

## **EDUCATIONAL PROCESS**

The mission of BITS 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 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 has established purposeful linkages with universities. 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 legiti-

mate educational and operational needs of students. Some of these aspects are described in various sections that follow.

## **PROGRAMMES OF STUDIES**

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 the next page gives all the programmes offered by the Institute.

**Birla Institute of Technology & Science, Pilani**  
**Three Tier Structure of Education**

Ph. D. Degrees			
Higher Degrees			
On-campus programmes		Off-campus Work-Integrated Learning Programmes	
<b>M.E.</b> Biotechnology, Chemical, Civil with specialisation in Structural Engineering, Infrastructure Systems and Transportation Engineering, Communication Engineering, Computer Science, Design Engineering, Electrical with specialization in Power Electronics & Drives, Embedded Systems, Manufacturing Systems Engineering, Mechanical, Microelectronics, Software Systems  <b>M. Pharm.</b>  <b>M. Phil.</b> Biological Sciences, Chemistry, Economics, English, Management, Mathematics, Physics  <b>Master of Business Administration (MBA)</b> Engineering & Technology Management, IT enabled Services Management		<b>M. Phil.</b> Hospital & Health Systems Management, Optometry, Physician Assistant  <b>M. Phil. (Applied)</b>  <b>M.S.</b> Consciousness Studies, Consultancy Management, Embedded Systems, Manufacturing Management, Mechanical Systems Design, Medical Laboratory Technology, Microelectronics, Pharmaceutical Operations and Management, Pharmaceuticals, Quality Management, Science Communication, Software Engineering, Software Systems, Telecommunications & Software Engineering.	
Integrated First Degrees			
On-campus programmes			Off-campus Work-Integrated Learning Programmes
<b>Group A</b> <b>B.E. (Hons.)</b> Chemical, Civil, Computer Science, Electrical & Electronics, Electronics & Instrumentation, Mechanical  <b>B. Pharm. (Hons.)</b>	<b>Group B</b> <b>M.Sc. (Hons.)</b> Biological Sciences, Chemistry, Economics, Mathematics, Physics	<b>Group C</b> <b>M.Sc. (Tech.)</b> Engineering Technology, Finance, General Studies, Information Systems,	<b>B.S.</b> Engineering & Industrial Technology, Engineering Technology, Industrial Engineering & Technology, Manufacturing Engineering, Information Systems, Marine Engineering, Nautical Sciences, Nautical Technology, Ophthalmic Assistant, Optometry, Physician Assistant, Power Engineering, Process Engineering  <b>M.Sc. (Tech.)</b> Pharmaceutical Chemistry

**For Admission to on-campus programmes**

**Integrated First Degree :**

Normal Input : Pass in 10+2 from the Central/State Board or its equivalent with Physics, Chemistry, Mathematics and adequate proficiency in English.

**Higher Degree :**

Normal input : Integrated First Degree of BITS or its equivalent.

**Ph.D. Degree:**

Normal Input: Higher Degree of BITS or its equivalent.

## **Integrated First Degree Programmes**

The Integrated First Degree Programmes are offered at the first tier with nomenclatures like B.E. (Hons.), B.Pharm. (Hons.), M.Sc. (Hons.), and M.Sc. (Tech.). 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., B.Sc. (Hons.), B.A., B.A. (Hons), 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. (Hons.)**

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

### **(b) B.Pharm. (Hons.)**

The Institute's B.Pharm.(Hons.) 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 this programme.

### **(c) M.Sc.(Hons.)**

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, they also incorporate many courses which have been notionally considered to be the preserves of engineers. The integrated nature of the programmes and their analytical and engineering science con-

tents 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 for a second degree from B.E.(Hons.) and B.Pharm. degrees under the dual degree scheme.

### **(d) M.Sc.(Tech.)**

These programmes are basically multidisciplinary 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 Engineering Technology, Information Systems, Finance and General Studies.

The programme on Engineering Technology is planned to give to the students an exposure in all engineering disciplines and it emphasises on issues and methodologies in the operation of various technological units. 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.(Hons.) Economics programme. 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. Further, the requirements of mathematics, science and applied science, etc. are normally different from B.E. (Hons.) and M.Sc. (Hons.). 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
<b>Group A programmes:</b> B.E. (Hons.) :Chemical :Civil :Computer Science :Electrical & Electronics :Electronics & Instrumentation :Mechanical B.Pharm. (Hons.)	Pass in the 12 <sup>th</sup> examination of the 10+2 system from a recognized Central/ State board or its equivalent with Physics, Chemistry, and Mathematics. Since the medium of instruction at BITS is English, candidates should have adequate proficiency in English. Further, the candidate should have obtained a minimum of aggregate 80% marks in Physics, Chemistry and Mathematics subjects in 12 <sup>th</sup> examination, with at least 60% marks in each of the Physics, Chemistry, and Mathematics subjects.	<b>Duration:</b> 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 individual student 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 years (10 semesters).  <b>Practice School:</b> All the integrated first degree programmes have Practice School options.
<b>Group B Programmes:</b> M.Sc. (Hons.) :Biological Sciences :Chemistry :Economics :Mathematics :Physics	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.	<b>Dual Degree:</b> Institute offers dual degree facility to number of students who are admitted. Specifically any student admitted to M.Sc.(Hons.) programmes is almost ensured to be accommodated in the dual degree in one of the B.E.(Hons.)programmes/ B. Pharm. (Hons.).
<b>Group C Programmes:</b> M.Sc. (Tech.) :Engineering Technology :Finance :General Studies		<b>Electives:</b> By judicious choice of electives, students of any of these programmes can make themselves prepared for (i) admission to Higher Degree programme (ii) a good career in teaching & research, (iii) Multidisciplinary professional

:Information Systems		career etc.
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## HIGHER DEGREE PROGRAMMES

### M.E./M.Pharm./M.Phil.

The requirements of these programmes are described in terms of the total number of units which a student is required to complete rather than the duration. However, a normal student may be able to complete such a programme in four semesters, wherein the last semester may be spent for either of the two available alternatives, namely, Dissertation and Practice School. Certain well prepared motivated and hardworking students who are in dissertation stream may finish the programme in three semesters by starting the

dissertation component right in their first semester. The programmes are intended to give a penetrating professional experience and an opportunity to acquire further competence either in one's own discipline or in many other traditional areas of Engineering, Pharmacy as well as interdisciplinary areas, like, Embedded Systems, Microelectronics, Software Systems, Biotechnology, Manufacturing Systems, Design Engineering, Transportation Engineering, etc.

Following is the exhaustive list of all the higher degree programmes approved by the Senate.

Name of the programme	Input
<b>M.E.</b>	<b>Normal input</b>
: Chemical	Integrated first degree of BITS in the same discipline or its equivalent.
: Civil, with Specialisation in <ul style="list-style-type: none"> <li>• Structural Engineering</li> <li>• Infrastructure Systems</li> <li>• Transportation Engineering</li> </ul>	
: Computer Science	
: Mechanical	
: Communication Engineering	Integrated first degree of BITS in Electrical & Electronics or in Electronics & Instrumentation or its equivalent
: Electronics & Control	
: Electrical with specialization in Power Electronics and Drives.	Integrated first degree of BITS in Electrical & Electronics or Electronics & Instrumentation or Computer Science or its equivalent.
: Embedded Systems	
: Internet Technology & e-Business	
: Design Engineering	Integrated first degree of BITS in Mechanical or its equivalent. Any other Integrated first degree of A & B groups or M. Sc. (Tech.) Engineering Technology of BITS or its equivalent with the requirement of taking certain additional courses.
: Manufacturing Management	
: Manufacturing Systems Engineering	
: Microelectronics	Integrated first degree of BITS in Electrical & Electronics or Electronics & Instrumentation or Computer Science or Physics

Name of the programme	Input
: Software Systems : Systems & Information	or its equivalent.  Any first degree of the Institute, provided the minimum component of MATH, TA, AAOC, ENGG, prescribed in each of the groups A, B and C through compulsory requirements or conventional options.  <b>Other inputs:</b> a) For those Integrated first degree programmes under distance learning and collaborative programmes which have no counterpart in Groups A, B and C, the minimum requirement should be at least what is prescribed in Group C  b) Any equivalent degree from other University with preparation indicated above.
: Bioengineering	Any integrated first degree from Groups A and B or M.Sc. (Tech.) Engineering Technology degree of BITS or its equivalent with adequate preparation in General Biology, Mechanics of Solids, Transport Phenomena, and Structure and Properties of Materials.
: Biotechnology	Any Integrated first degree of BITS or its equivalent with adequate preparation in Bio-Chemistry and Microbiology.
: Materials Science and Technology	Any integrated first degree from Groups A and B or M.Sc. (Tech.) Engineering Technology degree of BITS or its equivalent with adequate preparation in Structure and Properties of Materials.
<b>M.Pharm.</b>	Integrated first degree of BITS in Pharmacy or its equivalent.
<b>M.Phil.</b> in Public Health	Any Integrated First Degree of BITS or its equivalent; M.B.B.S., B.D.S., M.Sc. (Nursing) or their equivalent.
<b>M.Phil.</b>	Any Integrated first degree of BITS or its equivalent. Note: While no direct admissions are planned for M.Phil. degree, students who are admitted to Ph.D. may be asked whenever necessary, to register for this degree.

**Special features on Admissions to any M.E. programme:**

Students coming with integrated first degree of BITS in A & B groups may be considered for admission to any M.E. Programme with the requirement of taking additional courses. The duration in these cases may be more than the normal duration and will be determined on a case by case basis. Similar dispensation may also be possible for students coming with an engineering degree from IITs and other reputed institutions.

### Master of Business Administration

The Institute has been running a Management programme namely Master of Management Studies (MMS) with a strong foundation in Science & Engineering. Based on feedback from industry, a new MBA programme has been introduced with input requirement as first degree of BITS or its equivalent. The programme endeavors to create manpower who have scientific and engineering approach to business administration. Students will also have a reasonable exposure to certain modern technologies. The programme is designed to have many flexibilities and a very strong component of industry project experience. The input for the programme may have multiple entry points. While principal input will be

students already possessing an engineering degree, those who have other qualifications like B.Sc., B.A., B.Com. may also apply provided they have aptitude towards having training in science, mathematics and technology as well. The requirements of the programme will necessitate such students to spend additional time which may vary from 1 to 4 semesters depending upon their qualifications. For students not having an engineering degree, the course requirement will be worked out, looking at the earlier training on a case-by-case basis at the time of admission. However, for the current year, admissions are planned for an input with engineering degree only in which case the normal duration is 4 semesters.

Master of Business Administration (MBA) in	Input	Special features
(i) Engineering & Technology Management (ii) IT enabled Services Management	Any Integrated first degree of BITS or BE/BTech in Engineering from other recognized Universities	This programme is equivalent to the existing MMS programme of the Institute.

### DOCTORAL PROGRAMMES

The Institute's Ph.D. programme is structured on the basis of a preferred input of those who have completed one of the Institute's higher degrees. It requires each student to finally qualify for formal acceptance in the programme only after passing a qualifying examination.

The Institute also offers a unique opportunity for professionals at large to work for Ph.D. in the settings of their own work environments through Off-campus Ph.D. scheme.

Ph.D.	<p><b>Normal input</b> Any Higher degree of BITS or its equivalent.</p> <p><b>Other inputs</b></p> <ol style="list-style-type: none"> <li>Integrated First Degree of BITS or its equivalent.</li> <li>Any preparation between the above described first degree and higher degree.</li> <li>High professional standing and proven competence even without a formal degree.</li> </ol> <p>Note: Each case of other inputs will be decided on a case by case basis regarding admission and with the requirement of doing higher degree courses before taking qualifying examination. In the case of inputs with qualification like B.E., M.Sc., etc. without experience, the application will be first examined for suitability to any of the higher degrees of BITS.</p>	<p><b>Structure:</b> Qualifying examination, Teaching practice, Foreign language when required, Thesis and Seminar. Course work as specified for various input and prior preparation.</p> <p><b>Locale:</b> Normally any of the BITS campuses and other off-campus locations with prior approval.</p> <p><b>Ph.D. Aspirant:</b> To help in the development of professionals at large, provision exists for taking directly the qualifying examination as a 'Ph.D. Aspirant' even before seeking admission to the Ph.D. Programme. The Aspirants can work in the settings of their own work environment with the approval of Research Board.</p>
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## **PROGRAMMES OFFERED AT BITS, PILANI – GOA CAMPUS**

### **Integrated First Degree Programmes**

- B.E. (Hons.) Chemical
- B.E. (Hons.) Computer Science
- B.E. (Hons.) Electrical & Electronics
- B.E. (Hons.) Electronics & Instrumentation
- B.E. (Hons.) Mechanical
- M.Sc. (Hons.) Biological Science
- M.Sc. (Hons.) Chemistry
- M.Sc. (Hons.) Economics
- M.Sc. (Hons.) Mathematics
- M.Sc. (Hons.) Physics
- M.Sc. (Tech.) Information Systems

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

## **PROGRAMMES OFFERED AT BITS, PILANI – DUBAI CAMPUS**

### **Integrated First Degree Programmes**

- B.E. (Hons.) Computer Science
- B.E. (Hons.) Electrical & Electronics Engineering
- B.E. (Hons.) Electronics & Instrumentation Engineering
- B.E. (Hons.) Mechanical Engineering
- B.E. (Hons.) Chemical Engineering

All the programmes described above have a Practice School option that finds a formal method of bringing the real ambience of the world of work into the educational process.

### **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 aims at maximizing the learning 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 optimise his/her learning process. Self-study by the student is therefore an important factor in the planning of teaching and evaluation and the student exhibits interest and respond 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 organisational 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, 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 coursewise 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, home work, 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, B, 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 performance: A-Excellent, B-Good, C-Fair, D-Poor and E-Exposed. Further, these letter grades have points associated with them in a quantified hierarchy. 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 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 fulfil 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 authorised 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 for the degree.

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 the case of Ph.D., this is done by the 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 normalise all competing candidates, generally the Institute uses a Progressive Branching Index (**PBI**).

#### **Admissions in both Semesters**

The structural flexibilities available in the Institute make it possible to admit students in both the semesters. However, in the case of first degree programmes most of the admissions are made during the first semester itself. The few admissions made in the second semester are essentially to meet the depletion during the first semester and also to get the most outstanding students who could not apply in time for the first semester admissions. In the case of higher degree programmes, 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 only 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 candidates 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, Graphics and Workshop Practice. Such an overprepared student is required to take an appropriate higher level course, as determined by the Dean, Instruction.

#### **Dual Degree Scheme**

One of the most popular flexibilities provided in the Institute's educational structure is the dual degree scheme under which it is possible for a student to work for and complete concurrently two integrated first degrees within a reasonable period of time. All students admitted to Group B programmes are given an opportunity to work under this scheme for one of the Group A programmes also; assignment being made by competition on their performance during the first year at BITS.

In the assignment of dual degree, first priority is given to the students in Group B seeking a second degree under this scheme from amongst the programmes in Group A. After fully satisfying the known needs of the first priority, a second operation is done to consider the other priority, namely, students in any group seeking a second degree from amongst the programmes in the same group or another group.

#### **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 rigours 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. Since its very inception in 1864, 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 for 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".

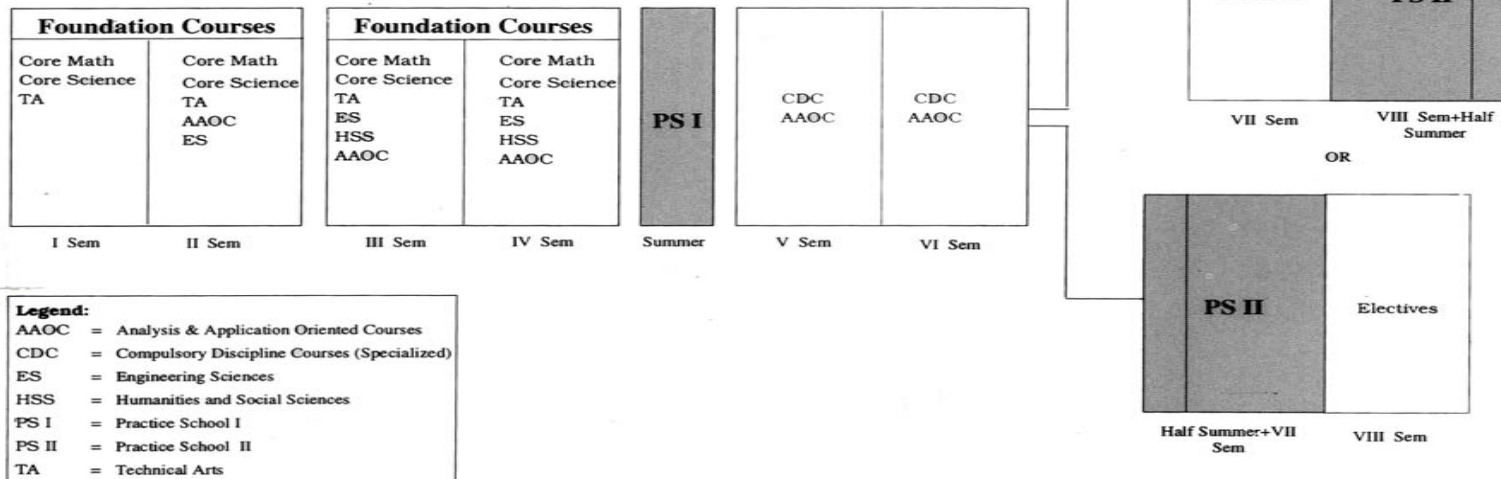
#### **Theme**

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 become more intelligent and capable of facing unfamiliar, open-ended real-life situations, and (iii) bear an economic relevance to society.

The Practice School (PS) method of education links the university with the professional world, by bringing the reality of the world of work into the educational process. The classroom is taken 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 was extended to accommodate all students from all disciplines. The distinguishing features of the PS method of education, viz., (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 III-7) Dual degree students can also opt for PS-II in both the semesters of the final year.



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

The **PS** Programme for Higher Degree has a single component, namely Practice School for Higher Degree operates in 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. Students observe science and technology in action, develop an awareness of the method of scientific experimentation, and often have occasion to see, study and operate sophisticated and costly equipment. They also observe the principles of management they have learnt in class, being put into practice, and see how multidisciplinary teams of experts from engineering, science, economics, operations research, and management participate in dealing with techno-economic problems at the micro and macro levels. Finally, it enables them to develop and refine their language, communication and inter-personal skills, both by its very nature, and by the various evaluation components, such as seminar, group discussion, project report preparation etc. The broad-based core education, strong in mathematics and science, and rich in analytical tools, provides the necessary foundation necessary for the student to understand properly the nature of real-life problems. The students are accompanied by a teacher, who is responsible for coordination with the organization, and the day-to-day educational as well as evaluation details.

Some of the places where this component has been implemented are Hindustan Copper Complex, Khetri; National Physical Laboratory, Delhi; Bhabha Atomic Research Centre, Mumbai; Central Food and Technological Research Institute, Mysore; Century Textiles & Industries Ltd., Mumbai; Space Application Centre, Ahmedabad; Bokaro Steel Plant, Bokaro; Hindustan Machine Tools, Hyderabad; Bharat Heavy Electricals Ltd., Hyderabad, Haridwar, Trichy and Bhopal; The Hindustan Times, New Delhi; CDRI, Lucknow; CSIR Complex, Chennai; Parke-Davis, Hyderabad; ITC, Chennai; ECIL, Hyderabad; MRF, Chennai; Madras Cements, Jaggayyapet; RBI, Mumbai.

#### **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 year round with batches coming about every six months. PS for Higher Degree is however available typically 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, and are then assigned to a group of students drawn from different discip-

lines. 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: The Design and Development of an Immediate Release Generic Drug Product for Regulated Market, Implementation of Broadcom Video Network (BVN) Block for Dual High Definition H.264 Decode Cable/Satellite Digital Settop Box Chip, Graphical User Interface for Fuel Cell and Battery Modeling for Hybrid Electric Vehicles, Efficiency Improvement of Reverse Osmosis Water Treatment Unit, Implementation of the Memory Testing Methodologies, Development and Validation of Software Tools for Mobile Platforms, Characterization of the Proteome of GPI-AP Enriched Endosomal Compartments, Bio-Mass Assessment and Energy Potential of Vedaranyam, Kilvelur and Thirukuvilai Talukas of Nagapattinam District, Counterfeit Currency Detection - Instrumentation Techniques, Web Tools for the Classroom : Two Web-Based Applications that Enhance the Learning Experience

#### **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. It should be mentioned here that 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 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 is collected from the host organization with regard to the total set of skills and attributes required of the student for the task at hand. 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.

The various activities related to PS, such as profile preparation, allotment, monitoring, and feedback are computerized to make 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 student work under the supervision of the faculty, in consulate 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 then 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 student 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.

#### **Some PS Statistics**

Ever since its beginning in the year 1973 with just one station accommodating 12 students and 4



## LIST OF PS-I STATIONS

### **Ahmedabad**

Vikram Sarabhai Community Science Centre

### **Ballarpur**

Ballarpur Industries Ltd.

### **Bengalooru**

ANZ Bank, B.W. Lions Super Speciality Eye Hospital, Bangalore Stock Exchange Ltd., Center for Information and Communication Technology, Hical Magnetics Pvt. Ltd., Hindustan Aeronautics Ltd., Indian Institute of Astro Physics, Indian Institute of Science, Indrion Technologies, Manjushree Extrusions Ltd., Rail Wheel Factory, Yuken India Ltd.

### **Bhadravathi**

The Mysore Paper Mills Ltd.

### **Bhilai**

Bhilai Steel Plant

### **Chennai**

BITSUNAMI, Brakes India Ltd., Cancer Institute, Central Electronics Engineering Research Institute Chennai Centre, Central Leather Research Institute, Indian Bank, Indian Overseas Bank, Laser Soft Infosystems Ltd., Lucas TVS Ltd., National Metallurgical Laboratory Madras Centre, Ramco Systems Ltd., Sankara Nethralaya, Sundram Fasteners Ltd., Tamilnadu Science & Technology Centre, The Madras Medical Mission

### **Dahanu**

Reliance Energy Ltd.

### **Dehradun**

Indian Institute of Remote Sensing

### **Delhi**

Centre for Railway Information System, JBM Auto Components, National Physical Laboratory, North Delhi Power Ltd.

### **Durgapur**

Durgapur Steel Plant

### **Erode**

Seshasayee Papers & Boards Ltd.

### **Faridabad**

Gemi Motors India Pvt. Ltd., Mitra Industries

### **Goa**

Chowgule & Co. Ltd., Control Net (I) Pvt. Ltd., D-Link India Ltd., GKB Industries Ltd., Goa Shipyard Ltd., Himachal Futuristic Communication Ltd., IFB Industries Ltd., National Centre for Antarctic and Ocean Research, National Institute of Oceanography, Orchid Bio Medical Systems, Pentair Water India Pvt. Ltd., Siemens Ltd., Zenith Computers, Zuari Industries Ltd.

### **Gurgaon**

Bechtel India Pvt. Ltd., Engineers India Ltd., Precision Tech Enterprises, Rites Ltd.

### **Hazira**

Oil and Natural Gas Corporation Ltd.

### **Hosur**

TVS Motor Company

### **Hyderabad**

Accenture Services Pvt. Ltd., Advanced Systems Laboratory, Andhra Bank, Bevcon Wayors Pvt. Ltd.(BWPL), Bharat Dynamics Ltd., CARE Hospital (Banjara Hills), CARE Hospital (Nampally), Hetero Drugs Ltd., ICICI Bank, Image Hospitals, Indian Institute of Chemical Technology, ITW India Ltd., Karvy Consultants Ltd., KLR Industries Ltd., L.V. Prasad Eye Institute, Mishra Dhatu Nigam Ltd., National Geophysical Research Institute, SMS Country Networks Pvt. Ltd., SMS Pharmaceuticals Ltd., Strategic Insurance Services Ltd., Tecumseh Products India Ltd., Thermopads Pvt. Ltd., Vybra Automet Ltd., Wipro, Yashoda Hospitals, Zyfix Tools Pvt. Ltd.

### **Jamnagar**

Essar Oil Ltd.

### **Kalpakkam**

Indira Gandhi Centre for Atomic Research

### **Khetrinagar**

Hindustan Copper Ltd.

### **Kochi**

Carborundum Universal Ltd., Cochin Port Trust

### **Kolkata**

TEXMACO Ltd.

### **Kota**

Chambal Fertilizer and Chemicals Ltd.

**Kozhikode**

Centre for Water Resources Dev. & Mgt.

**Lucknow**

Industrial Toxicological Research Centre, Tata Motors

**Mumbai**

Advanced Centre for Treatment Research and Education in Cancer, Tata Memorial Hospital, Bhabha Atomic Research Centre, Bharat Petroleum Corporation Ltd. (Refinery), Bharat Petroleum Corporation Ltd.(Marketing), Century Rayon , ITW India Ltd., Tata Power Company Ltd.

**Mysore**

Central Food Technological Research Institute, TVS Motor Company

**Nagda**

Grasim Industries Ltd.

**Nagpur**

Maharashtra State Seeds Corporation Ltd., Mahindra & Mahindra Ltd.

**Noida**

Indo-Asian Fuse Gear Ltd.

**Pilani**

Birla Museum, Central Electronics Engineering Research Institute, Mobile Medics Health Care Pvt. Ltd.

**Pune**

Bharat Forge Ltd., Central Institute for Road Transport, Divgi-Warner Ltd., M-Tech Innovations, Spaco Carburetor India Ltd.

**Ramagundam**

National Thermal Power Corporation, The Singareni Collieries Company Ltd.

**Renusagar**

Hindustan Aluminium Company Ltd.

**Rourkela**

Rourkela Steel Plant

**Simhadri (Vizag)**

National Thermal Power Corporation

**Singrauli**

National Thermal Power Corporation

**Sirpur Kaghaznagar**

The Sirpur Paper Mills Ltd.

**Tadipatri**

Ultra Tech. Cement Ltd.

**Tirupati**

Amararaja Batteries Ltd., Tirumala Tirupati Devasthanams

**Tiruchirapalli**

Bharat Heavy Electricals Ltd., Dalmia Cement (Bharat) Ltd.

**Thiruvanthapuram**

United States Technology Resource Initiative

**Udaipur**

Hindustan Zinc Ltd.

**Vijayanagar**

JSW Steel Ltd.

**Vijayawada**

Andhra Pradesh Heavy Machinery & Engineering Ltd., ICICI Bank, Kanaka Durga Agro Oil Products,

**Vindychal**

National Thermal Power Corporation

**Vizag**

Hindustan Petroleum Corporation Ltd., Hindustan Zinc Ltd.

**Yanam (Kakinada)**

Regency Ceramics Ltd.

**LIST OF PS-II STATIONS****Aurangabad**

Wockhardt Ltd.

**Austria**

Paramatrix, Vienna

**Bengalooru**

Accenture, Andale Information Technologies Pvt. Ltd., Altair Engg. India Pvt. Ltd., ARCD Design Complex – HAL, BEA Systems, Broadcom India Pvt. Ltd., BITSUNAMI, Business Objects Software (I) Pvt. Ltd., Cosmic Circuits Pvt. Ltd., Cisco System (I) Pvt. Ltd., Citrix R&D India Pvt. Ltd., Cypress Semiconductor Tech. India Pvt. Ltd., Siemens Corporate Technology, Daimler Chrysler (Research Centre India), Dell Inter-

national Services (I) Pvt. Ltd., HCL Technologies Ltd., Fiberlink Software Pvt. Ltd., GE BE Pvt. Ltd., Genesis Microchip (India) Pvt. Ltd., Honeywell Technology Solutions Lab. Pvt. Ltd., HP Global Software, HP Labs, Infineon Technologies India Pvt. Ltd., Intel Tech. India Pvt. Ltd., i2 Technologies India Pvt. Ltd., Juniper Networks India Pvt. Ltd., Jubliant Biosys Ltd., LSI Logic India Pvt. Ltd., Microsoft Research India Pvt. Ltd., Modelytics India Pvt. Ltd., Motorola India Electronics Ltd., National Aerospace Laboratories, Network Appliance Systems India Pvt. Ltd., National Centre for Biological Sciences, Nvidia Graphics India Pvt. Ltd., Novell Software Dev. (I) Pvt. Ltd., Oracle India Pvt. Ltd., Qualcomm India Pvt. Ltd., Rambus Chip Technologies India (P) Ltd., Strides Arcolab Ltd., Sap Labs India Pvt. Ltd., Satyam Computer Services Ltd., Sun Microsystems (I) Pvt. Ltd., ST Microelectronics Pvt. Ltd., Texas Instruments (I) Pvt. Ltd., Trilogy Software India Pvt. Ltd., Verisign India Development Centre, Yahoo Software Dev. India Pvt. Ltd.

#### **Chennai**

BITSUNAMI Trust, Central Leather Research Institute, IVRCL Infrastructure & Projects Ltd., NIIT-GIS Ltd., Satyam Computer Services Ltd., Structural Engg. Research Centre, Saharsa Solutions Pvt. Ltd., Sundaram Clayton Ltd.

#### **Dehradun**

Indian Institute of Petroleum

#### **Delhi**

ATS Services Pvt. Ltd., National Council of Applied Economic Research, NIIT-GIS Ltd.

#### **Denmark**

DHI Group

#### **France**

Insead Business School, Fontainebleau

#### **Gurgaon**

Agilent Tech. International Pvt. Ltd.

#### **Halol (Vadodara)**

General Motors India Ltd.

#### **Hosur**

Avtec Ltd., Harita Seating Systems Ltd.,

#### **Hyderabad**

Administrative Staff College of India, Bharat Dynamics Ltd., BITS-Pilani Hyderabad Campus Site, CA India Technologies Pvt. Ltd., Centre for DNA Fingerprinting and Diagnostics, Cypress Semiconductor Tech. India Pvt. Ltd., Dr. Reddy's Laboratories Ltd., Gnex Pharma Ltd., Intelligroup Asia Pvt. Ltd., Institute for Dev. and Research in Banking Tech., Indian Institute of Chemical Tech., Juno Online Services Dev. Pvt. Ltd., K-Raheja IT Park (Hyd.) Pvt. Ltd., Lanco Global Systems, Motorola India Electronics Ltd., Nagarjuna Constructions, Nicmar Construction Industry Staff College, Qualcomm India Pvt. Ltd., Sierra Atlantic Software Services Ltd., Satyam Computers Services Ltd., Vasant Chemicals, Wipro Technologies

#### **Kalyan (Mumbai)**

Century Rayon

#### **Kolkata**

BOC India Ltd.

#### **Kota**

Chambal Fertilizers and Chemical Ltd.

#### **Lucknow**

Central Drug Research Institute, Industrial Toxicological Research Centre

#### **Mumbai**

Central Bank of India, Development Consultants Ltd, First India Credit Corporation Ltd., Globeop Financial Services (I) Pvt. Ltd., Ipca Laboratories Ltd., J.P. Morgan Chase, Morgan Stanley Advantage Services, Morgan Stanley Capital Services, Tech Mahindra Ltd., National Stock Exchange of India Ltd., Patni Computers Systems Ltd., Polaris Software Lab Ltd., Thomas Weisel International Pvt. Ltd., Wockhardt Ltd.

#### **Nagda**

Grasim Industries Ltd.

#### **Noida**

Freescale Semiconductor India Pvt. Ltd., Senes Consultants India Pvt. Ltd., ST Microelectronics (I) Pvt. Ltd.

**Pilani**

Birla Museum

**Pune**

Behr India Ltd., Bharat Forge Ltd., Central Institute for Road Transport, Reflexis Systems Inc, Spicer India Ltd., Symantec Corporation Ltd., Tata Motors Ltd.,

**Sagore (Nagda)**

Avtec Ltd.

**Sweden**

Royal Institute of Technology (KTH) Stockholm

**Udaipur**

Hindustan Zinc Limited

**USA**

Cypress Semiconductor, San Jose, California, Iowa State University

**Vijayanagar**

JSW Steel Ltd.

**RESEARCH AT BITS**

Research is an important academic activity at BITS and 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, 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 the 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 part or whole of the research work at these organizations in the thrust areas of these organizations. Some of the organizations are, National Physical Laboratory, New Delhi in the area of Physical Sciences, National Aerospace Laboratory, Bangalore in the area related to Aerospace Sciences and Uniformed Services University of Health Sciences, Bethesda, USA in the area of Biomedical Sciences. Collaborations have also been established, providing Ph.D. opportunities to the research fellows, scientists, faculty and engineers from organizations such as Tata Institute of Fundamental Research, Mumbai; Central Electronics Engineering Research Institute, Pilani; Chennai Mathematical Institute, Chennai; Industrial Toxicology Research Centre, Lucknow; Central Drug Research Institute, Lucknow; SP Jain Institute of Management and Research, Mumbai; Sankara Nethralaya and Elite School of Optometry, Chennai; L V 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.

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

**(A) First Degree**

- (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) Normally, Thesis and Seminar courses are to be registered concurrently. Whenever the organisation of the Seminar is not feasible, the student will register in Independent Study in lieu of Seminar.
- (iii) 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 equalisation of the work-load of the supervisors.
- (iv) Thesis is a time-bound activity requiring total commitment. Registration in any course except the seminar course, is not allowed alongwith the Thesis course. The Thesis units cannot be split in different semesters. Thus if a student fails to submit his thesis within the prescribed time, a fresh registration in a subsequent semester would be required.
- (v) Thesis and Seminar/Independent study are graded in terms of non-letter grades.

#### **(B) Higher Degree**

For students who do not opt out for Practice School, Dissertation of 15-25 units is a required component. Dissertation may be registered for one full semester after completing all courses or may be registered concurrently for varied units along with other courses. This is a course in which the student takes up a research topic under the supervision of a faculty. Pursuit of research through this course in any semester must end up in a written report at the end of the semester. The performance is graded in terms of non-letter grades.

#### **(C) Ph.D. Degree**

Thesis is an integral component in the Ph.D.

degree programme. It carries a minimum of 40 units to be registered normally in four semesters. A Ph.D. student can register for the Thesis course only after passing the Qualifying Examination and after approval of his topic of research and a supervisor by the Research Board.

The pursuit of the thesis can be done on campus or at Practice School Centres and in certain circumstances at other specific centres with prior permission.

#### **Other Components and Features of the Ph.D. Programme**

##### **(i) Types of Input**

While the preferred input is a Higher Degree of BITS or its equivalent, the Institute's Academic Regulations permit an input which is at least a first degree of BITS or its equivalent or any input between these two extremes. Further, in a rare case of a person of high professional standing and proven competence who is deemed to have acquired mastery over all or substantial part of the course-work of a higher degree of the Institute through long professional experience exhibited through published papers, technical reports, etc. would also be an acceptable input.

##### **(ii) Qualifying Examination**

Every student admitted to On-Campus Ph.D. must pass the qualifying examination which is based on the courses of a higher degree programme which the candidate had earlier pursued or on the named courses of a BITS higher degree currently in vogue. The qualifying examination tests the student's knowledge, grasp of fundamentals and his ability to use them in unknown situations and is designed to be equivalent to the standard, content and intent of the comprehensive examination of the named courses.

The admission to On-campus Ph.D. programme is provisional in the first instance and gets confirmed only after passing the Qualifying examination within the prescribed time. Whenever a candidate is unable to pass the qualifying ex-

amination within the prescribed time, he will automatically be discontinued from the programme.

**(iii) Seminar**

Normally a Ph.D. student will have to register every semester in the Seminar course or in the Independent Study course.

**(iv) Course work**

The various categories of courses for the whole possible range of input of Ph.D. students are described in the Academic Regulations. In simple terms, in most cases, the course work consists of courses which are required to be completed for a higher degree programme of the Institute. Further, the qualifying examination is conducted on the basis of these courses. Departure from these normal situations is described in the Academic Regulations.

**(v) Teaching Practice**

There are two courses of Teaching Practice required to be done by every Ph.D. student. These courses attempt to train the student in the art, methodology and skill of teaching. Alternatively, Dean R & C may permit a student to register in Practice Lecture Series courses.

**(vi) Language Requirement**

The foreign language is prescribed as an eligibility requirement for the Ph.D. only when the supervisor and/or the Dean Research & Consultancy have made recommendations for the same for a particular topic of research and this recommendation is accepted by the Research Board. Otherwise English or an Indian language, as the case may be, would suffice.

A Ph.D. student for whom foreign language is prescribed is expected to demonstrate an ability to translate a piece from current periodicals in the area of major interest of the student in one of the modern European languages into English with the help of a dictionary.

**(vii) Fellowships and Scholarships**

Students admitted to Ph.D. Programme normally get fellowship from some reputed agencies like UGC, CSIR, MNES, etc. However, BITS resources are intended to take care of needs not covered by these sources.

**Off-campus Ph.D. under 'Ph.D. Aspirants' Scheme**

The Institute also offers a unique opportunity for experienced personnel and professionals of high standing and proven competence engaged in various industries, R&D organisations, public and private sector corporations, etc. to work towards Ph.D. degree of the Institute in the settings of their respective work environments and makes it possible for practicing professionals to be offered the same challenge and standard which traditionally have been given to teachers in universities. Such candidates are called as 'Ph.D. Aspirants'. Normally candidates holding any of the BITS degree or working in an organization collaborating with BITS are considered under this scheme.

**Admission**

The admission modalities given in the next part also apply to Ph.D. wherever applicable.

**Eligibility**

- \* A candidate with a formal higher degree which is the minimum qualification for the Ph.D. programme; namely M.E./ M.E. (Coll.)/ M.Phil./ M.Phil. (Applied)/ M.Pharm./M.S. of BITS or an equivalent degree of another university of standing.
- \* A person of a long and high professional standing and proven competence not possessing a higher degree but whose experience can measure upto a higher degree.
- \* A student coming after clearing all courses of a higher degree of the Institute or its equivalent without completing the degree.

There may be occasions where the admis-

sions of Ph.D. Aspirants end up in protracted correspondence. If the admissions are finalised before the starting of the semester the students will be registered in that semester. Otherwise the admission will be deferred to a subsequent semester. For administrative purposes there will be a last date for submission of application in each semester. However, an application submitted beyond the last date will be automatically considered for the next semester.

A 'Ph.D. Aspirant' can seek permission to appear in Ph.D. qualifying examination before the formalities of admission to Ph.D. programme are completed.

All 'Ph.D. Aspirants' after passing the qualifying examination shall seek formal admission to the Ph.D. programme at the earliest opportunity available to them and register in the Ph.D. Courses.

#### **Components of Ph.D. Programmes**

The components are (a) Course work, if necessary; (b) Qualifying Examination; (c) Foreign Language, when required; (d) Teaching Practice/Practice Lecture Series; (e) Seminar/Independent Study; and (f) Ph.D. Thesis.

#### **Operational Features**

*a) Place of work:*

On-Campus : Any of the BITS Campuses.

Off-campus Centre: Any of the Off-Campus centres of BITS where Practice School, Work-Integrated Learning programmes are conducted and organisations having collaborations and research linkages with BITS.

Outside Centre: In worthy circumstances, an outside centre not covered by the above may be approved.

*b) Topic of Thesis:*

From areas of focus of the Institute or from problems of intimate concern to the in-house R & D needs of the host organisation.

*c) Supervisor:*

Subject to final approval by the Research Board, technically any person of standing, authority and competence can become the Supervisor for the Ph.D. thesis. A supervisor at any point of time is any senior faculty member of the Institute or a person with equivalent responsibility in the campus or in an off-campus centre. However, rules provide for any outstanding person outside the Institute and the name can be suggested by the candidate.

*d) Places and Dates of Qualifying Examination:*

Normally arranged in January, March, August and October each year at Pilani but may also be arranged on other dates or at an off-campus centre with prior approval.

S.No.	Areas of Research
1.	<b>Biological Sciences:</b> Environmental Biotechnology, Microbial Biotechnology, Molecular Parasitology, Molecular Endocrinology, Tissue Culture Technology, Bioinformatics.
2.	<b>Bioengineering:</b> Biomaterials, Biomechanics, Bioinstrumentation, Bio- transport Process.
3.	<b>Civil Engineering:</b> Structures, Water Resources, Geotechnical, Transportation, Image Processing and G.I.S., Disaster Management, Earthquake Engineering, Finite Element Method, Disaster Loss Estimation, Genetic Algorithm and Neural Network Application.
4.	<b>Chemical Engineering:</b> Energy Integration, Separation Process, Process Control, Environmental Pollution Control, Biomass Gasification. Multiphase Reactors, Evolutionary Computation.
5.	<b>Chemistry:</b> Theoretical Chemistry, Synthetic Organic Chemistry, Physical, Analytical and Inorganic Chemistry.
6.	<b>Computer Science &amp; Information Systems:</b> Computer Networks, Database Systems, Software Engineering, Operating Systems, Multimedia, Computer Control Systems, Computer Architecture, Formal Methods, Information Retrieval.
7.	<b>Economics and Finance:</b> Macroeconomic Models and Policy, Microeconomic Analysis, Money and Financial Markets, Financial Engineering, Econometric Studies.
8.	<b>Electrical and Electronics Engineering:</b> Instrumentation and Control, Microelectronics, Signal Processing and Embedded Systems, Power Electronics, Telecommunication, Robotics and Intelligent Systems.
9.	<b>Humanistic Studies:</b> Gender Issues, Medical Sociology, Developmental Sociology, Indology, Indian Philosophy, Governance, Business Ethics, Conflict Management.
10.	<b>Languages:</b> Professional Communication, ELT, Indian Writing in English
11.	<b>Mathematics:</b> Pure and Applied Mathematics, Fluid Mechanics, Modeling Theory, Statistics.
12.	<b>Mechanical Engineering:</b> Manufacturing Systems/Manufacturing Excellence, Thermal Engineering, Design Engineering, Materials Engineering, Energy Management, Renewable Energy, Fracture Studies.
13.	<b>Management:</b> International Trade & Balance of Payment, Project Appraisal and Policy Formulation, Financial Management, Organizational Behavior, Human Resource Management, Supply Chain Management, Strategic Management, Marketing, Technology Management, Total Quality Management.
14.	<b>Pharmacy:</b> Drug Design, Screening, Drug Delivery Systems, Phytochemistry and Natural Drugs.
15.	<b>Physics:</b> Theoretical Physics, Semiconductor Device Physics, Materials Science.
16.	<b>Educational Innovation and Institutional Development</b>