

Word 23 - Disciplines for which the course is allowed, bit wise.

(Cont. ..)

(a) Course Master File (Continued)

#4 words 24-31 - Prerequisites etc.:

#5 Word 32 - Status:

Bit	UG	ME/MS	MPhil	MVS	BS
0	ABC	CHE	A		
2	C	CE	B		
3	AB	EEE	C		
4	C:DP	ME	D		
5	-	MPHA	E		
6	-	-	S		
7	-	COMP	-		
8	-	INSTR & CON	-		
9	CDC	S & I	-		CDC
10	DCOC	S & T	-		DCOC
11	Disp.Code	TO	-		
12	(1 TO 19)	PO	-		
13	for CDC/	SS	-		
14	DCOC	DC	-		
15		PE	-		

File name = CRINFO
Number of Records = 960
Records size = 64 bytes [32 words]
File size = 960 * 64 = 62 kb [240 blk]

(b) Alphanumeric Course Number Sorted Position File

Word	1	2 959	960
	RECORD NUMBER OF FIRST COURSE IN SORTED COURSE NUMBER LIST		RECORD NUMBER OF 960th COURSE

File name = CRSORT
Number of Records = 960
Records size = 2 bytes [1 word]
File size = 960 * 2 = 2 kb [8 blk]

B.4.4 Current Semester Course List File

(a) Student-Course Registrations/Performances

Word	1	2			3
Bit	RECORD NUMBER OF STUDENT	15 10	9 5	4 0	POINTER TO NEXT STUDENT OF SAME COURSE IN THIS FILE
		LECTURE SECTION NUMBER	PRACTICAL SECTION NUMBER	POSITION OF COURSE IN "REGDAT" FILE	

^^
||

UNITS	GRADE CODE #1	SAME AS ABOVE

(AFTER UNITS/GRADES HAVE BEEN POSTED)

#1 Grade Codes - as given in Appendix B.2.

Notes: 1. CRLIST file is a collection of forward linked lists, one for each course. The headers of each list are in "CRHEAD" file.
2. A total of 16000 Courses-Student pairs can be accommodated.

File name	= CRLIST
Number of Records	= 16000
Records size	= 6 bytes [3 words]
File size	= 16000 * 6 = 96 kb [375 blk]

(b) Course Headers for "CRLIST" File

Word	1	2 ...		... 960
	POINTER TO RECORD NUMBER OF "CRLIST" FILE WHICH CONTAINS FIRST STUDENT IN COURSE #1	POINTER FOR COURSE #2		POINTER FOR COURSE #960

Notes: 1. For a not offered course pointer is -1.
2. Pointer = 0 implies no student is registered.

File name	= CRHEAD
Number of Records	= 960
Records size	= 2 bytes [1 word]
File size	= 960 * 2 = 2 kb [7.5 blk]

B.4.5 Teaching Faculty File

(a) Faculty Name and Status

Word	1 … 16	17	18 … 31
	NAME (16A2)	RESERVED	

Word	32		
Bit	15 … 4	3 … 1	0
		STATUS #1	#2

#1 Faculty Status:

1 = On Campus
2 = Off Campus
3 = On Leave

#2 Continuity:

0 = Left
1 = On Rolls

```
File name             = FACLTY
Number of Records     = 960
Records size          = 64 bytes [32 words]
File size             = 960 * 64 = 62 kb [240 blk]
```

(b) Faculty Alphanumeric Sorted File

Word	1	2 959	960
	RECORD NUMBER OF FIRST FACULTY IN SORTED FACULTY NAME LIST		RECORD NUMBER OF 960th FACULTY

```
File name             = FACSOR
Number of Records     = 960
Records size          = 2 bytes [1 word]
File size             = 960 * 2 = 2 kb [7.5 blk]
```

B.4.6 Student Master File

(a) IDNO, Name and Status File

Word	1 5	6 21	22			23
			15 7	6 5	4 0	
	ID NO (5A2)	NAME (16A2)	YEAR OF ADMISSION	SEMESTER OF ADMISSION	TYPE OF STUDENT #1	Free

Word	24	25 26	27	28	29
	LATEST CGPA*100	ID CHANGE FLAGS #2	FREE	PRNO or DATE OF GRADUATION #3	YEAR/SEM 9.03 | 9.01 #4

Word	30	31 46	47	48	49	50	51	52
					INPUT			
	REGISTR-ATION & ON ROLLS FLAGS #5	IDNO CHAN-GES #2	LOCATION IN "OLDDAT" FILE FOR CUSM	NEXT	ACCU CUP	CGPA CUP	ACCU UNITS	CGPA UNITS

Word	53	54	55 56	57 59	60 64
	CHART CODE	PBI	DD OPTIONS (Bit Wise) #6	RESERVED	STATUS TAGS #5

#1 **Word 22 - Student Type:**

0=Unknown	1=Formal FD	2=ME(COLLAB)	3=ME
4=M PHIL	5=M PHIL(A)	6=Ph D	7=CASUAL
8=M V S	9=MVS	10=MS	

#2 **IDNO Changes:**

Words 25 & 26 - Flags:

15					0	15					0
SEMESTER IN WHICH IDNO CHANGED [bit set to 1]											
1	2	3	..	..	16	17	18	..	..		32

(Cont. ..)

(a) IDNO, Name and Status File (Continued)

Words 31 to 46 - Previous IDNOs:

31 32	33 34	35 44	45 46
FIRST IDNO CHANGE	2nd IDNO CHANGE		8th IDNO CHANGE

two words contain middle four characters of previous IDNO.

#3 Word 28 - Graduation Date:

15 11	10 7	6 0
DAY(dd)	MONTH(mm)	YEAR(yy)

#4 Word 29 - Graduation:

15 10	9 8	7 2	1 0
9.03		9.01/Left	
Offset year	Sem	Offset year	Sem

#5 Words 30,60,61,62,63 & 64 - These contain STATUS tags for eligibility sheet and other use. Details are given in Appendix B.3.

#6 Dual Degree Preferences:

55				56			
15 12	11 8	7 4	3 0	15 12	11 8	7 4	3 0
DUAL DEGREE PREFERENCE NUMBER FOR							
A1	A2	A3	A4	A5	A6	A7	A8

File name = IDNAME
Number of Records = 4500
Records size = 128 bytes [64 words]
File size = 4500 * 128 = 576 kb [2250 blk]

(Cont. ..)

(b) Alphanumeric IDNO Sorted Files

(i) One Record:

Word	1	2.. ..4499	4500
	RECORD NUMBER OF 1st STUDENT IN SORTED IDNO LIST		RECORD NUMBER OF 4500th IDNO

```
File name          = IDSORT
Number of Records  = 1
Records size       = 9000 bytes [4500 words]
File size          = 1 * 9000 = 9 kb [36 blk]
```

(ii) 4500 Records:

Record	1	2.. ..4499	4500
	RECORD NUMBER OF 1st STUDENT IN SORTED IDNO LIST		RECORD NUMBER OF 4500th IDNO

```
File name          = IDS1RT
Number of Records  = 4500
Records size       = 2 bytes [1 word]
File size          = 4500 * 2 = 9 kb [36 blk]
```

(iii) Inverted IDNO Sorted File

Record	1	2.. ..4499	4500
	POSITION OF STUDENT AT RECORD NUMBER 1		POSITION OF STUDENT AT RECORD NUMBER 4500

```
File name          = RECPOS
Number of Records  = 4500
Records size       = 2 bytes [1 word]
File size          = 4500 * 2 = 9 kb [36 blk]
```

B.4.7 Miscellaneous File

Word	1	2	3	4
	NUMBER OF STUDENT IN "IDNAME" FILE	MAXIMUM COURSE CODE IN "CRINFO" FILE	CURRENT SEMESTER {e.g.1/2/3}	CURRENT YEAR {e.g.1988}

Word	5	6	7	8
	NUMBER OF BASE CHARTS	FREE	PRND PRIMER	MAXIMUM TSRN IN "FACULTY" FILE

Word	9	10 ... 39
	MAXIMUM NUMBER OF ROOMS IN "ROOMSF" FILE	RESERVED

Word	40	41	42	43	44 80
	YEAR 1	STARTING RECORD NUMBER FOR YEAR1 IN "IDNAME" FILE	YEAR 2	STARTING RECORD NUMBER FOR YEAR2 IN "IDNAME" FILE	

(YEAR WISE IDNAME DIVISIONS FOR 20 YEARS [MAX])

Word	81 ... 128
	RESERVED

```
File name          = MSCFIL
Number of Records  = 1
Records size       = 256 bytes [128 words]
File size          = 256 * 1 = 0.256 kb [1 blk]
```

B.4.8 Cumulative Semesterwise Performance Information File

Word	1 ...			... 224
	INFORMATION FOR SEMESTER 1 NO. OF WORDS = 2 * N1 + 5 (N1 IS NO. OF COURSES REGISTERED IN SEMESTER 1) #1	INFORMATION FOR SEMESTER 2 <<2*N2+5>>		INFORMATION FOR SEMESTER m <<2*Nm+5>>

#1 Structure for a Semester:

Word	1				2	3	4	5
Bit	15 14	13 10	9 2	1 0				
	FREE	NUMBER OF COURSES REGISTERED	YEAR	SEM	ACC CUP	CGPA CUP	ACC UNITS	CGPA UNITS

Word	6		7			8	9 ..	..M
Bit	15 6	5 0	15 11	10 6	5 0			
	CODE	COURSE 1 INFORMATION UNITS	GRADE CODE	CATEGORY CODE	REPEAT CODE	COURSE 2 INFORMATION		COURSE N INFORMATION

(M = 2 * N + 5)

#1 Grade Codes - as given in Appendix B.2.

Notes: 1. The input CUP Information is stored in "IDNAME" File.
2. For a not registered semester, number of words required = (

File name = OLDDAT
Number of Records = 4500
Records size = 448 bytes [224 words]
File size = 4500 * 448 = 2016 kb [7875 blk]

B.4.9 Semesterwise Program Chart and Performance File

Word	1	
Bit	15 ... 7	6 ... 0
	NEXT AVAILABLE WORD IN THIS FILE	TOTAL COURSES IN CHART

Word	2		3				4
	COURSE 1 INFORMATION						
Bit	15 ... 6	5 ... 0	15 ... 12	11 ... 6	5 ... 2	1 ... 0	POINTER TO REPEAT PERFORMANCE OF THIS COURSE IN THIS FILE, IF ANY
	COURSE CODE	UN-ITS	CATEGORY CODE #1	GRADE CODE #2	YEAR OFFSET #3	SEMESTER (1/2/3)	

Word	5 6 7	8 9 10	... ...	254 255 256
	COURSE 2 INFORMATION	COURSE 3 INFORMATION		COURSE 85 INFORMATION

Note: Total Course-performances that can be stored = 85.

#1 Category Codes: (4 Bits => 16 Max)

CODE	COURSE TYPE
0	Named Course
1	Exempted Course
2	AU (Audit)
3	OE (Optional Elective)
4	CDC 1 (Compulsory Discipline Course of First degree)

CODE	COURSE TYPE
5	CDC 2 (Compulsory Discipline Course of second degree)
6	EL (Elective)
7	UT (Untagged)
8	FR (Frozen Course)
9	MD (Marginal Deficiency)

#2 Grade Codes - as given in Appendix B.2.

#3 Year offset: Year offset = Year of performance-Admission year

```
File name          = PRFORM
Number of Records  = 4500
Records size       = 512 bytes [256 words]
File size          = 4500 * 512 = 2304 kb [9000 blk]
```

B.4.10 Current Semester Courses Registration and Performance File

Word	1	2		3					
Bit		15 6	5 0	15 11	10 6	5 3	2	1	0
		COURSE 1 INFORMATION							
	NUMBER OF COURSES REGISTERED	CODE	UNITS	GRADE CODE #1	CATEGORY CODE #2	REPEAT CODE #3	#4		#5

CODE	LECTURE SECTION NUMBER	PRACTICAL SECTION NUMBER	SAME AS ABOVE

Word	4	5 ...		... 28	29	30	31	32
	COURSE 2 INFORMATION		COURSE i INFORMATION		ACC CUP	CGPA CUP	ACC CUP	CGPA CUP

#1 Grade Codes - as given in Appendix B.2.

#2 Category Codes - as given in Appendix B.2.

#3 Repeat Codes - as given in Appendix B.2.

#4 Previous Semester NC Repeat tag.

#5 Dean's Permission tag (all clauses).

Notes: 1. Two words per course are used (Maximum of 10 courses).
2. CUP data is after Current Semester grades Loading & Posting.

File name = REGDAT
Number of Records = 4500
Records size = 64 bytes [32 words]
File size = 4500 * 64 = 288 kb [1125 blk]

B.4.11 Time-table Information Files

(a) Time-table Common Information

Word	1					2		
Bit	15	14	13 12	11 6	5 0	15 8	7 4	3 0
	CANC-LLED 0=NO 1=YES	OFFERED 0 = NO 1 = YES	TUTO-RIAL OR COMMON LECTURE #1	NUMBER OF LECTURE SECTIONS OFFERED	NUMBER OF PRAC-TICAL SECTIONS OFFERED	STATUS #2	LECT-URE "L"	PRAC-TICAL "P"

Word	3															
Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	COMMON TUTORIAL HOUR															
	DAYS						HOURS									
	S	F	Th	W	T	M	10	9	8	7	6	5	4	3	2	1

Word	4			
Bit		9 5	4 1	0
	FREE	COMPREHENSIVE		
		DATE	MONTH	SESSION #3

Word	5	6	7	8		
Bit				15 2	1	0
	INSTRUCTOR-IN-CHARGE TSRN	POINTER TO STARTING LOCATION IN "TTEXPF"	EQUIVALENT COURSE CODE (IF ANY)	TOTAL NUMBER OF STUDENT REGISTERED	GRADES VERIFIED	GRADES LOADED

#1 Tutorial or Common Hour:

0 => None; 1 => Tutorial; 2 => Common Hour.

#2 Status

* => Special Instructions to be seen elsewhere.

#3 Comprehensive Session: - 0 => Afternoon; 1 => Forenoon.

Note: This file has one to one correspondence with "CRINFO" file.

```
File name            = TTINFO
Number of Records    = 960
Records size         = 16 bytes [8 words]
File size            = 960 * 16 = 16 kb [60 blk]
```

(b) Time-table Section Information File

Word	1		2			
Bit	15 — 10	9 — 0	15 — 12	11 — 8	7 — 6	5 — 0
	NUMBER OF RECORDS FOR COURSE (ONLY IN FIRST RECORD)	COURSE CODE	FREE	NUMBER OF INSTRUC-ORS	LECTURE/ PRACTICAL #1	SECTION NUMBER

Word	3															
Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	DAYS						HOURS									
	S	F	Th	W	T	M	10	9	8	7	6	5	4	3	2	1

Word	4	
Bit	15 — 8	7 — 0
	ROOM NUMBER CODE	
	PRACTICAL	LECTURE

Word	5	6	7	8	
Bit	INSTRUCTOR TSRN IN "FACLTY" FILE	POINTER TO MORE THAN ONE INSTRUCTOR IN "TTPNTR" FILE	POINTER TO NEXT RECORD OF SAME COURSE IN THIS FILE	15 — 1	0
				FREE	MORE DAYS 1=YES,2=NO

#1 Lecture/Practical: 1=>L; 2=>P; 3=>both; 0 is invalid.

File name = TTEXPF
Number of Records = 960
Records size = 16 bytes [8 words]
File size = 960 * 16 = 16 kb [60 blk]

(c) Time-table More Instructors Pointer File

Word	1	2	3	4 . . .	958	959	960
	TSRN	POINTER TO NEXT INST-RUCTOR IN THIS FILE	SAME AS WORDS 1 & 2		SAME AS WORDS 1 & 2	NEXT AVAILA-BLE LOCATION IN "TTEXPF" FILE	NEXT AVAILA-BLE LOCATION IN "TTPNTR" FILE

File name = TTPNTR
Number of Records = 960
Records size = 2 bytes [1 word]
File size = 960 * 2 = 2 kb [8 blk]