Birla Institute of Technology & Science, Pilani

Pilani | Dubai | Goa | Hyderabad

EDUCATIONAL PROCESS

AND

PROGRAMMES OF STUDIES

The mission of BITS Pilani is to prepare young men and women to act as leaders for the promotion of the economic and industrial development of the country and to play a creative role in society. It has the reputation of a highly purposive and innovative university often setting the pace for workable reforms in higher education, suitable and relevant for the Indian cultural milieu.

BITS Pilani has been following semester system with continuous and internal evaluation since its inception. The educational programmes are modular and flexible. Through its Practice School programme, BITS Pilani has established purposeful linkages with industries. The Institute has evolved a direction for Research which makes research relevant to the national development and social needs. It has developed and adopted a unique academic administrative structure which makes all its innovations possible and workable.

The Institute operates educational programmes at three tiers of education, namely, the Integrated First Degree programmes, Higher Degree programmes and the Doctoral programmes. All programmes in the Institute are designed to allow as many components of science and applied science as are necessary for the graduates of the programmes to function effectively and efficiently in the technological society. All programmes contain certain structural commonality and the common courses are invariably operated together irrespective of the clientele who are required to take the courses. Similarly, irrespective of the ultimate degree for which a student qualifies, the large factor of this commonality between all students creates an educational basis which provides easy professional linkage, communication and group activity among students graduating in different degrees. This similarity among different students graduating with different degrees is further welded in a

stronger professional bond when they work as internees in the Practice School stations or as members in a team working on mission-oriented time-bound research and development projects.

The various structural flexibilities provide not only scope for multiple point entries but also enable the system to accommodate many legitimate educational and operational needs of students. Some of these aspects are described in various sections that follow.

All programmes of studies are based on the principle that a series of courses make up the hierarchy of the structure where each course is self-contained but nevertheless acts as a bridge between what precedes and what comes after. A formal contact hour is such that a student is invariably required to spend several times of these hours towards self-study. Attempt here is to awaken curiosity in the mind of the student and train him to think rationally and scientifically and enable him to face the unfamiliar. Through the Practice School option, the flavour of the professional world is sought to be imbibed by the student as well as the teacher. Even many co-curricular activities are converted into a learning situation whereby the growth of a student becomes a continuing operation.

The Institute also conducts Off-campus Work-Integrated degree programmes as a means of continuing education for employed professionals as part of the human resource development programmes of specific organizations at the various off-campus centres. In all these programmes, emphasis is on self-learning and the pedagogy attempts to incorporate as many modern technologies as desirable. While each one of these programmes requires collaboration of an organization, some programmes have a highly structured collaboration with planned classroom activities and some programmes may have less structured planning. While a number of degrees are offered through structured collaboration with many collaborating organizations, there are also degrees, which are available in an open manner for a large number of organizations, each of which may sponsor only few students. For all these programmes, faculty/resource persons are drawn from the Institute and the participating organizations as well as other Institutions.

The Three Tier Structure shown on page II-3 gives all the programmes offered by the Institute.

Integrated First Degree Programmes

The Integrated First Degree Programmes are offered at the first tier with

nomenclatures like B.E., B. Pharm. and M. Sc.. These are all level wise equivalent degrees. These are called integrated degrees for two reasons: (i) there are several common courses amongst these degrees, and (ii) no intermediate degrees, like, B.Sc. etc. are awarded. These degrees are based on a modular structure and their academic requirements are spelt out in respect of the number of courses and units rather than the number of years. All these programmes are structured in such a way that normally a student will be able to finish a programme in eight semesters. Of course, the flexibility of the Institute allows a student to do his programme at a faster pace and finish it earlier than 8 semesters or at a slower pace to finish it later than 8 semesters.

(a) B.E.

These programmes in engineering are mathematics and hard science based and incorporates many up-to-date techniques of analysis and synthesis.

(b) B.Pharm.

This programme has been so structured that it not only meets the requirements of the Pharmacy Council of India but also has additional courses which give a shape and flavour of both engineering and fundamental sciences to the programme.

(c) M.Sc. (Programmes under Group B)

These are integrated degree programmes without any intermediate B.Sc. degree. While these programmes ensure the required science component in any comparable postgraduate science degrees of other universities are met, they also incorporate many courses which have been notionally considered to be part of the engineering domain. The integrated nature of the programmes and their analytical and engineering science contents give them a professional character and enable students to participate usefully in industrial jobs. While a good 10+2 input may be able to complete these programmes in four years, any person coming from 10+2+3 system with a B.Sc. degree admitted on advanced standing basis will require two to three years to finish the programme. Almost all students who are admitted for these degrees also aspire and work towards a second degree under the dual degree scheme.

(d) M.Sc. (Programmes under Group C)

These programmes are basically multi-disciplinary and technological in character and are designed to meet the requirements of newly emerging professional activities. The areas which are currently incorporated in these degree programmes are

Information Systems, Finance and General Studies.

The programme on Information Systems gives among other things a good exposure to the students on computer software and software engineering techniques, both at the conceptual and application levels. The Finance degree has been designed to meet the manpower needs arising due to the new thrust given to growth patterns in the economy. The courses planned for this programme are of such a nature that they fulfil the requirements of financial institutions as well as financial management needs of any industry. This programme is complementary to the M.Sc. Economics programme.

Birla Institute of Technology & Science, Pilani

Three Tier Structure of Education

Ph. D. Degrees	
Higher Degrees	
On-campus programmes	**Work-Integrated Learning Programmes**
M.E. Biotechnology, Chemical, Civil with specialization in Structural Engineering, Civil with specialization in Infrastructure Engineering & Management, Civil with specialization in Transportation Engineering, Computer Science, Communication Engineering, Design Engineering, Embedded Systems, Manufacturing Systems Engineering, Mechanical, Microelectronics, Software Systems, Sanitation Science, Technology and Management ***Chemical with specialization in Petroleum Engineering, Chemical with specialization in Nuclear Engineering, Civil with specialization in Water Resources Engineering, Computer Science with specialization in Information Security, Electrical with specialization in Power Electronics & Drives, Mechanical with specialization in Thermal Engineering* **M. Pharm.** M. Pharm., M. Pharm. with specialization in Pharmaceutics, M. Pharm. with specialization in Pharmaceutical Chemistry, M. Pharm. with specialization in Pharmacology **M. Phil.** Liberal Studies ***Biological Sciences, Chemistry, Economics, English, Management, Mathematics, Physics* **Master of Business Administration (MBA)** Business Analytics, ***Finance, Information Systems Management, Marketing, Operations and Decision Sciences, Organization Behavior and Human Resource Management, Strategy & Entrepreneurship* **Note: Details of On campus Programmes are given in Part IV and Part VI.**	**M.B.A.** Business Analytics, Consultancy Management, Finance, FinTech, Hospital and Health Systems Management, Manufacturing Management, Quality Management. **M. Tech.** Automotive Electronics, Automotive Engineering, Computing Systems and Infrastructure, Data Science and Engineering, Design Engineering, Digital Manufacturing, Embedded Systems, Environmental Engineering, Manufacturing Management, Microelectronics, Pharmaceutical Operations and Management, Quality Management, Sanitation Science, Technology and Management, Software Engineering, Software Systems, Systems Engineering, ***Telecommunications and Software Engineering, **Transportation Engineering* **Note: Details of Work Integrated Learning Programmes are given in Part V.**

Integrated First Degrees			
On-campus programmes			**Work-Integrated Learning Programmes**
Group A	**Group B**	**Group C**	
B.E. Biotechnology, Chemical, Civil, Computer Science, Electrical & Electronics, Electronics & Communication, Electronics & Instrumentation, Manufacturing, Mechanical **B. Pharm.**	**M.Sc.** Biological Sciences, Chemistry, Economics, Mathematics, Physics	**M.Sc.** General Studies, ***Information Systems, **Finance*	**B.Sc.** Design & Computing, **Pharmaceutical Sciences **M.Sc.** Business Analytics, **Information Systems **B.Tech.** **Engineering Design, Engineering Technology, **Information Systems, Manufacturing Technology, **Power Engineering, Process Engineering..
**These programmes are not offered during academic year 2021-22			
Minor programs			
Minor programs are being offered in certain areas as options for integrated first degree students with the intent of encouraging them to add focus to their supplemental learning (outside a major area) as well as recognizing and certifying the knowledge obtained in an area that is outside of their major area. A minor would allow a Department (or multiple Departments) to offer a package of courses in an area/sub-area to students for whom this area/sub-area would not be part of their (major) program (e.g. a minor in Finance for students who are not pursuing a program in Finance). A minor will be recognized by means of a separate certificate. At present Sixteen minor programs viz. Minor in Aeronautics, Computational Economics, Computing and Intelligence, Data Science, English Studies, Entrepreneurship, Film and Media, Finance, Management, Materials Science and Engineering, Philosophy, Economics and Politics (PEP), Physics, Public Policy, Robotics and Automation, Supply Chain Analytics and Water and Sanitation have been designed which are selectively being offered at different Campuses. **The details of minor programs are described in Part IV of this Bulletin.**			

For Admission to on-campus programmes	
Integrated First Degree :	**Higher Degree :**
For admission to all the programmes: Candidates should have passed the 12th examination of 10+2 system from a recognized Central or State board or its equivalent with adequate proficiency in English. Except for admission to B. Pharm., the candidates should have Physics, Chemistry, and Mathematics as subjects. For admission to B. Pharm. , candidates should have Physics, Chemistry, and either Biology or Mathematics as subjects.	Normal input: Integrated First Degree of BITS Pilani or its equivalent. **Ph.D. Degree:** Normal Input: Higher Degree of BITS Pilani or its equivalent.

The General Studies programme aims at providing an opportunity to the students to acquire specific skills to meet varied career objectives through judicious use of electives and project oriented courses. Students are given opportunities to take two different streams, namely Communications and Media Studies or Development Studies by choosing courses of specific streams. Further, the requirements of mathematics, science and applied science, etc. are normally different from Group A and Group B Programmes. Candidates admitted to this programme have to take humanities courses as well as certain general science and technology courses.

All the Integrated First Degree programmes described above have a Practice School option which consists of two courses, Practice School I and Practice School II. A student goes to Practice School I of two months' duration during the summer following second year and to Practice School II of five and a half months' duration during the final year. The curriculum, through Practice School, finds a formal method of bringing the reality of professional environment into the educational process.

For the various programmes in all the three tiers of education, the admission policy and the educational process at BITS take care of multiple entry into the programmes and allow several other flexibilities. The on-campus integrated First Degree programmes are divided into Groups A, B and C. The following table provides a tabular condensation of the information.

INTEGRATED FIRST DEGREE PROGRAMMES

Name of the Programme	Normal Input	Special features
Group A programmes: B.E. : Biotechnology : Chemical : Civil : Computer Science : Electrical & Electronics : Electronics & Instrumentation : Electronics & Communication : Manufacturing : Mechanical B.Pharm. **Group B Programmes:** M.Sc. : Biological Sciences : Chemistry : Economics : Mathematics : Physics **Group C Programmes:** M.Sc. : General Studies	**For admission to all the programmes:** Candidates should have passed the 12th examination of 10+2 system from a recognized Central or State board or its equivalent with adequate proficiency in English. Except for admission to B. Pharm., the candidates should have Physics, Chemistry, and Mathematics as subjects. For admission to B. Pharm., candidates should have Physics, Chemistry, and either Biology or Mathematics as subjects. **Admission to all the programmes is subject to the conditions given below:** Admissions will be made purely on merit. The merit position of the candidate will be based on the score obtained by the candidate in a Computer based Online Test (BITSAT) conducted by BITS, Pilani. The candidate should have obtained a minimum of aggregate 75% marks in Physics, Chemistry and Mathematics subjects (if he/she has taken Mathematics in BITSAT) or a minimum of aggregate 75% marks in Physics, Chemistry and Biology subjects (if he/she has taken Biology in BITSAT) in 12th examination, with at least 60% marks in each of the Physics, Chemistry, and Mathematics / Biology subjects.	**Duration:** Planning has been made such that a student will be able to finish any of the integrated first degrees in 4 years (8 semesters). However, the flexibilities available and the modular structure of the system will allow the individual students to have variation in the duration of his degrees. Some can finish earlier than 4 years and some may take more than 4 years. Students who take two degrees simultaneously under dual degree scheme will spend about 5 to 5½ years (10 to 11 semesters). **Practice School:** All the integrated first degree programmes have Practice School options. **Dual Degree:** Institute offers dual degree facility to number of students who are admitted. The features of dual degree scheme are described later in this part under the section 'Flexibilities'. **Electives:** A student is required to complete at least 12 elective courses under the categories of Humanities electives, Discipline electives and Open electives. By judicious choice of these courses a student can obtain depth in his/her discipline and/or expand his/her horizon to gain exposure to one or more other areas of study.
For Details of Admission policy to Work Integrated Learning Programmes Refer to Part V.		

PROGRAMMES OFFERED AT BITS PILANI, PILANI CAMPUS

Integrated First Degree Programmes

B.E. Chemical

B.E. Civil

B.E. Computer Science

B.E. Electrical & Electronics

B.E. Electronics & Instrumentation

B.E. Electronics and Communication

B.E. Manufacturing

B.E. Mechanical

B. Pharm.

M.Sc. Biological Sciences

M.Sc. Chemistry

M.Sc. Economics

M.Sc. Mathematics

M.Sc. Physics

M.Sc. General Studies

PROGRAMMES OFFERED AT BITS PILANI, K.K. BIRLA GOA CAMPUS

Integrated First Degree Programmes

B.E. Chemical

B.E. Computer Science

B.E. Electrical & Electronics

B.E. Electronics & Communication

B.E. Electronics & Instrumentation

B.E. Mechanical

M.Sc. Biological Sciences

M.Sc. Chemistry

M.Sc. Economics

M.Sc. Mathematics

M.Sc. Physics

All these programmes have the same educational process, syllabus, evaluation method and academic flexibilities like transfer, dual degree etc. as followed at BITS Pilani, Pilani Campus.

PROGRAMMES OFFERED AT BITS PILANI, HYDERABAD CAMPUS

Integrated First Degree Programmes

B.E. Chemical
B.E. Civil
B.E. Computer Science
B.E. Electrical & Electronics
B.E. Electronics & Communication
B.E. Electronics & Instrumentation
B.E. Mechanical
B. Pharm.
M.Sc. Biological Sciences
M.Sc. Chemistry
M.Sc. Economics
M.Sc. Mathematics
M.Sc. Physics

All these programmes have the same educational process, syllabus, evaluation method and academic flexibilities like transfer, dual degree etc. as followed at BITS Pilani, Pilani Campus.

PROGRAMMES OFFERED AT BITS PILANI, DUBAI CAMPUS

First Degree Programmes

- B.E. Chemical Engineering

- B.E. Civil Engineering

- B.E. Electrical & Electronics Engineering

- B.E. Mechanical Engineering

- B.E. Computer Science

- B.E. Biotechnology

- B.E. Electronics & Communication Engineering

TEACHING-LEARNING PROCESS

The objective of class room education is to awaken the curiosity of the student, generate habits of rational thinking in him/her, gear his/her mind to face the unfamiliar and train him/her to be able to stand on his/her own. With its team of committed and dedicated faculty, BITS Pilani aims at maximizing the learning process through teaching. Through their innovative teaching, the teachers enable the student search for knowledge on his/her own and motivate him/her to use the facilities like the library, laboratory and the environment to optimize his/her learning process. Self-study by the student is therefore an important factor in the planning of teaching and evaluation and in this environment the student exhibits interest and responds to this challenge. Teaching and evaluation form a unity of function and operate in a climate of mutual understanding and trust.

Every course whether single section or multi-section is conducted by a member of the faculty called instructor-in-charge, with the assistance, where necessary, of the required number of instructors – who will be partners with him in meeting the full academic perceptions and organizational needs of teaching the course and evaluating the students.

Within one week of the beginning of class work, the instructor-in-charge/ instructor announces to his class/section through a hand-out, the necessary information in respect of (i) the operations of the course (its pace, coverage and level of treatment, textbooks and other reading assignments, home tasks etc.); (ii) various components of evaluation, such as tutorials, laboratory exercises, home assignment, project, several quizzes/ tests/ examinations (announced or unannounced, open book or closed book), regularity of attendance, etc., (iii) the frequency, duration, tentative schedule, relative weightage etc. of these various components; (iv) the broad policy which governs decisions about make-up; (v) mid-semester grading; (vi) grading procedure (overall basis, review of border line cases, effect of class average, etc.) and (vii) other matters found desirable and relevant.

EVALUATION

All courses are conducted and evaluated in a continuous & internal manner by the faculty who teach these courses. The student registers for a certain number of courses each semester; the year being divided into two semesters, and a summer term, whenever offered. A faculty member, as registration advisor, helps a student to draw up his programme, suitable to his pace and needs, which is made possible by the course wise time-table of the Institute. Every student gets, incidentally, a

training in decision-making through (i) choice of load, i.e. number of courses per semester to suit his/her pace, (ii) selection of his/her own time-table to suit his/her convenience, and (iii) picking up courses as electives to meet his/her own aspirations. It is the responsibility of the student to attend classes regularly and to maintain a required level of scholastic standing.

The performance of a student in each course is assessed by the teacher by means of continuous evaluation throughout the semester in classwork, periodical quizzes (sometimes unannounced), tests (both open and closed book), tutorials, laboratory work, homework, seminars, group discussions, project, etc., and a comprehensive examination at the end of the semester. The student is thereby given a large number of opportunities to carryout various academic assignments and be evaluated. Besides encouraging and rewarding continuous and systematic study, the system provides a constant feedback to the student as to where he/she stands, thus enabling him/her to cultivate regular habits of studying and preparing himself/herself for the future.

The system discards the conventional emphasis on a single final examination and numerical marks as the only absolute indication of the quality of student's performance. Thus, at the end of the semester the teacher of the course awards letter grades **A, A⁻, B, B⁻, C, C⁻, D, E** to the student based on the total performance of the student and it is relative to the performance of others taking the same course. These letter grades stand for quality of performance: A (Excellent), A⁻ (Very Good), B (Good), B⁻ (Above Average), C (Average), C⁻ (Below Average), D (Poor) and E (Exposed). Further, these letter grades have points associated with them in a quantified hierarchy: a maximum of 10 (for an A) to a minimum of 2 (for an E). There are also courses in which the teacher awards non-letter grades which have only a qualitative hierarchy. The teacher may also pronounce the performance of a student in a course in terms of certain reports which should not be misconstrued as grades.

Although BITS Pilani does not stipulate a minimum percentage of attendance before a student is permitted to appear in any test/examination, the Institute, being a fully residential university with internal and continuous evaluation system, expects every student to be responsible for regularity of his/her attendance in classrooms and laboratories, to appear in scheduled tests and examinations and to fulfill all other tasks assigned to him/her in every course. The system has adequate resilience to accommodate unforeseen situations through withdrawal from a course, make-up test, feedback from examinations and interaction with teachers. In spite of all these

facilities when a student fails to cooperate with the teacher in the discharge of his/her part of the contract to such an extent that the teacher is unable to award any grade, the teacher is authorized to give a "Not Cleared" (**NC**) report.

A student is deemed to have cleared a course if he/she obtains a grade in the course. However, the educational philosophy of the Institute interlinks and at the same time distinguishes between the performance of a student in a single course and his/her overall cumulative performance. The overall performance of a student is indicated by an index known as the "Cumulative Grade Point Average" (CGPA). It is the weighted average of the grade points of all the letter grades received by the student since his/her entry into the Institute and is expressed on a 10-point scale. In the case of Integrated First Degree programmes the final division for the degree is decided on the basis of CGPA and there are three classifications, namely Distinction, First Division and Second Division. However, in the case of Higher Degree and the Doctoral programmes no division is awarded.

During the student's stay in the Institute, the Institute expects him/her to show a certain minimum performance and progress. The minimum academic requirements regarding the performance and progress for the Integrated First Degrees and Higher Degrees are:

(i) A CGPA of at least 4.5 at the end of every semester for integrated First Degree students and 5.5 for Higher Degree/Ph.D. students.

(ii) Not more than one E grade in a semester for integrated First Degree programmes and no E grade in the Higher Degree programmes.

(iii) The pace of progress of a student should be such that at any stage of reckoning he/she should not have spent more than 50% extra time than what is prescribed for him/her upto that stage in his/her programme.

The Institute's Academic Regulations must be consulted regarding the minimum academic requirements for the pursuit of the Ph.D. programme and also for off-campus programmes.

Students who fail to meet the minimum academic requirements stipulated above are put under an appropriate committee which monitors their programmes and give guidance so that they are properly rehabilitated at the earliest. In case of Ph.D., this is done by the Departmental Research Committee (DRC) and Doctoral Counselling Committee and in the case of Higher Degrees and integrated First Degrees this is done by Academic Counselling Board (ACB). These Committees are appointed by

the Senate and are given authority to take appropriate action including discontinuance of the student or transfer to other programme.

FLEXIBILITIES

The admission policy and the educational process at BITS take care of multiple entry into the programmes and allow several other flexibilities.

Wherever a flexibility is possible according to the Academic Regulations of the Institute, the implementation of the decision invariably takes place along with registration at the beginning of a semester for the continuing students. As in the admission process, the decision is guided by the principle of merit, preferences and facilities available.

It is obvious that CGPA cannot serve as the only measure of merit when the total number of courses/units is different between two competing candidates. To normalize all competing candidates, generally the Institute uses a Progressive Branching Index (**PBI**).

Admissions in both the Semesters

The structural flexibilities available in the Institute make it possible to admit students in both the semesters. However, in the case of both First Degree and Higher Degree programmes most of the admissions are made during the first semester itself. In the case of Ph.D. and off-campus Degree programmes, admissions are planned in both the semesters. However, a separate advertisement is given for the second semester admissions and applications for the same are made available only after an advertisement is issued.

Admission with Marginal Deficiency

While the academic preparation required for the admission to each Degree has been clearly spelt out there is a provision in the Institute Academic Regulations whereby brilliant students whose prior preparation has been marginally deficient in terms of stated courses/subjects may also be admitted with the condition that they are required to do additional courses over and above those prescribed for a student with normal preparation and the sequence is determined by the institute. This flexibility is invariably used in the case of higher Degree programmes where students may come without sufficient exposure to courses like computer programming.

Admission with Advanced Standing

When a candidate for any programme in the three tiers of education of the Institute comes with a preparation beyond the minimum requirement for admission in that programme, the admission of such a candidate is handled under what is known as admission with advanced standing. While such admission is not available as a matter of right, at the time of admission the Institute would spell out in detail the advanced credit it proposes to give to the candidate and the matter would be handled within the framework of the Institute's operation for normal students. Essentially the guiding principle is two-fold: the courses the candidate has already done before entering the Institute cannot be repeated and also that the time spent elsewhere is not wasted. Such an open-ended situation is handled on a case by case basis. It is important that the candidate supplies all the pertinent data in respect of syllabus of courses taken by him/her, examinations passed, question papers of the examinations and the grades/marks obtained by him/her in different subjects. A candidate who is shortlisted for such admissions would be asked to come to Pilani and explore a workable programme that would be appropriate for him/her before admission is completed. If required, the candidate may have to take certain examinations in various subjects that he/she has completed before a prescribed programme is pronounced for him/her there onwards.

However, there are certain situations which cannot be treated as advanced standing. In view of the uncertainty of the level to which some of the courses of the First Degree programmes is treated as optional subjects in the 10+2 system, to be consistent with the past tradition, no student is allowed to register in a course if he/she is considered to be overprepared in relation to the content of the course. Some examples of such courses are: General Biology, Engineering Graphics and Workshop Practice. Such an overprepared student is required to take an appropriate higher level course, as determined by the Associate Dean, Academic, Undergraduate Studies Division.

Dual Degree Scheme

The Institute has created facility by which any student who is admitted to M.Sc. programmes (offered under Group B) is offered a second degree in B.E programmes under dual degree scheme. This assignment is made on the basis of Progressive Branching Index (PBI) at BITS at the end of the first year, separately in Pilani, Goa and Hyderabad campuses.

Number of dual degree seats in any particular branch of engineering is decided by using following formula:

$$A = \frac{P \times Q}{R}$$

Where A is the number of dual degree seats in an engineering branch; P is the total number of students eligible for dual degree in science; Q is the number of engineering students admitted in an Engineering Branch in which number of dual degree seats need to be assigned; and R is the total number of students admitted in Engineering on the day of admission.

If any student is under the purview of ACB, his/her pursuit of the Dual Degree will be governed by the clause 7.02 of the Academic Regulations. He/She is required to maintain a minimum CGPA of 4.5 at the end of the fourth Semester failing which ACB may recommend withdrawal of the dual degree offer made to him/her.

Students in any other group seeking a second degree from amongst the programmes in the same group or another group will also be considered under 'other' priorities.

Transfer

(i) Within the same tier

It is possible for a student to seek transfer from one programme to another in the middle of a programme without starting from the beginning. This is possible because he/she is given credit for what he/she has done till then towards the requirements of the programme to which he/she seeks the transfer. Details have to be seen in the Academic Regulations. Transfer is possible from M.E. (all branches) and M.Pharm. to M.Phil. On the other hand, very restricted and tutored transfer would be possible from M.Phil. to M.E./ M.Pharm.

Since admission to a programme is done on assigned and competitive basis, there cannot be any scope of undoing the fact of an assigned admission through transfer. Thus only exceptionally meritorious students in a limited number of cases can expect to compete for transfer to a more sought-after programme. On the other hand, transfer to a less sought-after programme for a student who is unable to cope with the rigors of the programme in which he/she has been admitted would be readily used to rehabilitate him/her without much loss of time. In any event, transfer must be treated as an admission process.

(ii)   From First Degree to Higher Degree / Ph.D. Degree:

In the case of bright and promising student of the Integrated First degree programmes a transfer to Higher Degree and/or Ph.D. degree may also be provided.

(iii)   Between Ph.D. and higher degree programmes:

Under special situations a transfer between Ph.D. and higher degree programmes may be permitted. Movement in either direction is theoretically possible. The Institute's Academic Regulations must be consulted for details.

Audit

The facility of taking a course on audit is principally conceived to give an opportunity to a student to update his/her knowledge in selected courses. It is expected to meet primarily the needs of casual students (not enrolled for degree). No degree of the Institute can be acquired by merely taking courses on audit. There are certain courses like Foreign Languages, Music, etc. which are neither part of a degree programme nor are available through electives. Any student who wishes to take such courses can take them only on audit basis and also on payment of additional fees.

Other Flexibilities

The structure of degree programmes and the Academic Regulations also provide certain other flexibilities like choice of electives, number of electives, repetition of courses, departure from normal pace, withdrawal from or substitution of course(s) etc.

Academic Regulations

The operations described above are not exhaustive. For precise rules, Academic Regulations of the Institute may be consulted.

UNIVERSITY-INDUSTRY LINKAGE

A recurring theme in the realm of educational reform and innovation has been that of linking university education with industry experience. Since its very inception in 1964, the Institute has been committed to University-Industry Collaboration. Beginning in 1973, the Institute has taken pioneering initiatives towards the development of institutionalized linkages with industry, through its (i) Practice School, (ii) Technology Innovation Center, and (iii) Off-campus work-integrated learning programmes. The details of Practice School are described here.

PRACTICE SCHOOL

All Integrated First Degree and Higher Degree Programmes of the Institute provide a Practice School option. A student who exercises this option receives, on successful completion of the requirements of the programme, a degree which carries the tag, "With Practice School".

Theme

BITS is strongly committed to the view that university education must be oriented so as to (i) meet the rapidly changing needs and challenges of the environment, (ii) help people use their intelligence and become capable of facing unfamiliar, open-ended real-life situations, and (iii) bear an economic relevance to the society.

The Practice School (PS) method of education links the university with the professional world, by infusing the reality of the world of work into the educational process. The classroom is shifted for a period of 7½ months to a professional location where the students, under the supervision of the faculty, are involved in applying the knowledge acquired in the classroom to finding solutions to real life problems. The PS experiment began with a small group of 12 students in 1973 and has been extended to accommodate all students from all disciplines. The distinguishing features of the PS method of education - (i) the work of the students is supervised and evaluated by faculty, (ii) the credits earned by the student count towards the total credit requirement of the degree, and (iii) the PS option is available to students of all disciplines - make it a bold and radical educational reform with no parallel.

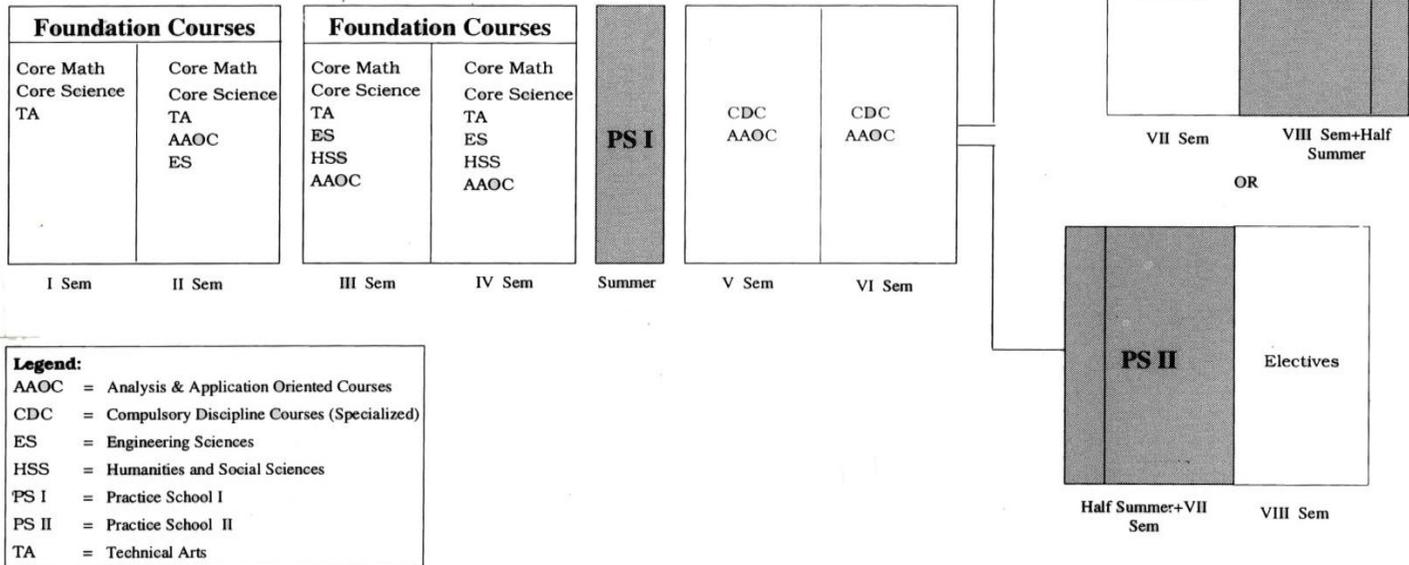### Operation of the PS Programme

The **PS** programme for the Integrated First Degree has two components, namely **PS-I** of two months duration implemented during the summer following the 2nd year and **PS-II** of five and a half months duration implemented during either of the semesters of the final year. (Refer to the chart on page II-12) Dual degree students can also opt for PS-II in both the semesters of the final year.

The **PS** Programme for Higher Degree has a single component, namely Practice School for Higher Degree operating in an identical fashion to PS-II, in the final semester of the Higher Degree Programme.

Practice School - I (PS-I)

This component is the first exposure to the world of work, necessary for the

subsequent problem solving experience during PS-II. It is implemented at large industrial complexes, research and development centers, software development houses, pharmaceutical companies, etc. While the general aim of PS-I is to afford an opportunity for the student to learn how work is organized and carried out; by a process of observation and participation, the learning can be quite varied and exhaustive depending on the nature of the organization. It provides an opportunity for a detailed understanding of vast engineering operations and its various facets such as inventory, productivity, management, information systems, human resource development, etc.

Foundation Courses		Foundation Courses								
Core Math Core Science TA	Core Math Core Science TA AAOC ES	Core Math Core Science TA ES HSS AAOC	Core Math Core Science TA ES HSS AAOC	PS I	CDC AAOC	CDC AAOC		Electives	PS II	
I Sem	II Sem	III Sem	IV Sem	Summer	V Sem	VI Sem		VII Sem	VIII Sem+Half Summer	

OR

PS II	Electives
Half Summer+VII Sem	VIII Sem

Legend:

AAOC	=	Analysis & Application Oriented Courses
CDC	=	Compulsory Discipline Courses (Specialized)
ES	=	Engineering Sciences
HSS	=	Humanities and Social Sciences
PS I	=	Practice School I
PS II	=	Practice School II
TA	=	Technical Arts

The Structure of Integrated First Degree Programme
(Practice School Option)

20

Practice School - II (PS-II)/ PS for Higher Degree

PS-II is attended by the students of the Integrated First Degree Programmes in their final year of study. This is also faculty supervised, and for this purpose, teachers are located at various centers around the country where PS stations operate. In order to maintain continuity of operation, the students are divided into two batches, about half the students doing PS-II in the first semester and the other half in the second semester. In either case, the time duration is augmented by a part of the summer term (preceding or following the semester). The operation is therefore round the year with batches coming about every six months. PS for Higher Degree is however available only in the final semester of the programme, after completion of the campus-based courses. The PS-II/PS component is implemented at Production and Manufacturing units, Design, Development and Consulting Agencies, Research and Development Centers, Financial Institutions, Software Development organizations, etc. The student education here is in terms of the direct involvement of the student in problem solving efforts of specific interest to the host organization. The assignments are identified by the PS faculty well in advance in consultation with experts from the host organization. The problems are often multidisciplinary in nature, which are assigned to a group of students drawn from different disciplines. The professional expert in charge of a particular problem and the PS faculty play the roles of consultant and supervisor respectively. The students are encouraged to work independently and are required to defend the technical aspects of their work through periodic written and oral presentations. Emphasis is laid on realizing the importance of teamwork, development of leadership qualities, and the need for effective time management.

Some of the typical assignments that the students have undertaken are: Development of Category Configuration Portal; System on Chip Design and Verification; Design and Development of Features in the Mtg-Automation; Risk and Control Tools in Operations; Integrating HP Performance and HP Nonstop Measure; Planning and Implementing Events at ECLUB and Work at Resource Bureau; Partial Metadata Get/Set Support in CDMI Server; Sabre Cruises Booking Analytics Tool; Mobile Engineering at Pocket Gems; Data Management and Organizaion of Datasets.

Typical PS Station – A Model

The PS station is the analogue, in the professional world, of the university classroom and laboratory. The Institute endeavours to ensure that each PS station has all the physical facilities necessary to carry out meaningful education. In fact, host organizations have always come forward with all possible assistance. At least one faculty member is attached with each PS station. Since a city may have more than one PS station, the term PS Centre is used to designate a location where one or more PS stations are present.

PS Assignments

The general nature of PS-I assignments is of study and orientation. However, the assignment plays a pivotal role in PS-II and is of direct and immediate relevance to the host organization. The educational challenge is therefore that of evolving the pedagogy for teaching, learning, and evaluation while the students are involved in their problem solving efforts. The tasks are generally multidisciplinary, mission oriented and therefore time bound and open ended. The development of solutions to such problems requires a scientific attitude, technical competence, discipline and adherence to procedure, decision making ability, and a spirit of curiosity and exploration. Often, the assignments form a part of long term research and development projects.

Student Allotment in PS

Allotment in PS-I is done keeping the student's preferences and academic performance in view, along with the availability of physical facilities, in particular, accommodation. Student allotment in PS-II is, however, a much more complex and multi-dimensional task. With the help of the PS faculty, information about the total set of skills and attributes required of the student for the task at hand is collected from the host organization. Simultaneously, a profile of each student is prepared, incorporating details such as CGPA, performance in various categories of courses including electives and projects, assignment worked on in PS-I, professional interests, and extra-curricular achievements. With this information base, a matching is carried out, keeping in view the student's preferences and constraints of physical facilities.

Computerization of the various activities related to PS, such as profile preparation, allotment, monitoring, and feedback has made the entire process expeditious and efficient.

Evaluation in PS courses

The PS method of education, as has been emphasized earlier, is a medium for integrating real-life situations with the learning process. In line with this objective, the student is given the responsibility of planning, scheduling, implementing, and defending the steps to the solution of the assigned problem. The students work under the supervision of the faculty, in consultation with the professional expert(s). As with all other courses, a process of continuous evaluation is followed. The PS method of education seeks out and focuses attention on many latent attributes which do not surface in the normal classroom situation. These include professional judgment and decision making capacity, inter-disciplinary approach, data-handling skills, ability in written and oral presentation, leadership qualities, ability for team work, sense of responsibility, ability to meet deadlines, etc. These attributes are judged by the faculty through various instruments of evaluation, namely quiz, viva, seminar, group discussion, project report, diary, and daily observation. At the end of each PS course, a student is awarded a letter grade based on his total performance. Supplementing the degree transcript issued by the Institute, the PS Division issues a 'Practice School Transcript' to those students who opt for the PS stream. This transcript gives a complete record of the performance of the student in the PS programme. It also includes a rating sheet which describes qualitatively the student's personality traits mentioned earlier.

Since the PS programme interfaces with the world outside the campus, whenever the progress of a student in a PS course is found to be unsatisfactory and/or guilty of conduct unworthy of the professional world, the PS option may be withdrawn by the Institute, without any reason being assigned.

Role of Professional Experts in PS

The PS programme clearly places demands on the time and energy of various officers from the host organization. However, every effort is made to ensure that they are not burdened with the day-to-day details concerning the educational and

administrative organization of the PS programme, these being the responsibility of the PS faculty.

In the case of PS-I, the preparation of the educational schedule is initiated at the Institute itself. On reaching the PS station, the faculty discusses the same with officers from the host organization, seeking their concurrence and their suggestions. The faculty engages the students on various assignments and periodically informs the experts of the progress made. The faculty may also arrange meetings of the students with the experts and also invite them to participate in seminars given by the students from time to time. At the end of the course, the faculty seeks the expert's critical comments on the report submitted by the student, to receive essential feedback on the quality of the work.

In respect of PS-II, the officers from the host organization first come into picture when the faculty is compiling the problem bank for the batch of students to come. At this stage, the experts provide the details of the various problems on which the students will work, as well as their requirements in terms of the type of student input for each assignment. After the arrival of the students at the PS station too, the faculty remains at the helm of affairs, forming student groups, assigning projects, conducting evaluation components, etc. The faculty also ensures that each student blends well with the group of fellow students and staff from the host organization, in which he/she is working. When seminars or group discussions are held, the faculty invites the officers to participate. During the course of the assignment, the students seek consultation with the expert, normally through the faculty, who ensures that the student is well-prepared for these meetings. At the end of the course, the student is required to present a seminar and defend the technical credibility of the work before as large a gathering of experts as possible. Detailed discussions ensue on various technical aspects of the problem, often resulting in the resolution of critical issues involved.

More details about Practice School are given under Practice School section.

RESEARCH AT BITS

Research is an important academic activity at BITS Pilani. Large number of students at all levels of the educational programmes are involved in research that exploits the multidisciplinary educational base emerging out of the broad-based integrated education in engineering, science and humanities. Strong emphasis is laid on interdisciplinary, mission-oriented and relevant research. The Practice School, which is an important component of the integrated programmes of BITS Pilani, provides an opportunity to identify research problems relevant to industrial needs. The participation of students and the faculty members in research ensures a team effort towards problem solving activities. Such a total involvement of the faculty as well as the student population integrate research and teaching activities of the Institute in such a manner that they draw strength and support from each other.

Research Areas

Topics of Research can be chosen from any of the disciplines in which the Institute offers Higher Degree and First Degree programmes and also from the areas given in Table at the end of this Part.

Research Linkages

The Institute has built up research linkages with a large number of R & D organizations in the country and abroad and provisions exist for candidates to work for a part or whole of the research work at these organizations in their thrust areas. Some of the organizations are: Uniformed Services University of Health Sciences, Bethesda, USA; Tata Institute of Fundamental Research, Mumbai; Central Electronics Engineering Research Institute, Pilani; Central Drug Research Institute, Lucknow; Institute of Pathology, New Delhi; Sankara Nethralaya and Elite School of Optometry, Chennai; LV Prasad Eye Institute, Hyderabad; and Institute of Cardio-Vascular Diseases, Chennai.

Research Components in the Educational Programme

Research is emphasized in all the educational programmes of the Institute. At the first degree level, Thesis and at the higher degree level Dissertation are optional alternatives to the Practice School. Thesis is an integral component of the Ph.D

programme.

While some salient features are described below, for further details, please refer to Academic Regulations.

(i) In the First tier, a single degree student must take either Thesis or PS and a dual degree student has to normally do Thesis for one degree and PS for the other degree. Such a student can also opt for PS/Thesis for both the degrees.

(ii) Students will be assigned a topic of research and a supervisor after giving due consideration to the student's preference, the research goals of the Institute and the equalization of the work-load of the supervisors.

(iii) A first degree student opting for a Thesis has two options: (i) register for a 16-units Thesis, in which case the student cannot be simultaneously registered in any other course; or (ii) register for a 9-units Thesis, in which case it may be necessary for the student to take additional elective courses to meet graduation requirements and He/she may be permitted to register in courses simultaneously with the Thesis

(iv) Thesis is graded in terms of same letter grades.

(v) Thesis can also be done at collaborating organization, industries under joint supervision.

Areas of Research

1. **Biological Sciences:** Environmental Biotechnology, Bioinformatics, Microbial Biotechnology, Molecular Biology, Molecular Parasitology & Vector Biology, Molecular Diagnostics, Genomics, Plant Biotechnology.

2. **Bioengineering**: Biomaterials, Biomechanics, Bioinstrumentation, Bio-transport Process.

Areas of Research

3. **Civil Engineering**: Structures, Water Resources, Geotechnical, Transportation, Environmental Engineering, Image Processing and G.I.S., Disaster Management, Earthquake Engineering, Solar Architecture, Finite Element Method, Non-traditional optimization algorithms, Artificial Neural Networks, Fuzzy Logic and Multicriterion Decision Making and their applications.

4. **Chemical Engineering:** Biochemical Engineering, Biomass Gasification, Computation Fluid Dynamics, Energy Engineering, Environmental Engineering, Evolutionary Computation, Modeling and Simulation, Multi-Objective Optimization, Multiphase Reactors, Process Dynamics and Control, Process Integration and Process Intensification, Reaction Engineering, Polymer Science and Engineering, Process Synthesis and Design, Separation Processes and Petroleum Refining and Petrochemicals.

5. **Chemistry:** Organic including Natural products, Bioorganic, Inorganic, Bioinorganic, Physical, Biophysical, Medicinal, Analytical, Green, Theoretical and Computational Chemistry; Nanomaterials; X-Ray Crystallography.

6. **Computer Science & Information Systems:** Computer Networks, Distributed Systems, Database Systems, Software Engineering, Operating Systems, Multimedia, Computer Control Systems, Computer Architecture, Compilers, Formal Methods, Information Retrieval.

7. **Economics and Finance**: Macroeconomic Models and Policy, Microeconomic Analysis, Money and Financial Markets, Financial Engineering, Econometric Studies, Financial Modeling, Mathematical Economics, Environmental Economics, Resource Management Systems, Growth Economics, Banking, Micro Finance, Capital Markets, Macroeconomic Modeling, Applied Finance, Environment and Resource Economics International Trade and Finance, Strategy, Financial Management, Corporate Planning, Entrepreneurship, Project Management.

Areas of Research
8. **Electrical and Electronics Engineering:** Communication Systems, Wireless and Mobile Ad-hoc Networks, Optical Communication and Networks, Microelectronics and VLSI Design, Signal Processing and Embedded Systems, Power Electronics and Drives, Power Systems, Telecommunication, Robotics and Intelligent Systems, Fiber Optic Sensors, Artificial intelligence techniques in robotics, Instrumentation & Control, Wearable computing, Energy and Power Systems.
9. Humanities and Social Sciences: Film Studies, Music, Theatre, History and Politics, Language, Communication and Soft Skills, Literature and Cultural Studies, Comparative Indian Literature, ELT, Media Studies and Advertisement, Ethics and Indian Philosophy, Psychology, Public Policy, Public Administration and Development
Studies, Urban and Landscape Studies, Digital Humanities, Journalism, Tourism and Travel, Sociology, Philosophy, Ethics, Higher Education, Spiritual Intelligence, Development Studies, Computer-Mediated Communication, Technology Enabled Learning / Education.
10. **Mathematics:** Coding Theory, Cryptology, Algebraic Geometry, Parallel Computing, Fuzzy Logic and its applications, Water pollution, Mathematical Modelling, Nonlinear functional analysis, Computational fluid dynamics, Optimization, Operations Research, Mathematical Biology, Differential equations, Fractional Calculus, Dynamical System, Epidemiology.
11. **Mechanical Engineering:** Product Design and Development, Manufacturing Engineering, Manufacturing Excellence Practices, Design Engineering, Materials Engineering, Fracture Studies, Non-destructive Testing, Robotics and Intelligent Systems, Nano Technology, Thermal Engineering, Energy Systems Engineering and Energy Management.

Areas of Research

12. Management: Indian Management Practices, Management Practices in MNC, Cross Cultural Management, Performance Appraisal, Strategic Marketing, Retail, Brand Management, Clustering Methodology, Strategy, Sustainable Development, Evolving Capitalism& Regulations, Project Management, Production Management, Facility Layout Planning, Application of TOC in Operations Management, Supply Chain Management, R&D Management, R&D Performance Measurement, Technology Management, ERP, MIS, E-business, Image Processing, Risk Management, Capital Markets, Quantitative Methods, Business

Modeling, Stochastic Modeling of Production Systems, Reliability Analysis & Modeling, Organizational Behavior, Positive Health Psychology, I/O Psychology, Indian Psychology, Innovation and Creativity, Negotiation Skills, Managerial Skills, Entrepreneurship and Health Care Management.

13. **Pharmacy**: Drug Design, Synthesis and Screening of New Bioactive Molecules, Drug Delivery Systems, Phytochemistry and Natural Drugs.

14. **Physics**: Materials Physics; Condensed Matter Physics; Nuclear, Particle and High Energy Physics; Optics & Spectroscopy.

15. **Interdisciplinary Research:** Nanotechnology and nanoscience, Nano-robotics, Micro-electro-mechanical systems (MEMS), Nanomaterials, Mechatronics, Waste, Water and Energy management

16. **Educational Innovation and Institutional Development**

Respective Department HOD's may be contacted for further information

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