Thirteenth Meeting
Finance Committee
National Institute of Technology, Uttarakhand

Date : **06 March 2018**
Time : **10.30 am**
Venue : **NIT Transit House, New Delhi**

Agenda

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Registrar

FC 13.01: To confirm the Minutes of the 12th Meeting of Finance Committee.

Minutes of the 12th meeting of Finance Committee, duly approved by the Chairman were circulated vide email dated 26th Jan 2018 with the request to confirm if they have been recorded correctly or need modification(s) if any. Comments / suggestions were received by the Institute from Shri Sanjeev Sharma (Director NITs) and Shri. Anil Kumar (Director IFD). Accordingly, modified minutes of the 12th Meeting of Finance Committee, incorporating the changes suggested by the members are placed as **Annexure FC 13.01**.

Finance Committee is requested to confirm the same.

राष्ट्रीय प्रौद्योगिकी संस्थान, उत्तराखण्ड
NATIONAL INSTITUTE OF TECHNOLOGY, UTTARAKHAND

MINUTES OF THE 12th MEETING OF FINANCE COMMITTEE
HELD ON 23rd January 2018 at NIT Transit House, New Delhi

The following members were present:

1. Prof. Shyam Lal Soni : Chairman
2. Mr. Sanjeev Kumar Sharma : Member
3. Mr. Anil Kumar : Member
4. Prof. Pramod Agarwal : Member
5. Col. Sukhpal Singh : Member Secretary

Mr. Anil Goyal could not attend the meeting due to some prior commitments.

At the outset Member Secretary, Finance Committee welcomed the Chairman and all the members and requested Chairman Finance Committee to preside over the today meeting of the Finance Committee.

The Committee discussed the following agenda:

FC 12.01: To confirm the Minutes of the Eleventh Meeting of Finance Committee.

Minutes of the 11th meeting of Finance Committee, duly approved by the Chairman were circulated vide email dated 6th Dec 2017 with the request to confirm if they have been recorded correctly or need modification(s) if any. No comments/ suggestions were received. Minutes are enclosed as **Annexure FC 12.01**

In view of above, the Finance Committee confirmed the minutes.

Resolution: Confirmed.

FC 12.02: Action Taken Report.

Resolution: The Finance Committee noted the action taken.

Finance Committee was apprised about the IT services being taken from MNIT Jaipur regarding Online Application Software for ensuing Faculty Recruitment. MNIT Jaipur has quoted to charge ₹2.00 Lakh for providing online application services for 400 applications and ₹500 per application beyond 400. Such IT support is required to be taken from an established NIT as NIT Uttarakhand does not have this expertise, as also to encourage and invite more number of applications in Faculty cadre. There is need for ensuring data integrity and confidentiality. An MoU should be signed with MNIT Jaipur in this regard.

FC 12.03 Grant of honorarium to Faculty In- charge Training & Placement.

Training and Placement cell is established in NITUK for guiding students to choose right career and to give knowledge, skill and aptitude for meeting the manpower requirements of the Industry. This Training and Placement cell at NITUK is facilitated by Faculty in Charge Training & Placement. Faculty in Charge Training & Placement accomplished following tasks in every academic year:

1. To assist students to develop/clarify their academic and career interests, and their short and long-term goals through individual counseling and group sessions.

(02)

2. Maintaining and regularly updating database of students. Maintaining database of companies and establishing strategic links for campus recruitments.

3. Gathering information about job fairs and all relevant recruitment advertisements.
4. Coordinating with companies to learn about their requirements and recruitment procedures
5. Identifying the needs and expectations of the companies to assist them in recruiting most suitable candidates.
6. Organizing pre-placement training/workshops/seminars for students.
7. To assist students for industrial training at the end of fourth and sixth semester.
8. To assist employers to achieve their hiring goals.
9. To assist students in obtaining placement in reputed companies.

Keeping in view the additional responsibility of Training & Placement cell, it is proposed to provide, special allowance of ₹2000/Month to the Faculty In-Charge **Training and Placement cell.**

The FC is requested to approve the above proposal.

Resolution: **On strong recommendations from the Director, the Finance Committee approved the same.**

FC 12.04 **Approval for B.Tech Fee structure for the Year 2018-19.**

As per FC resolution vide agenda item no 11.07 (D) Finance Committee expressed its concern for the raise in expenditure for management of student's hostels and suggested to consider revision of Hostel Seat Rent presently being charged from the students, from the next Academic Session onwards as the present rent charged (i.e. Rs.1600/- per Semester which comes out to be Rs.267/- only per month) is very low in comparison to the actual expenditure.

As per directives of Finance Committee revised fee structure will be tabled for approval.

Resolution: **Finance Committee approves the revision as proposed by the committee of Associate Deans. Seat Rent is revised to ₹3,200/- per semester, Electricity and Water Charges are revised to ₹2,000/- per semester and charges for Security Services is revised to ₹6,000/- FC further approves 10% annual enhancement in Hostel Seat Rent, Electricity & Water charges and charges for Security Services.**

FC 12.05 **Approval for Expenditure for Training & Placement.**

Approval regarding expenditure on Training and Placement activities was sought vide FC Agenda Item No 04.14. Against the said Agenda, following proposal was approved by Finance Committee for a period of three year.

1) Each student visiting any place in India other than Dehradun and Rishikesh shall be paid ₹1000 per head per visit subject to maximum of four visits in a year.
2) If Institute is conducting interviews in Dehradun/ Rishikesh than each student shall be paid ₹500 per head for the visit subject to maximum of four visits if no arrangements are made by the Institute.

Still the response of the Industry for campus interviews is lukewarm due to remoteness of our Institute location; hence it is proposed that above mentioned provisions may be extended for a period of three more years so that students can get better placements.

Finance Committee is requested to approve the above proposal.

Resolution: **Students visiting any place to attend the interview for job in the companies which have been arranged by NIT Uttarakhand will be reimbursed as per actual to and fro Rail/Bus fare. The entitle class of travel will be 3rd AC in Train. They have to produce the necessary supporting documents like proof of their attendance of test/interview, tickets etc. They shall be allowed upto of maximum 4 such journeys. If they get job offer from the company, no reimbursement will be done for subsequent travels for above purposes.**

FC 12.06: **Administrative and financial approval for hiring hotels for creating additional hostels for students.**

Institute is presently having nine hostels (07 within the campus and 02 hired hotels), which can accommodate only 514 students in ideal conditions i.e. 2/3 students per room. However 589 students are yet to be accommodated for which additional hotels buildings are to be hired.

There is an urgent and inevitable necessity to hire additional hotels in the nearby locality i.e. Srinagar (Garhwal) to create additional hostels for the students. An advertisement was published in the local newspapers on 28/09/2017 for inviting proposals for offering hotels on lease to the Institute to be using it as hostel accommodation for the students.

Four hotel owners of Srinagar (Garhwal) submitted their proposals. A duly constituted committee visited the hotels and with due scrutiny submitted its reports and recommended 04 hotels for hiring. The proposals of the 04 hotels were sent to the CPWD Office, Srinagar (Garhwal) to access as per authenticated CPWD rates for hiring of hotel building.

Based on the recommended CPWD rates, comparative statement of expenditure of hiring these 04 hotels for creating additional student hostel is as under:

Sl. No.	Name of Hotel	No. of Rooms	Likely number of students to be accommodated	CPWD accessed rates (per month)	GST (per month) @18%	Annual rent as per CPWD rates
01.	Hotel Devlok	18	54	₹91,300	₹16,434	₹12,92,808
02.	Hotel Velly in	20	60	₹1,30,200	₹23,436	₹18,43,632
03.	Hotel Urvashi	33	99	₹1,76,900	₹31,842	₹25,04,904
04	Hotel Prachi	32	66	₹1,29,800	₹23,364	₹18,37,968
Total			**279**	**₹5,28,200**	**₹95,076**	**₹74,79,312**

In addition to the annual expenditure on rent, following additional expenditure towards provisioning of security, housekeeping and transportation is envisaged as follows:

Sl. No.	Details	Monthly Expenditure	GST (per month) @18%	Annual Expenditure
01.	12 persons for Housekeeping @ ₹14,000 per person per month	₹1,68,000	₹30,240	₹23,78,880
02.	12 Persons for Security @ ₹19,000 per person per month	₹2,28,000	₹41,040	₹32,28,480
03.	04 Buses for Transportation @ ₹ 1,80,000 per bus per month	₹7,20,000	₹1,29,600	₹1,01,95,200
Total		**₹11,16,000**	**₹2,00,880**	**₹1,58,02,560**

The electricity and water charges shall be charged from the students on actual consumption basis.

Keeping in mind the accommodation constraints of temporary campus, it is recommended to take the above mentioned hotels on lease, on above mentioned rates, for a period of one year with a provision to renew the lease agreement further for one more year subject to satisfactory services.

The worthy Chairman, Board of Governors is requested to accord administrative and financial approval for Gross Expenditure of **₹2,32,81,872** per annum for hiring of above mentioned 04 hotels with allied services for the purpose of creating additional hostels for students.

Resolution: a) It was appraised to the Finance Committee that total student strength in NIT Uttarakhand is 1103. Out of which 103 students are accommodated in recently hired hotel Love Kush & hotel Srikot Castle with approval of FC & BoG vide agenda item no FC 11.06 and BoG 15.06 respectively. Rest 593 students are accommodated in hostels of the Institution within the campus. The existing capacity of the hostels is to accommodate 406 students. Therefore, balance 193 students are in excess to the capacity of the hostels.

To accommodate these 193 students Finance Committee resolved that hotels may be hired for accommodating these students and also creating the capacity to accommodate students who are presently residing outside the campus under their own arrangement.

Accordingly, Institute published an open Letter of Intent (LOI) to call for the bids for hiring hotels in Srinagar (Garhwal) on rental basis for both students and Staff hostels, where it was mentioned that rate of the hotel building will be accessed by CPWD. In response to the open LOI, 06 hotels submitted their letter of intent. A Committee was constituted for physical evaluation of the proposals received vide Institute office order no Hostel/19/158 dated 23.10.2017.The committee recommended 04 hotels, namely Hotel Devlok, Hotel Velly Inn, Hotel Urvashi & Hotel Prachi, to be hired for accommodating the students and two residential buildings namely Siddhi Dev Guest House and Hotel Shreeyantra Tapu for Staff.

The CPWD accessed the rent value of 04 hotels for accommodating 279 students. The same was offered to the above mentioned hotels, who accepted the rates. The Finance Committee, given the extreme shortage of hostel capacity in the campus and also the discontentment among the students, decided to recommend the proposal of hiring Hotel Devlok, Hotel Velly Inn, Hotel Urvashi & Hotel Prachi for accommodating 279 students, at the rate accessed by the CPWD and accepted by the hotels, which totals to ₹74,79,312/-, for a period of one year. The same may be reviewed for extension through Finance Committee.

Finance Committee directed to get the police verification of the hotels being hired before agreement.

b) Further, Finance Committee was appraised that 02 guest house/hotel namely Siddhi Dev Guest Houst and Hotel Shreeyantra Tapu were hired to accommodate 20 Faculty

members and 14 staff members, as per the resolution in the First Board meeting, vide agenda item no BOG 1.06. The agreement for these 02 hotel/guest house is going to expire on 31st January 2018, the same needs extension.

The Finance Committee recommends the proposal if the total expenditure on renting the buildings is within the HRA limit of the Faculty/Staff residing in the hotel/guest house; however, if total expenditure exceeds the HRA limit of the staff/faculty residing in it, the decision of the Board vide agenda item no. BOG 1.06 shall need revision. As an interim measure, Finance Committee recommends that sufficient time i.e 2-3 months may be given to the faculty/staff, who are residing in these hotel/guest house, to vacate and discontinue the arrangement of hiring staff hostels.

c) The Finance Committee was appraised that additional expenditure is to be incurred towards provisioning of Security, Housekeeping and Transportation for the students residing in the hired hotels.

The Open Tender for hiring 04 buses was floated. The rate for hiring 04 buses for a period of one year, with minimum running of 2400 km/bus/month is total ₹60,96,000 per annum.

There is requirement of 10 persons for basic housekeeping and 02 persons for Supervisor (Housekeeping). The estimated monthly expenditure for 10 person for housekeeping is of ₹1,54,700.00 (₹15470x10) and 02 person for Supervisor (Housekeeping) is of ₹43,552.00 (₹21776x02).Therefore total annual expenditure on provisioning of Housekeeping support will be ₹23,79,024/-. The stated deployment will be through on-going manpower, upkeep and sanitation service provider.

There is also requirement of security personnel (12 Guards) for 24x7 security arrangements. The total annual expenditure, for 04 hotels, as per the ongoing contract on current rate is ₹31,01,904/- (₹21541x12x12).

The Finance Committee, given the urgency and necessity of the situation, recommends the proposal for hiring personnel for Housekeeping, Security and buses for the Transportation, at an total annual expenditure of ₹1.16 Crore, for a period of one year. The same may be reviewed for extension through Finance Committee.

FC 12.07 (A) Approval of Payment of Honorarium for Inquiry Conducted by Shri Vishram Jamdar, ex-Chairperson, VNIT, Nagpur.

MHRD letter No .F.No.9-3/2017-TS.III dated 19th December, 2017 (enclosed as **Annexure FC 12.02)** is presented before the Board, regarding claim of honorarium for inquiry conducted by Shri Vishram Jamdar, ex-Chairperson, VNIT Nagpur in respect of complaint received against Shri. H.T.Thorat, ex-Director, NIT, Uttarakhand.

FC is requested to approve the honorarium as per DOPT order dated 15th September 2017, enclosed as **Annexure FC 12.03.**

Resolution: Withdrawn

The meeting ended with vote of thanks to the Chair.

Colonel Sukhpal Singh
Member Secretary

Submitted for approval.

Approved/Not Approved

Chairman
Finance Committee
NIT Uttarakhand

FC 13.02: Action Taken Report.

The Action Taken Report is as below:

Agenda Item No.	Agenda Item	Action Taken
FC 12.01	To confirm the Minutes of the Eleventh Meeting of Finance Committee	Noted & Implemented
FC 12.02	Actions Taken Report	Noted & Implemented
FC 12.03	Grant of honorarium to Faculty In- charge Training & Placement	Noted & Implemented
FC 12.04	Approval for B.Tech Fee structure for the Year 2018-19	Noted & Implemented
FC 12.05	Approval for Expenditure for Training & Placement	Noted & Implemented
FC 12.06	Administrative and financial approval for hiring hotels for creating additional hostels for students.	Noted & Implemented

FC 13.03 Purchase of Workstation and Desktop Computers through GeM.

Requirement of 04 Workstation and 60 Desktop Computers, of total worth ₹56.00 Lakh, has been received from all the Departments and sections of the Institute. The requirement was placed before Store Purchase Committee of the Institute. Store Purchase Committee accepted the proposal and recommended for procurement as per GFR provision. The items are available on Government e-Market place (GeM).

Finance Committee is requested to approve procurement of 04 Workstation and 60 Desktop Computers worth ₹56.00 Lakh through Government e-Market place (GeM).

FC 13.04 Procurement and installation of Pre-Fabricated Sewage Treatment Plant.

As per FC resolution vide agenda item no 11.05 detailed project report on procurement and installation of Pre- Fabricated Sewage Treatment Plant is placed before the Finance Committee as **Annexure FC 13.02**. The approximate cost is of ₹43.00 Lakh. The proposed expenditure is inevitable keeping in view the severe unhygienic conditions prevailing in the temporary campus.

Finance Committee is requested to approve the above proposal through advertised tender enquiry.

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Proposal

As the campus of NITUK falls on hilly area where no sewer lines are laid yet, toilet waste is being disposed beneath the ground in Septic Tanks and Soak-Pits.

The campus of NIT Uttarakhand at present is temporary in nature having lesser space availability for constructing more and more Soak Pits and Tanks. Also, the area falls in the vicinity of the river Alaknanda basin, therefore the water table is not significantly deep from earth crust. Capacity of Soak pits become lesser with passage of time and the waste outflow from the underground tanks instead of soaking it. Sometime the sewage collector vehicle of Municipality Corporation does not reach at our peak requirement, resulting in unhygienic condition at campus.

Generally, the sewage waste was disposed by Sewage collector vehicle by Municipality Corporation on the STP of Jal Sansthan, but at present Jal Sansthan is not providing consents to dispose the waste on the same.

A letter dated 07/04/2017 was received from Jal Sansthan Srinagar Garhwal subjected to disposal of sewage on 3.5 M.L.D sewer treatment plant, It was told not to dispose the dead sewage waste on plant and suggested only fresh sewage (Not more than one or two days old) may be disposed. Another letter dated 25/04/2017 was received by the same organization and it was mentioned on the letter that due to dead sewage disposal, the reports of samples are reaching beyond the standard limits, N.G.T have also shown rage about the same.

Institute has sent a letter dated 17/07/2017 to Jal Sansthan requesting them to allow the disposal of sewage waste. A letter in this regard also sent to Chairman, Nagar Palika Parishad and S.D.M Srinagar on dated 01/08/2017.

After this several verbal request have also been made for the same, but the positive reply is still awaited. At present the sewage waste is being disposed at Soak pits of buildings at ITI Campus, the capacity of which may be over at any time.

The approximate expenditure to be incurred is 43 Lakh.

(Paras Sah)
Tech. Asst.
(Civil)

A.D. (Estate): The detailed project report for your perusal is submitted

(10)

Registrar :- Permission may be granted to present the report in the next FC meeting.

DIRECTOR

Detailed Project Report on Sewage Treatment Plant

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(Parvesh)

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(Paras Agh)

SEWAGE TREATMENT PLANT

1. **Introduction:** As the campus of NITUK falls on hilly area where no sewer lines are laid yet, toilet waste is being disposed at beneath the ground at Septic Tanks and Soak-Pits.

The campus of NIT Uttarakhand at present is temporary in nature having lesser space availability for constructing more and more Soak Pits and Tanks.

Also, the area falls in the vicinity of the river Alaknanda basin, therefore the water table is not significantly deep from earth crust. Capacity of Soak pits become lesser with passage of time and the waste outflow from the underground tanks instead of soaking it.

Sometime the sewage collector vehicle of Municipality Corporation does not reach at our peak requirement, resulting in unhygienic condition at campus. Also, in the event of strike or shortage of manpower in future at Municipality Corporation, it would be difficult to control such intolerable unhygienic conditions because of our entire dependency on Municipality Corporation.

Generally, the sewage waste was disposed by Sewage collector vehicle by Municipality Corporation on the STP of Jal Sansthan, but at present Jal Sansthan is not providing consents to dispose the waste on the same.

A letter dated 07/04/2017 was received from Jal Sansthan Srinagar Garhwal subjected to disposal of sewage on 3.5 M.L.D sewer treatment plant, It was told not to dispose the dead sewage waste on plant and suggested only fresh sewage (Not more than one or two days old) may be disposed.

Another letter dated 25/04/2017 was received by the same organization and it was mentioned on the letter that due to dead sewage disposal, the reports of samples are reaching beyond the standard limits, N.G.T have also shown raze about the same.

Institute has sent a letter dated 17/07/2017 to Jal Sansthan requesting them to allow the disposal of sewage waste. A letter in this regard also sent to Chairman, Nagar Palika Parishad and S.D.M Srinagar on dated 01/08/2017.

A letter was received from office of Executive Engineer, Jal Sansthan Pauri on dated 15/09/2017, which stated that disposal of fresh sewage waste, shall be allowed only after testing of sample, it was also instructed to arrange for sewage treatment at from Institute's level.

Institute sent a letter to Jal Sansthan requesting them to allow disposal of sewage waste after sample testing on dated 09/10/2017, after this several verbal request have also been made for the same, but the positive reply is still awaited.

At present the sewage waste is being disposed at Soak pits of buildings at ITI Campus, the capacity of which may be over at any time.

(Paras Sah)

In the light of the facts, a Sewage Treatment Plant is required for the campus of NIT Uttarakhand with a Tractor towed Sewer Suction Machine mounted on Trailer Chassis.

1.1 OBJECTIVE

The object of sewage treatment is to stabilize the organic matter present in sewage so as to produce an effluent liquid and a sludge, both of which can be disposed of into the environment without causing health hazard or nuisance.

The endeavor should be to adopt modern and cost-effective technologies and equipment to achieve value for money and maximum user satisfaction.

2. BASIC DESIGN CONSIDERATIONS

2.1 Essential Parameters

Before proceeding with design of the treatment plant & disposal mechanism, it is essential to know the following-

a) Quantity of sewage and its origin- e.g Domestic.

b) Physicochemical characteristics of the raw sewage.

c) Desirable final effluent standards which shall be dependent upon the conditions under which the effluent is to be discharged e.g., on land, into a water body etc.

2.2 Degree of Treatment

The degree of treatment shall be decided by regulatory bodies like local municipality or Pollution Control Board (PCB) which may have laid down standards for effluent and may have specified the conditions under which the effluent could be discharged into a natural stream, sea or disposed of on land. Besides, the method of treatment adopted should not only meet the above requirements of regulatory bodies but also result in the maximum use of end products.

2.3 Design Period

The treatment plant is normally designed for a 30 year period. It is suggested that the construction of the STP be organised in phases with an initial design period of 5 to 10 years. STPs are to be designed for average flow of wastewater per day. Generally these are designed for present loads with possibility of augmentation for future increase. Care should be taken to see that the plant is not considerably under loaded in the initial stages.

2.4 Population Served

(Parag Sah)

Estimates for present and future population or areas involved in the project needs to be on realistic basis.

3. POLLUTANTS IN WASTEWATER

The three chief categories of pollutants in wastewater are the dissolved and suspended solids and the water-borne organisms. These are tabulated hereunder-

Table 1:Pollutants in Wastewater

DISSOLVED SOLIDS		SUSPENDED SOLIDS		MICRO-ORGANISMS
Inorganic Compounds	Biodegradable, Water Soluble Organic Compounds (BOD) Such as Starches, Fats, Carbohydrates, Proteins, Alcohols, Fatty and Amino Acids, Aldehydes and esters	Biodegradable, Water Insoluble Organic Compounds (COD) Such as Tannin, Lignin, Cellulose, Phenols, Detergents, Petroleum Products, Pesticides, Insecticides, Industrial Chemicals and Hydrocarbons	Biodegradable, Water Insoluble Organic Compounds Resistant to Bacterial Decomposition	Includes various Species of Bacteria including Pathogenic Bacteria, Viruses, Protozoa, Fungi etc.

4. WASTE WATER FLOW AND SEWAGE CHARACTERISTICS

The quantity of sewage and its characteristics are important considerations. Detailed analysis of waste being obtained in each specific case is essential for characterisation of wastewater in order to develop an effective and economical wastewater management program. This constitutes the primary data required for process design which helps in choice of treatment methods, deciding the extent of treatment, assessing the beneficial uses of wastewater in a planned and controlled manner. Collection of waste water from other similar location may be taken during initial stages of planning for this data. The various parameters to be determined are -

a) Sources of Toxic waste water (if any):-
   (i) Hospital Waste
   (ii) Butchery's Waste
   (iii) Industrial Waste

b) Sewage Characteristics for each type- Physical and chemical properties of raw sewage viz. BOD_5 (mg/l) at 20° and suspended solids (mg/l), etc. as given below are to be forwarded preferably at peak flow & lean flow time, with a repeat test at an interval of 2 days.
   (i) Temperature.
   (ii) pH.
   (iii) Color & Odour
   (iv) Solids-TSS,VSS,NVSS

(Paras Sah)

(v) Nitrate
(vi) Phosphorus
(vii) Chlorides
(viii) BOD_5
(ix) COD
(x) Toxic Metals & Compounds
(xi) Greases & Oils, etc

4.1 Characterization of Wastewater

a) **Temperature:** This is useful in indicating Oxygen transfer capacity of aeration equipment and rate of biological activity. Extremely low temp affects adversely, thus proper design and selection of technology for low temp areas are required.

b) **Hydrogen Ion Concentration (pH):** This indicates development of septic conditions.

c) **Colour and Odour:** With passage of time waste become stale, dark and emits foul smell.

d) **Solids:** Sewage contains only 0.1 percent solids, the rest being water. Still the nuisance caused by the solids cannot be overlooked, as they are highly putrescible and therefore need propel disposal. The sewage solids may be classified into suspended and dissolved fractions which may be further subdivided into volatile and non- volatile solids. Information of the volatile or organic fraction of solid, which is putrescible, becomes necessary as this contributes to the load on biological treatment units.

e) **Nitrogen:** The principal nitrogenous compounds in domestic sewage are proteins, amines, amino-acids and urea. Generally domestic sewage contains sufficient nitrogen to take care of the needs of the biological treatment.

f)

g) **Phosphorus:** substantially to the phosphorus content. Phosphorus, just as nitrogen, is an essential nutrient for biological process.

h) **Chlorides:** Concentration of chlorides in sewage above the normal chloride content in the water supply is used as an index of the strength of the sewage. The daily contribution of chlorides averages to about 8 gm per person.

i) **Biochemical Oxygen Demand:** The Biochemical Oxygen Demand (BOD) of sewage or of polluted water is the amount of oxygen required for the biological decomposition of biodegradable organic matter under aerobic conditions.

j) **Chemical Oxygen Demand:** The Chemical Oxygen Demand (COD) test gives a measure of the oxygen required for chemical Oxidation. This test

(Barcas Sah)

does not differentiate between biologically Oxidiable and nonoxidiable material. However, the ratio of the COD to BOO does not change significantly for a particular waste and hence this test could be used conveniently for interpreting performance

k) **Toxic Metals and Compounds:** Some heavy metals and compounds such as chromium, copper and cyanide, which are toxic, may find their way into sewage through hospital/ industrial discharges, also from institutional laboratories. Determination of these compounds assumes importance if such waste is to be treated by biological process or disposed off into a stream or on land.

l) Grease and oils in excessive amounts not only add considerably to the cost of treatment, but also pose a disposal problem.

5. DEGREE OF TREATMENT

5.1 Choice of Treatment

Analysis, in totality, for collection, disposal, treatment and safe reuse of wastewater is done before selecting a technology. Due care be taken for climate conditions while selecting technologies particularly with regard to biological units. For very small and isolated population, the time tested septic tank with two soak wells may still be a safe option, provided water table is not too high (<3.0m). Modifications to septic tank or soak well can be planned if rocky strata are encountered. However this may not be a preferred option.

5.2 Effect of Hospital, Butchery or Workshop Wastes

Wastes from these locations can form an important component of sewage flows both in volume and composition. It is therefore necessary that detailed data about the nature of the waste from these sources is estimated. Quantity and character of wastes based on laboratory analysis and their variations which may affect the sewerage system or the sewage treatment process, are to be assessed for individual and for the composite samples. Where water reclamation is to be practiced, due consideration is to be given to the effect in these waste components on the final effluent. In certain instances, it is more economical to tackle these wastes at the source itself.

5.3 Other Considerations

Degree of Treatment required shall also depend on

a) Method of Effluent Disposal.

b) Possibilities of Reuse, if any during monsoon, winters and summers with confirmation of same from users.

5.4 Treatment Parameters

In case of sewage, the degree of treatment is considered in terms of removal of BOD/COD, nutrients (nitrogen and phosphorous), coliforms, heavy metals etc. Land disposal generally has to meet less stringent discharge standards than disposal to

(Paras Sah)

surface waters. Land disposal also has the advantage of obtaining nutrient utilization for the soil and is, thus, preferred wherever feasible. It is not enough to aim only at BOD removal and other factors be left to unspecified, incidental removal. The selection of a treatment process depends on the extent of removal efficiency required for all important parameters and the need to obviate nuisance conditions.

Table 2: Wasterwater Characteristics for Disposal

a)	Ph	:	6.5-9
b)	TSS	:	<20 mg/l
c)	BOD	:	<10 mg/l
d)	COD	:	<50 mg/l
e)	Fecal Coliform	:	<100 MPN/100 mL

5.5 Recycle and Reuse

As a matter of policy wastewater should be recycled for non-potable users after proper treatment unless there are reasons for not doing so. Normally tertiary treatment has three stages i.e. filtration by dual media sand filter, super chlorination and finally adsorption by activated carbon column. Following specifications are to be adhered for treated effluent for non-potable reuse. In case wastewater is to be reused for cooling towers, softening will be required to avoid scaling of pipes.

6. EFFLUENT DISPOSAL AND UTILISATION

The sewage after treatment may be disposed either into a water body such as lake, stream, river, or onto land. It may also be utilized for several purposes such as agriculture, washing of vehicles, cooling systems, golf courses or boiler feed. If the sewage effluent is to be discharged into inland surface waters, tolerance limits prescribed by statutory agencies, IS: 4764 or as mentioned above, should be followed.

7 REACTOR DESIGN PRINCIPLES

7.1 Unit Operations and Processes

Removal of contaminants is brought about by a sequential combination of various physical, chemical and biological unit processes. The physical unit operations include -

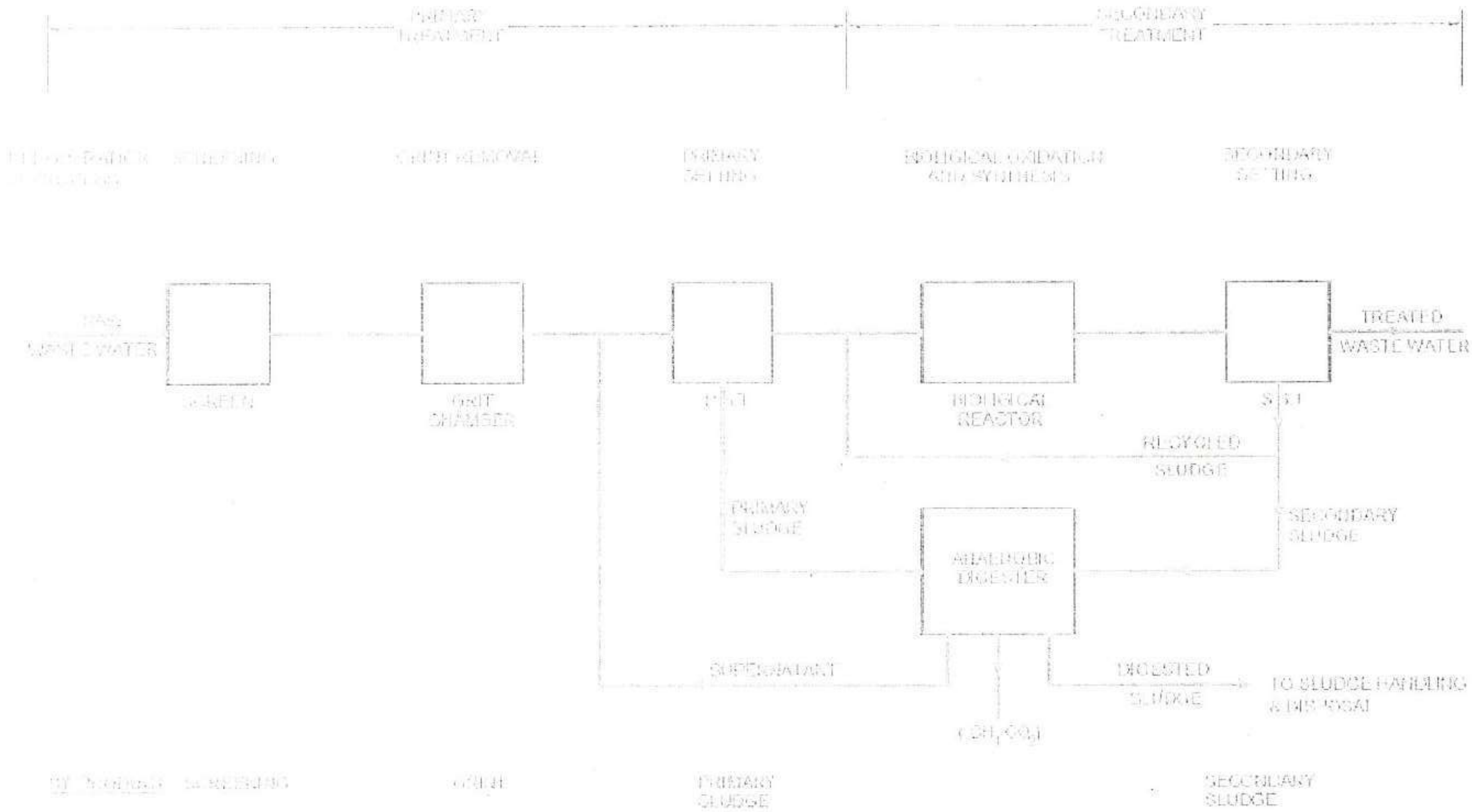
a) Pretreatment – removes material that can cause operational problems through screening, such as settleable solids, floating plastics etc.

b) Primary treatment – removes ~60% of solids and ~35% of BOD.

c) Secondary treatment – removes ~85% of BOD and solids.

d) Tertiary treatment– varies:~ 95+ % of BOD and solids and also Nitrogen add phosphorus.

(Ansari Sahib)


PRIMARY TREATMENT
SECONDARY TREATMENT
GRIT REMOVAL
PRIMARY SETTLING
BIOLOGICAL OXIDATION AND SYNTHESIS
SECONDARY SETTLING
RAW WASTE WATER
SCREEN
GRIT CHAMBER
BIOLOGICAL REACTOR
TREATED WASTE WATER
RECYCLED SLUDGE
PRIMARY SLUDGE
SECONDARY SLUDGE
ANAEROBIC DIGESTER
SUPERNATANT
DIGESTED SLUDGE
TO SLUDGE HANDLING & DISPOSAL
GRIT
PRIMARY SLUDGE
SECONDARY SLUDGE

(P.f.) (Paras Sah)

7.2 Process Flow Chart for Domestic Waste

The unit operations and processes employed in domestic wastewater treatment are as shown in Fig (as above)

7.2.1 Screening: This removes large floating, suspended and settleable solids.

7.2.2 Grit Removal: Removal of inorganic suspended solids.

7.2.3 Primary Sedimentation: Removal of organic and inorganic settleable solids

7.2.4 Reactor: Any container in which the chemical or biological reactions occur can be termed as a reactor. Reactors are basically classified as:

a) Batch Reactors

b) Continuous flow Tank Reactors (CSTR)

c) Plug Flow (PF)

d) Arbitrary Flow Reactors.

7.2.5 Biological Reactor: Biological reactors are reactors in which organic matter, which serves as substrate or food to micro organisms, is utilized for the growth of micro organisms. These processes are-

a) Aerobic Biological Suspended Growth Process: Conversion of colloidal, dissolved and residual suspended organic matter into settleable biofloc and stable inorganics.

b) Aerobic Biological Attached Growth Process: Conversion of colloidal, dissolved and residual suspended organic matter into settleable biofloc and stable inorganics.

c) Anaerobic Biological Growth Process: Conversion of organic matter into CH_4 & CO_2 and organic relatively stable organic residue.

8. CLASSIFICATION OF THE PROCESSES

A number of treatment processes are available depending upon method of disposal, degree of treatment, waste water influent quality (domestic or industrial), availability of the land etc and requirement of recycling treated waste water. Waste Water Treatment Methodology commonly adopted for treatment of domestic waste may be any of the following:

8.1 Biological Processes

(Arras Bath)

In these processes a mixture of wastewater and microorganisms (biomass) is agitated and aerated. Certain microbes, mainly bacteria of specific kind, have the capability to oxidize the dissolved organic matter in the waste water. Microbial growth is accelerated and controlled in the process. Thus, reduction or removal of organic matter in waste is brought about by microorganisms by oxidation. After oxidation, the sludge is separated from wastewater. These, microbial induced processes are further classified as Aerobic and Anaerobic.

a) Aerobic Processes- In presence of oxygen
b) Anaerobic Processes- In absence of oxygen

8.1.1 Aerobic Processes- The following conventional methodologies are examples of Aerobic Processes-

a) Activated sludge process (ASP)
b) Trickling filters
c) Facultative aerated lagoons
d) Extended aeration process
e) Wet Lands
f) Oxidation ponds
g) Oxidation ditches

In modern nomenclature the aerobic processes are divided into Aerobic Suspended and Attached Growth Processes and the Soil Biotechnology.

8.1.1.1 Aerobic Suspended Growth Processes (SGP) The conventional activated sludge process (ASP) is the best known suspended growth aerobic system and is the process most commonly used in large, centralized WWTPs though it can also be used in small plants. Some of the process variants of ASP are-

a) Sequencing Batch Reactor (SBR)
b) Extended Aeration
c) Membrane Bioreactors (MBR)

8.1.1.2 Aerobic Attached Growth Processes (AGP). Under the AGP, two proven and fairly known treatment processes are available as following:

a) Moving Bed Biological Reactor (MBBR) The Moving Bed Biological Reactor may be known by different names as under, however the process remaining same with free floating media of different shapes, sizes and materials (generally plastic).

(i) Fluidised Bed Reactor (FBR)
(ii) Moving Bed Bio Reactor (MBBR)
(iii) Sequential Batch Reactor (SBR)

b) Fixed Bed Biological Reactor (FBBR) Similarly, the Fixed Bed Biological Reactor may also be known by different names as under, but the technology remains same as that

(Parag Sah)

of MBBR except that the media is fixed horizontally/ radially or sloping (normally at 60°) in packed beds of different depths and of different sizes and materials (generally plastics).

(i) Submerged Aerobic Fixed Film (SAFF)
(ii) Fixed Bed Reactor (FBR)
(iii) Fixed Media Reactor (FMR)
(iv) Fixed Media Biological Reactor(FMBR)
(v) Fixed Bed Biological Reactor(FBBR)
(vi) Bio Tower
(vii) Rotating Biological Contractors (RBC) (Also called Biodisks).

8.1.1.3 Soil Biotechnology or Constructed Wetlands.

8.1.2 Anaerobic Units These can be generally grouped into the following:-

a) Anaerobic ponds/ stabilization ponds

b) Upflow Anaerobic Sludge Blanket (UASB) reactor followed by lagoons etc (Suitable for large capacity plants say 20 mld or above).

8.2 Chemical unit processes

a) Chemical neutralization: to control or adjust pH.

b) Chemical coagulation: to remove colloidal particles by chemical destabilization and flocculation.

c) Chemical precipitation: to enhance the removal of suspended solids, Phosphorous, heavy metals, and BOD in the specific system conditions.

d) Chemical oxidation: to remove grease, ammonia, BOD, COD, and odour control.

e) Chemical disinfection: to kill pathogens in influent and treatment effluents.

8.3 Design of Process Flow Sheets

8.3.1 The process design involves selection of an appropriate combination of various unit operations and unit processes to achieve a desired degree of contaminant removal. The selection of unit operations and processes primarily depends on the characteristics of raw wastewater and the required levels of contaminants permitted in the processed effluents.

8.3.2 The main contaminants in domestic wastewater to be removed are biodegradable organics. The contaminants are usually measured in terms of BOD_5, suspended solids and pathogens. It is generally the objective of domestic wastewater treatment plant to produce treated effluents having BOD_5 of 30 mg/l or less and suspended solids of 50 mg/l or less for disposal into inland water bodies.

(Paras Nath)

8.3.3 The conventional process flow sheet of wastewater treatment plant comprises the unit operations of screening, grit removal and primary sedimentation followed by unit process of aerobic biological treatment. The sludges removed by primary and secondary sedimentation are digested anaerobically followed by drying on sludge drying beds.

8.3.4 For new central sewage schemes, the sewage load should be worked out and STP based on any of technologies referred above or a combination of two or more technologies can be adopted. These modern systems are based on technologies which requires lower hydraulic retention time; obviate recycling of sludge and provisioning of sludge digester for a viable population load.

8.3.5 For the quantity of treated waste water that can not be reused, or where re-use of treated water is NOT required, treatment should only be planned up to the secondary level. Disinfection, wherever required, can be considered depending upon location of discharge of treated water.

8.3.6 Higher detention time should be catered for in the design of STP where ambient temperature is lower than 20°C or alternate design criteria may be adopted.

8.3.7 With the better understanding of microbiology and biochemistry of anaerobic treatment, it is now feasible to treat domestic wastewater also directly through anaerobic treatment such as Upflow Anaerobic Sludge Blanket (UASB) Reactor, Fluidised-Bed Submerged Media Anaerobic Reactor (FB-SMAR) and Anaerobic Filter (AF) or Static-Bed SMAR(SB-SMAR) and Anaerobic Rotating Biological Contactor (ARBC). It is generally reported that BOD removal efficiencies may range from 60-80%. Consequently post treatment will generally be required to achieve the prescribed effluent standards.

8.4 **Selection of Treatment System**

Selection of treatment system is not an easy decision to make. It is a tough job that requires substantial field experience as well as sound technical knowledge of the various unit operations. It shall depend on availability and topography of land at the treatment site, availability of mechanical equipment and skilled personnel and various factors as stated below.

a) Less to No Need for Skilled Supervision

b) Auto Vigilance of MLSS, DO and F/M Ratios

c) Low Power Requirement

d) Low Footprint (Plan) Area

e) High Oxygen Transfer Efficiencies

f) Least Need For Sludge Recycling

g) Less to No Need for Drives or Moving Parts Within Units

h) Less Sludge Production

(Paras Sah)

i) Stainless Steel Construction to Ensure Longevity and Corrosion Safety

j) No Odour Problem

k) Least No. Of Operational Units And Hence Least Staff And O & M Headaches

l) No Need for Tertiary Units

m) Least Operation Cost

n) Flexibility And Adaptability to High Loads

o) Nitrification (N) And Denitrification (DN) for ensuring Stable, Disposable Sludge with No Odor and Storable Longitivity.

p) Nutrient and Phosphorus Removal to Safe Guard against Algal Growth Downstream After Disposal in Receiving Water Bodies etc.

8.5 Comparison and Assessment of Various Treatment Processes

A comparison of various treatment processes has been given as Annexure-I.

8.6 Oxygen Requirements

Oxygen is required in the aeration process for the oxidation of a part of the influent organic matter and also for the endogenous respiration of the micro- organisms in the system. The total oxygen requirements per Kg BOD removed for different aeration processes are important to work out for each STP depending upon raw sewage report of waste water. The amount of oxygen required for a particular process will increase within the range as the F/M value decreases.

8.6.1 Aeration Facilities: The aeration facilities at the plant are designed to provide the calculated oxygen demand of the waste water against a specific level of dissolved oxygen (DO) in the waste water. The aeration devices apart from supplying the required oxygen demand shall also provide adequate mixing or agitation in order that the entire mixed liquor suspended solids (MLSS) present in the aeration tank will be available for the biological activity. The recommended dissolved oxygen concentration in the aeration tank is in the range 1 to 2 mg/l for extended aeration type activated sludge plants and above 2 mg/l when nitrification is required in the activated sludge plant. Aerators are rated based on the amount of oxygen they can transfer to tap water under standard conditions of 20°C, 760 mm Hg barometric pressure and zero DO.

8.6.2 Diffused Aeration: Diffused air aeration involves the introduction of compressed air into the sewage through submerged diffusers or nozzles. Compressed air is released at or near the bottom of the aeration tank through porous tubes or plates made of aluminum oxide or silicon oxide grains cemented together in a ceramic matrix. The aerators may be of the fine bubble or coarse bubble type. Air supplied to diffusers should contain less than 0.02 mg of dust per ml. Diffusers are located 0.3m to 0.6m above tank floor to aid in tank cleaning and reduce shutdown.

(Akash Sah)

8.6.3 Surface Aerators: Surface aerators were not widely installed in the past but with recent improvements in their design, they are being increasingly used for large plants in preference to diffused air aeration systems. Some of their advantages are higher oxygen transfer capacity, absence of air piping and air filter and simplicity of operation and maintenance.

8.6.4 Mixing Requirements: The aeration equipment is also required to provide adequate mixing in the aeration tank to keep the solids in suspension.

8.7 Measuring Devices

Measuring Devices should be installed for indicating flow rates of raw sewage or primary effluent, return sludge and air to each aeration tank.

8.8 Secondary Settling

Secondary settling assumes considerable importance in the Activated Sludge process as the efficient separation of the biological sludge is necessary not only for ensuring final effluent quality but also for return of adequate sludge to maintain the MLSS level in the aeration tank. The most important aspect in the operation of an activated sludge plant is the maintenance of proper F/M which is achieved by increasing or decreasing the MLSS levels in the aeration tank to suit the influent BODs loads.

8.9 Nitrification

Activated sludge plants are ordinarily designed for the removal of only carbonaceous BOD. However, there may be incidental nitrification in the process. Nitrification will consume part of the oxygen supplied to the system and reduce the DO level in the aeration tank. Nitrification will also lead to subsequent denitrification.

8.10 Maintenance

Due consideration must be given in the design of aeration tanks to the need for emptying them for maintenance and repair of the aeration equipment. Intermediate walls should be designed for empty conditions on either side. The method of dewatering should be considered in the design and provided for during construction.

Effluent parameter should be well within pollution norms laid down by Central Pollution Control Board/ State Pollution Control Board, whichever is more stringent. In this connection please refer our policy letters. This may also be referred on web site www.cpcb.nic.in.

9. TERTIARY TREATMENT OF SEWAGE FOR REUSE

9.1 General

(Paras Sah)

Tertiary treatment is supplementary to primary and secondary treatment for the purpose of removing the residual organic and inorganic substances and in some cases for even the refractory and dissolved substances to the degree necessary. Tertiary Treatment of sewage is increasingly being adopted in India.

Re-use of treated wastewater should invariably be planned while selecting the overall scheme. Reuse may be restricted to only non potable applications i.e. irrigation, arboriculture, recreation lake, eco lake, gardening, golf-courses fire fighting, air conditioning, water in cooling systems, flushing, car wash or ground water recharge for augmenting ground water resources.

The tertiary treatment may be considered only to the extent of quantity of water to be reused and hence designed accordingly to achieve cost economy. All technologies except Soil Bio-technology (SBT) require tertiary treatment before wastewater is reused. It consists of filtration, adsorption and chlorination.

Tertiary treatment is quite use-specific and may involve only one item like simple chlorination of treated sewage or several items depends on end use. It is, therefore, very important that clear cut specifications of the reusable water are first obtained.

A tertiary treatment plant, therefore, generally, looks like a sewage treatment plant followed by a typical industrial water treatment plant.

10. EFFLUENT DISPOSAL AND UTILISATION

10.1 General

The effluent from sewage treatment plants may be discharged in receiving waters such as lakes, streams, rivers, estuaries, oceans or on land. The nature and degree of treatment given to the sewage depends upon the requirements imposed by the regulatory authorities. It is necessary to adhere to the standards laid down by the Pollution Control Boards with regard to the quality of the sewage to be discharged into a body of water, inland or marine or on land for farming purposes or underground for purposes of recharge aquifers.

10.2 Disposal into Water Bodies

Treated effluent conforming to prescribed standards may be disposed into a stream course or into sea or a stagnant body of water. The quality, quantity and use of the receiving water body into which the effluent is discharged, decides the degree of treatment required for the sewage. Since the treated waste water may still have a high coliform density, disinfection or any other treatment methods may be considered for reducing the coliform density before disposal of water into the water body. Disposal of westewater in a river causes organic, chemical and microbial pollution. Organic pollution not only depletes

(Parsar Sah)

the oxygen content in the river resulting in killing of fish and marine life but also leads to heavy algal growth downstream.

10.3 Reclamation of Treated Effluent

Complete reclamation of sewage effluent is not generally adopted. Reclamation is restricted to meet the needs depending upon the availability and cost of fresh water, transportation and treatment costs and the water quality standards and its end uses like irrigation, arboriculture, recreation lake, eco lake, gardening, Golf-courses fire fighting, air conditioning water in cooling systems, flushing and car wash, ground water recharge for augmenting ground water resources. Some of these uses may need tertiary treatment as discussed

10.4 Artificial Recharge of Aquifers

Artificial recharge of ground water aquifers is one of the valuable source and methods for combining effluent disposal with water reuse. Replenishment of ground water sources has been done on a practical scale.

10.5 Disposal on Land (Sewage Farming)

The nutrients in sewage like nitrogen, phosphorus and potassium along with the micronutrients as well as organic matter present in it could be advantageously employed in sewage farming to add to the fertility and improve the soil quality. Even application of treated effluent to land has to be done with certain precautions as it is not completely free from this risk.

11 EMERGING TECHNOLOGIES FOR SEWAGE TREATMENT

11.1 General

Activated Sludge Process and Extended Aeration Systems give insignificant return on capital investment. To overcome these limitations of currently practiced sewage treatment technologies, researches have been carried out to develop alternative technologies. Some of these emerging technologies include,

a) Duckweed- Pond Technology

b) Vermiculture Technology

c) Technology utilising raw sewage for forestry

d) Artificial wet Lands / Root Zone Technology

These technologies are based on natural systems of waste management and treatment. They possess the following distinct advantages-

a) Minimum use of mechanical equipment

(Prasad)

b) More Eco - Friendly

c) Capable of generating revenue

11.2 Duckweed Pond Technology

The wastewater treatment employing duckweed pond system is relatively simple to construct, operate arid maintain. Duckweed (lemnaceae) is an aquatic plant which can grow prolifically when temperature ranges between 15 to 30° C, doubling its weight with in 2 - 4 days. It requires basically nitrogen, phosphorus and potassium for growth. It can be used as cheap and high quality (high protein) animal feed, valuable protein component of chicken feed and feed for fish.

11.3 Vermiculture Technology

This technology utilises earthworms for the treatment of domestic wastewater. The earthworms have been called as natural bioreactors. The earthworms produce both microorganisms and enzymes that breakdown complex bio-molecules into simple compounds which are utilised by the micro organisms. It is claimed that aerobic conditions are maintained by virtue of its hemoglobin with high saturation constant and therefore no external aeration may be required. The earthworms produce vermicastings with immobilised microflora and nutrients. Vermicastings have the potential of being used as biofertilisers.

11.4 Root Zone Technology or Wet land process

This method is useful for smaller stations where availability of land is not a problem and water table is more than 20m below ground level. In this method, the domestic wastewater, after the septic tank, is diverted into a lined pond filled with media of coarse aggregates. The liquid flows through the pores of media in sub surface condition and there is a growth of plants on top of media, their roots spreading upto the bottom of pond. The bacterial growth takes place around the roots. Aerobic bacteria grow near the roots due to presence of oxygen in roots and anaerobic bacteria grow away from roots. Thus the organic matter in the effluent is trapped and stabilized in the pores by aerobic as well as anaerobic bacteria.

This method does not require any maintenance for many years. The only precaution to be taken is that flow should remain sub surface to avoid breeding of mosquitoes. Many varieties of plants including flowering ones are available for this treatment and one has to check from local horticulture department for specific local species.

The root zone technology also referred to as artificial constructed wetland system, is basically a man made wetland where wastewater is kept at or above the soil surface for enough time during the year to maintain saturated conditions and appropriate vegetation. The three essential components of the system include the soil, the

BT (Paras Bath)

appropriate vegetation such as reeds. Cat tails, bulrushes and sedges and the microbial organisms.

The principal merits of the system include:-

a) No requirement of energy and mechanical equipment for aeration.

b) Self regeneration of reed bed and virtually maintenance free.

c) System can provide natural habitat for fauna.

12. EFFECT OF EXTERNAL TEMPERATURE ON TREATMENT

Biological activity reduces sharply with drop in temperature. As such necessary modification to the plant design is necessitated in areas experiencing extended periods of cold weather. On the other hand, the dissolved oxygen (DO) content reduces with increase in temp. This causes rapid putrification of organic matter and hence necessitates design modification to speed up the treatment. It may be remembered that the standard plant design caters for ambient temperature of about 20-25°C at which the microbes thrive.

13. OPERATION & MAINTENANCE FOR STP

Treatment system should be simple as far as possible in operation. The treatment plant should be operational round the clock to achieve the laid down parameters. STP should have low capital cost, lower power consumption and low life cycle cost for a period of 30 years.

The Contract Agreement will include construction, commissioning, operations and maintenance and defect liability period (DLP). The CEs should invariably enter in to contract with the executing firms as per criteria laid down in the policy at Apex. However, while preparing the specification for O&M, proper clause/schedule for the periodical checking of the plant, oiling, greasing, and routine maintenance and consumables for the same may be included in the scope of the work. Electricity for operation of the STP may be provisioned to be given by the department. While estimating the project, it may be borne in mind that the cost for revenue expenditure is debitable to maintenance and operation.

A report regarding Recommendations and Guidelines of Sewage Treatment Plant from the experts of IITs and other prestigious organization is attached as Annexure-II.

14. General Specification and approximate cost:

1. Fully Automated.
2. Prefabricated type.
3. Capacity =60 Kld

(Paras Sah)

4. Water quality of output should be as per standards of CPCB (File No. A-19014/43/06-MON, Dated 21/04/15) or as per new amendments from time to time.
5. Any technology may be adopted to achieve latest output parameters of CPCB/ Uttarakhand Environmental protection & Pollution Control board.
6. System may consist of Bar Screen, Oil & Grease unit, new Equalization tank/ Collection tank, Aeration units, filtering system, pumping units, and other essential units
7. U.V / chlorine dozer is required
8. Complete Installation of plant shall be done by vender including platform, foundations and equipment shed/ panel room.
9. Demonstration of Plant Operation will be required after complete installation.
10. Site Visit shall be welcomed.

Estimated expenditure to be incurred is Rs. 43,00,000/-
The requirement may be fulfilled through open tender process.

P.t (Parsan Sah)

APPENDIX 'A'

15. LIST OF INDIAN STANDARDS ON SEWERAGE AND SEWAGE TREATMENT

IS 2470 (PT 1)&(PT 2) : 1985	Code of practice for installation of septic tanks: Design criteria and construction (second revision) Secondary treatment and disposal of septic tank effluent (second revision)
IS :4733-1972	Methods of Samoling Test Sewage Effluent
IS : 6908-1975	Sewage and Drainage
IS :7022 (PT II)-1979	Glossary of Terms Relating to Water Sewage and Industrial Effluents PT II
IS:1538-(PT-XXIV)-1982	Press Pipes for Water, Gas and Sewage
IS 5600: 2002	Pumps-sewage and Drainage-Specification
IS 5611 : 1987	Code of practice for waste stabilization ponds (facultative type) (first revision)
IS : 5600-1970	Specification for Sewage and Drainage Building Elements
IS : 4764-1973	Tolerance Limits for Sewage Effluents Discharged In to In land Surface Water
IS 6279 :1971	Equipment for grit removal devices
IS 6280 : 1971	Sewage screens
IS 7232 : 1974	Method for Imhoff cone test
IS 7784: Part 1 & 2: Sec 1 to 5	Code of practice for design of cross drainage work : Part 1 General features
IS 8413 (PT 1) : 1977	Requirements for biological treatment equipment Part 1 Trickling filters
IS 8413 (PT 2) : 1982	Requirements for biological treatment equipment Part 2 Activated Sludge process
IS 9110 : 1979	Hand operated augers for cleaning water closet, pipe and sewer
IS 9213 : 1979	BOD Bottle
IS 10087 : PT1 to 3 : 1981	Requirements for sludge dewatering equipment. Part 1 sludge drying beds-sand, gravel and underdrains
IS 10261 : 1982	Requirement for settling tank (clarifier equipment) for waste water
IS 10552 : 1983	Buckets to be used in power driven buckets type sewer cleaning machine
IS 10595 : 1983	Requirement for power driven bucket-type sewer

(Paras Sah)

	cleaning machine
IS 11117 : 1984	Requirement for power driven rodding machine for sewers
IS 11387 : 1985	Requirement for high pressure jetting machine for sewer cleaning
IS 11972 : 1987	Code of practice for safety precautions to be taken when entering a sewerage system
IS 12115: Part 1 to 4 : 1987	Specification for Couplings for Disposal of Sewage water for Inland Vessels- Part 1 : Flange Coupling)

(Paras Sah)

Annexure-I

Table 4- COMPARISION OF VARIOUS TREATMENT PROCESS

Parameter	Moving Bed Bio- reactor (MBBR- FAB)	Sequencing Batch Reactor (SBR)	Upflow Anaerobic Sludge Blanket Reactor (UASB)	Activated Sludge Process (ASP) - Extended aeration	Rotating Biological Contactors (RBCs)
Type of Process	BOD reduction takes place aerobically. Fixed film process.	BOD reduction takes place aerobically. Suspended growth process. Improvised Activated Sludge Process	This is strictly anaerobic process. BOD reduction takes place by converting organic matter to methane / carbon di-oxide and other gases, through bacterial systhesis.	BOD reduction takes place aerobically. Suspended growth process.	This is an attached growth process, much similar to trickling filters. The biomass is attached to rotating media.
	Organic matter is brought in contact with bacteria attached to plastic media, which is in suspension. Excess sludge is sloughed off automatically, and separated in the clarifier. No sludge recycle is required.	The organic matter is brought in contact with bacteria in suspension. Oxygen supplementation is normally done by surface aerators or diffused air aeration. The biomass is separated in same tank. The operation of the process is in two main phases & two intermediate phases. The sewage is fed to the 1st compartment & mixed with activated sludge. After partial absorption of organic matter the sewage is taken into 2nd compartment & continuously aerated for further absorption of organic matter. Finally the sewage is taken into 3rd compartment for sedimentation. The operation is cyclic in nature. Excess sludge has to be wasted form the last compartment. In the next cycle the operation is same except the direction is reversed.	Pre-treated sewage is passed through a blanket (bed) of sludge in an upwards direction. Upon contact with the organic matter, the bacteria anaerobically convert the organics to methane and other gases. The gas bubbles get released from the sludge bed and rise upwards. Gas - Solid and Liquid separation is achieved in a separator placed at the top of the reactor. Additional settling devices may be provided outside the reactor.	The organic matter is brought in contact with bacteria in suspension. Oxygen supplementation is normally done by surface aerators or diffused air aeration. The biomass is separated in subsequent clarifier. Settled biomass is recycled to aeration tank to maintain Mixed Liquor suspended Solids of the desired level (usually between 2,500 to 4,000 mg/l).	The media is in a form of circular / octagonal discs, mounted on a central shaft. The discs are submerged in a 'VAT' (upto about 45%). The discs slowly rotate, thereby submerging in the sewage for half the time and then in the air for remaining time. The "air time" induces oxygen, allowing bacterial biomass to synthesize the organic matter, when the discs are submerged. Sloughing takes similar to that in trickling filter system.
Process	No sludge volume	Need to maintain certain level of	Upflow velocity plays a	Need to maintain	The disc speed must be

variables.	index / recycle need be checked. System is self sriaustaining. Excess biomass automatically gets wasted off. MLSS levels upto 12,000 mg/l are easily achieved.	MLSS, sludge volume index like activated sludge process. MLSS levels upto 5000 mg/l are possible. Higher levels hinder settling and results in poor performance.	very crucial role in performance. Also variation in inlet BOD / COD affects performance. Sludge bed height and sludge concentration are very important variables.	certain level of MLSS, sludge volume index like SBR system. MLSS levels upto 5000 mg/l are possible. Higher levels hinder settling and results in poor performance.	precisely controlled, else process efficiency drops drastically.
Sensitivity of process	Sensitivity is low, owing to very high bacterial population. No sensitivity to temperature.	Moderately sensitive.	UASB is also very sensitive to low temperatures, and performance drastically reduces with lower temperatures. Flow fluctuations can disturn the sludge blanket, thereby affecting performance.	Moderately sensitive to flow fluctuations, organic loading rates etc.	Highly sensitive to load variations, hydraulic loading and power failures.
Area requirements	Very small area required as compared to SBR, ASP, UASB, RBC	Area required is higher than MBBR but less then ASP.	Area required is larger than ASP and other processes.	Very large area required for aeration tank as well as for secondary clarifiers.	Very large area is required since the loading rates on the disc are limited by the surface area available.
Power requirement	Power requirement is lower than MBR.	Power required is more than MBBR or equal to activated sludge process.	Power requirement is lower than most of the processes. However UASB alone cannot produce desired outlet quality. Additional ASP / ponds must be provided, thereby increasing the power requirement.	Large power is required for aeration, return sludge pumping etc.	Low power than ASP, higher than UASB.

Moving parts	No moving part in biological process.	Moving parts in biological process. Decanter mechanism is mechanically activated and hence needs continuous maintenance. Without decanter, SBR does not function at all. Very high level of instrumentation is required.	No moving parts within UASB. However downstream ASP has typical maintenance requirements.	Depending on the aeration system, there can be moving parts such as surface aerators, brush rotors etc, which need maintenance.	Main moving part is the central shaft and drive, which come under continuous stress
Operation & Maintenance	No scum formation in the process & less moving parts in the system. Hence very low maintenance. Therefore the manpower cost is low. All the components of the system are indigenous & are readily available. Media for FAB never needs replacement of cleaning. Media life of more than 25 years can be guaranteed.	The entire plant operation is cyclic in nature & controlled by **PLC only**. The process requires very high level of instrumentation & sequencing operation. The entire instrumentation & control equipment are usually imported. The entire plant performance depends on functioning of all the instruments & sequence of operation. Needs spares of all the imported instruments in stock for repairing / replacing so that the plant is in operation within a short period. Availability of spares needs to be checked. The decanter mechanism is motorized and hence high degree of maintenance is required. Spares must be imported, Indian spares are not suitable.	Gas hoods need to be cleaned every 06 months or so, to remove scum that accumulates at the top surface. This is a major operation, needing to take the UASB out of service. Maintenance of other related equipments in the downstream ASP is also required.	Relatively simpler maintenance of mechanical equipment such as aerators, blowers, pumps etc. Because of shock loadings, filamentous growth takes place and makes the sludge particles to float in secondary clarifier. Once formed, it is difficult to remove such growth, making operation more operator dependent.	Prone to lot of maintenance of shaft / drive parts. In few cases, media discs have been seen to be buckled under biomass weight, needing complete replacement.
Power shut downs	Prolonged power shutdowns does not affect performance since after power cut-off, media floats at the top, keeping the micro-organisms, alive	At power shut down, all the sludge settles down and becomes septic within short span of time. Hence quick restart is not possible.	The downstream ASP process is severely affected during power shut-downs. UASB itself has little effect.	At power shut down, all the sludge settles down and becomes septic within short span of time. Hence quick restart is not possible.	Power failure causes serious process problems since top half of the disc remains in air, and becomes dry. The submerged portion remains in sewage and becomes septic, hence quick restart is not possible.
Sludge	Sludge is fully	Sludge is active hence anaerobic	Sludge is active and must	Sludge is mostly	Sludge is mostly

properties	digested hence can be dewatered directly without any further treatment	(or aerobic) digester is a must, for complete destruction of biomass. This increases plant cost and operator attention.	be further digested aerobically. Because of presence of SRB, sludge can smell very bad (rotten egg smell).	digested and does not need further treatment, similar to MBBR system. Dewatering is relatively easier.	digested and does not need further treatment, similar to MBBR system. Dewatering is relatively easier.
Amount of excess sludge	Sludge age is very high, and hence sludge production is about 0.1 – 0.15 kg / kg of BOD destroyed, hence very small amount of excess sludge is generated.	Sludge age is low hence sludge production is about 0.3 – 0.6 kg / kg BOD destroyed. Which means that the amount of excess sludge generated is about 200 to 400% higher than MBBR. This calls for large sludge handling system.	Excess sludge production of UASB itself is low, lower than most of the processes. However downstream ASP sludge production is high.	Excess sludge production is low, since Mean Cell Residence Time is high.	Excess sludge production is low, since Mean Cell Residence Time is high.
Expandability	High. Higher loads can be accepted with extra media filling. Modular construction is possible.	Very low. Higher loads can not be accepted. However, Modular construction is possible.	Very low. Overloading is not possible. Parallel units must be added to expand capacity.	Low. Usually extended aeration systems are not suitable for expansion. Separate parallel tanks and clarifiers must be built, which can be very expensive.	Low. Multiple modules need to be installed. Expansion within existing system is not possible.
Usage of treated effluent	No further treatment required for gardening & horticulture.	Treated effluent "as-such" can be used for low end purposes such as construction, floor washing etc. For gardening or higher end uses, chlorination and filtration are a must.	Treated effluent "as-such" can not be used for even low end purposes such as construction, floor washing etc. Secondary treatment in form of ASP., followed by tertiary treatment must be provided even for low end uses.	Treated effluent "assuch" can not be used for even low end purposes such as construction, floor washing etc. Tertiary treatment must be provided even for low end uses.	Treated effluent "assuch" can not be used for even low end purposes such as construction, floor washing etc. Tertiary treatment must be provided even for low end uses.
Treated sewage disinfection : Chlorine demand	About 2 - 3 ppm chlorine required to reduce "E-Coli" to less than 1000 MPN / 100 ml.	About 10 - 15 ppm chlorine required to reduce "E-Coli" to less than 1000 MPN / 100 ml.	About 10 - 15 ppm chlorine required to reduce "E-Coli" to less than 1000 MPN / 100 ml, provided there is an ASP process succeeding UASB system.	About 15 - 20 ppm chlorine required to reduce "E-Coli" to less than 1000 MPN / 100 ml.	About 15 - 20 ppm chlorine required to reduce "E-Coli" to less than 1000 MPN / 100 ml.
"SIZE-WISE" suitability of the process	Suitable for any size, no limitation.	Suitable for any size, no limitation. Larger sizes demand much higher space.	Suitable for any size, no limitation. Larger sizes demand much higher	Suitable for any size, no limitation. Larger sizes demand much	Suitable only for small sizes. Larger sizes demand much higher

			space.	higher space.	space, and also much higher maintenance.

Comparison of SAFF, FAB & SBR

Sr No	Parameter for Comparison	Submerged Aerobic Fixed Film (SAFF)	Fluidised Aerobic Bed (FAB)	Sequencing Batch Reactor (SBR)
1	Space (Sqm/ Avg. DWF MLD) (say)	600 - 800	500 - 700	500 - 600
2	Capital Cost (Rs./ MLD)	65	50	70
3	Material of Construction	open units	open units	stainless steel container
4	Cost of O & M/Annum (Rs.Lakh/ MLD)	10-11	7.5 - 8.5	7.65 - 8.65
	Chemical	1.5	2.5	0.45
	Manpower	1.5	1.5	0.7
	Power	7-8	3.5 - 4.5	6.5 - 7.5
5	Quality of Sludge	short life and needs to be disposed off early	short life and needs to be disposed off early	sludge can be stored for several months in underground storage tank
6	Power (units / day)	11000	12000	8000
7	**Additions**			

	Secondary Settling	Tube Settler	Clari Settler	nil
	PAC (chemical)	nil	yes	nil
8	Fitness of Effluent for Irrigation	1 to 2 dilution water for tolerant and semi tolerant crops	1 to 2 dilution water only for semi tolerant type of crops	totally fit without dilution.
9	Acceptibility by Industries for Reuse	nil	nil	yes

ANNEXURE -II

Report Code: 003_GBP_IIT_EQP_S&R_02_Ver 1_Dec 2010

Sewage Treatment in Class I Towns:

Recommendations and Guidelines

Preface

In exercise of the powers conferred by sub-sections (1) and (3) of Section 3 of the Environment (Protection) Act, 1986 (29 of 1986), the Central Government has constituted National Ganga River Basin Authority (NGRBA) as a planning, financing, monitoring and coordinating authority for strengthening the collective efforts of the Central and State Government for effective abatement of pollution and conservation of the river Ganga. One of the important functions of the NGRBA is to prepare and implement a Ganga River Basin: Environment Management Plan (GRB EMP).

A Consortium of 7 Indian Institute of Technology (IIT) has been given the responsibility of preparing Ganga River Basin: Environment Management Plan (GRB EMP) by the Ministry of Environment and Forests (MoEF), GOI, New Delhi. Memorandum of Agreement (MoA) has been signed between 7 IITs (Bombay, Delhi, Guwahati, Kanpur, Kharagpur, Madras and Roorkee) and MoEF for this purpose on July 6, 2010.

This report is one of the many reports prepared by IITs to describe the strategy, information, methodology, analysis and suggestions and recommendations in developing Ganga River Basin: Environment Management Plan (GRB EMP). The overall Frame Work for documentation of GRB EMP and Indexing of Reports is presented on the inside cover page.

There are two aspects to the development of GRB EMP. Dedicated people spent hours discussing concerns, issues and potential solutions to problems. This dedication leads to the preparation of reports that hope to articulate the outcome of the dialog in a way that is useful. Many people contributed to the preparation of this report directly or indirectly. This report is therefore truly a collective effort that reflects the cooperation of many, particularly those who are members of the IIT Team. Lists of persons who are members of the concerned thematic groups and those who have taken lead in preparing this report are given on the reverse side.

Dr Vinod Tare
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Development of GRB EMP
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3. Treatment Chain

All sewage treatment plants should follow a process chain depending upon the technology chosen and the treatment capacity. In general, treatment is to be done in three stages as per the flow sheet presented in Figure 1.

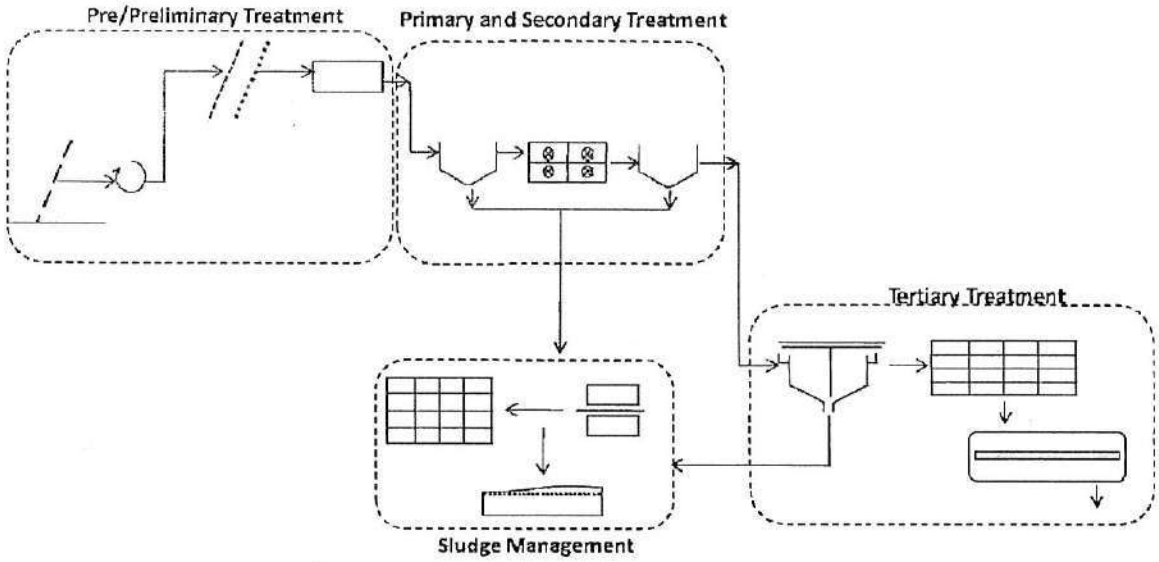

Figure 1: Process Chain for Sewage Treatment

Specifications and treatment objectives at each stage of treatment are as follows.

Stage I Preliminary Treatment:

a) Three Stage Screening: - 25 mm bar racks (before pumping)
- 12 mm bar racks
- 5 mm mesh (< 2 mm mesh for Membrane Bio Reactor, MBR)

b) Aerated Grit Chamber if following unit operation is aerobic and Normal Grit Chamber if following unit operation is anaerobic.

Expected effluent quality after preliminary treatment:

- No floating materials including polythene bags, small pouches, etc.
- Proper collection and disposal of screening and grit.

Stage II Primary and/or Secondary Treatment: Many options are available for second stage treatment. These options can be grouped into following three categories.

a) Pond Based Systems or
b) Activated Sludge Process (ASP) and its Modifications or equivalent systems including but not limited to SBR, UASB followed by ASP, ASP operated on Extended Aeration mode (EA-ASP), ASP with Biological Nutrient Removal (ASP+BNR), and MBBR or
c) Membrane Bio Reactor (MBR)

1. General

Sewage is a major point source of pollution. The target of "Nirmal Dhara" i.e. unpolluted flow can be achieved if discharge of pollutants in the river channel is completely stopped. Also, sewage can be viewed as a source of water that can be used for various beneficial uses including ground water recharge through surface storage of treated water and/or rain/flood water in an unlined reservoir. This may also help achieving "Aviral Dhara".

In order to reduce substantial expenditure on long distance conveyance of sewage as well as treated water for recycling, decentralized treatment of sewage is advisable. As a good practice, many small sewage treatment plants (STP) should be built rather than a few of very large capacity. All new developments must build in water recycling and zero liquid discharge systems. Fresh water intake should be restricted only to direct human-contact beneficial uses of water. For all other uses properly treated sewage/wastewater should be used wherever sufficient quantity of sewage is available as source water for such purposes. All new community sanitation systems must adopt recycling of treated water for flushing and completely isolate fecal matter until it is converted into safe and usable organic manure. The concept of decentralized treatment systems and water/wastewater management will be covered in detail in subsequent reports.

2. Selection of Appropriate Sewage Treatment Technology

Item 4.5.2 in Guidelines for the Preparation of Urban River Management Plan (URMP) for all Class I Towns in Ganga River Basin (Report No. 002_GBP_IIT_EQP_S&R_01) concerns with sewage treatment plant. One of the most challenging aspects of a sustainable sewage treatment system (either centralized or decentralized) design is the analysis and selection of the treatment processes and technologies capable of meeting the requirements. The process is to be selected based on required quality of treated water. While treatment costs are important, other factors should also be given due consideration. For instance, effluent quality, process complexity, process reliability, environmental issues and land requirements should be evaluated and weighted against cost considerations. Important considerations for selection of sewage treatment processes are given in Table 1.

Table 1: Sewage Treatment Process Selection Considerations

Consideration	Goal
Quality of Treated Sewage	Production of treated water of stipulated quality without interruption
Power requirement	Reduce energy consumption
Land required	Minimize land requirement
Capital Cost of Plant	Optimum utilization of capital
Operation & Maintenance costs	Lower recurring expenditure
Maintenance requirement	Simple and reliable
Operator attention	Easy to understand procedures
Reliability	Consistent delivery of treated sewage
Resource Recovery	Production of quality water and manure
Load Fluctuations	Withstand variations in organic and hydraulic loads

country should not be construed as showing technological limitations, nor to affirm that plants outside that range do not exist. The ranges simply indicate most frequently found sizes. A comparison of treatment costs and evaluation of various technologies for sewage treatment in India is presented in Table 2.

In general it is accepted worldwide that the technologies which are deemed to be appropriate have to be qualified through application of a rigorous framework underscoring the performance expectations as well as the choice should be concurrent with the socio-economic acceptability.

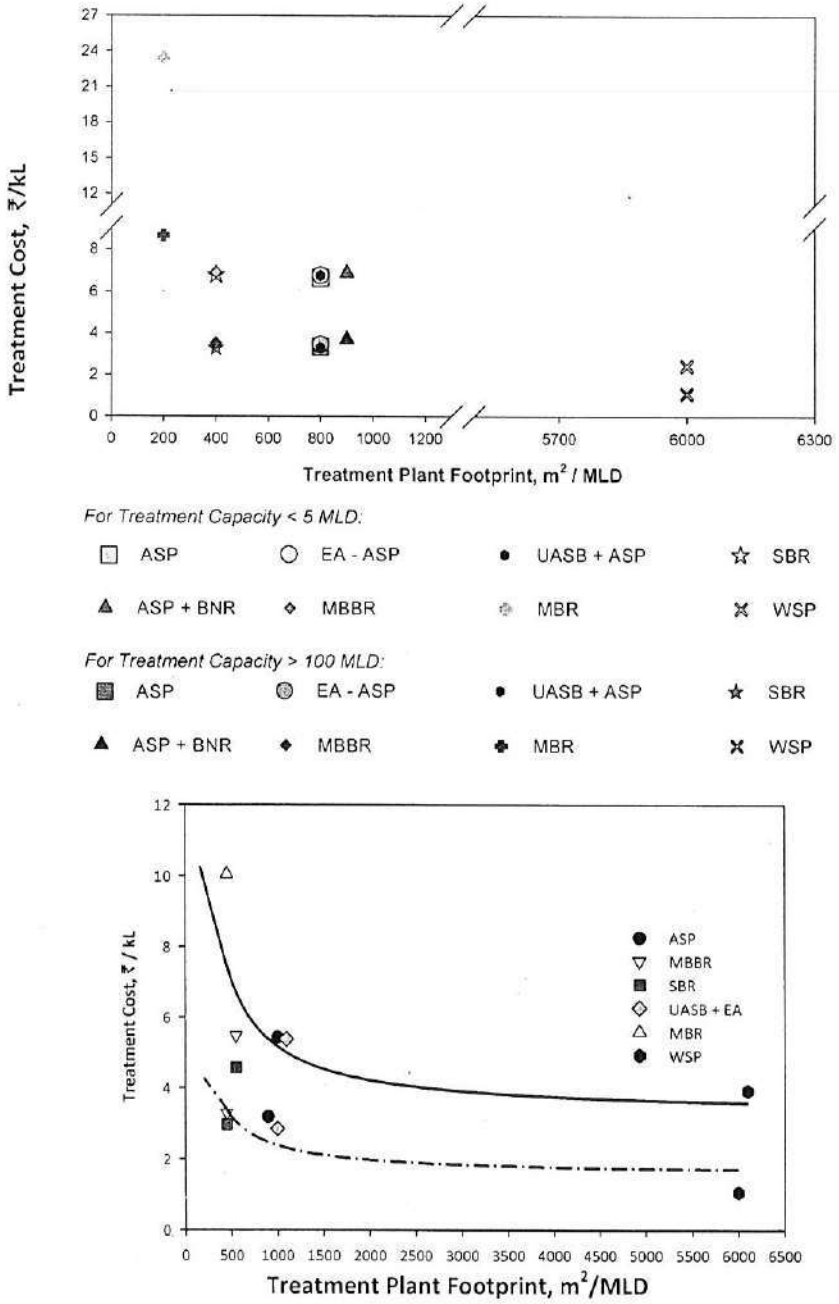

Figure 2: Treatment Cost (as in 2010) and Corresponding Plant Footprint for various Secondary Treatment Options

Expected effluent quality after primary and secondary treatment:

- BOD < 30 mg/L
- SS < 20 mg/L
- Nitrified effluent

A brief description of various technological options available for secondary treatment are presented in Appendix I. EA-ASP, ASP+BNR are considered to be variations of ASP and produce more or less same quality effluent (particularly when tertiary treatment is adopted after secondary treatment) and have approximately same treatment plant footprint. The treatment cost is also of the same order and hence are not considered to be distinctly different than ASP.

Stage III Tertiary Treatment: Coagulation-flocculation-settling followed by filtration and disinfection is generally recommended. Other processes could be selected on the basis of land availability, cost considerations, O&M cost, reuse option, compatibility issues in case of up-gradation of existing plants, etc. However, disinfection operation should invariable be included. Expected effluent quality after tertiary treatment:

- BOD < 10 mg/L
- SS < 5 mg/L
- Phosphate < 0.5 mg/L
- MPN of fecal coliforms < 10/ 100 mL

Where sewage flows are low and/or land can be spared without compromising on other developmental objectives or agriculture, waste stabilization ponds followed by constructed wetland can be adopted without coagulation-flocculation-settling.

4. Cost of Treatment and Land Requirement

Comprehensive analysis of capital cost, operation and maintenance costs, reinvestment cost, energy cost and land requirement based on data obtained from various STPs in the Ganga river basin and elsewhere in India has been done. This analysis has been summarized in Figure 2 as linkage between the treatment cost (₹/KL as in 2010) and the required footprint of the treatment plant (m^2/MLD) for various suggested technological options. For a particular desired effluent quality, the technological option with higher treatment cost will generally require lower treatment plant footprint, and vice versa.

5. Decision Matrix

The selection of a process requires analysis of all factors, not just treatment costs. In order to provide additional factors for the final considerations, key parameters need to be evaluated and weighed as shown in the Exhibit 1 to reach a final recommendation. The matrix attributes are ranked as Low, Medium, High and Very High recognizing that differences between processes are relative, and often, the result of commonly accepted observations. The column entitled "Typical Capacity Range" is added to illustrate the range in which the treatment plants based on specific processes have been built so far in the

S. No.	Assessment Parameter/Technology	ASP*,a	MBBR*,c	SBR*,a	UASB+ASP*,b	MBR*,a	WSP**,b
5.0	Operation & Maintenance Costs						
5.1	**Energy Costs (Per MLD)**						
5.1.1	**Avg. Technology Power Requirement**, *kWh/d/MLD* *Secondary Treatment + Secondary Sludge Handling*	180.00	220.00	150.00	120.00	300.00	2.00
5.1.2	**Avg. Technology Power Requirement**, *kWh/d/MLD* *Tertiary Treatment + Tertiary Sludge Handling*	1.00	1.00	1.00	1.00	1.00	1.00
5.1.3	**Avg. Non-Technology Power Req.**, *kWh/d/MLD* *Secondary Treatment*	4.50	2.50	2.50	4.50	2.50	2.50
5.1.4	**Avg. Non-Technology Power Req.**, *kWh/d /MLD* *Tertiary Treatment*	0.20	0.20	0.20	0.20		0.20
5.1.5	**Total Daily Power Requirement (avg.)**, *kWh/d /MLD*	185.70	223.70	153.70	125.70	302.50	5.70
5.1.6	**Daily Power Cost (@₹ 6.0 per KWh)**, *₹. /MLD/h* *(Including Standby power cost)*	46.43	55.93	38.43	31.43	75.93	1.43
5.1.7	**Yearly Power Cost**, *₹. lacs pa/MLD*	**4.07**	**4.90**	**3.37**	**2.75**	**6.65**	**0.49**
5.2	**Repairs cost (Per MLD)**						
5.2.1	**Civil Works per Annum**, *as % of Civil Works Cost*	3.00	3.00	3.00	3.00		3.00
5.2.2	**E&M Works**, *as % of E&M Works Cost*	1.00	1.00	1.00	1.00		1.00
5.2.3	**Civil Works Maintenance**, *₹. Lacs pa /MLD*	1.94	1.30	1.04	2.11		1.70
5.2.4	**E & M Works Maintenance**, *₹. Lacs pa*/MLD	0.43	0.65	0.81	0.38		0.06
5.2.5	**Annual repairs costs**, *₹. Lacs pa/MLD*	**2.38**	**1.94**	**1.84**	**2.48**		**1.76**
5.3	**Chemical Cost (Per MLD)**						
5.3.1	**Recurring Chemical/Polymer Costs**, *₹. Lacs pa/MLD* *Secondary Treatment*	0.40	0.40	0.40	0.40		0.00
5.3.2	**Recurring Chemical**, *₹. Lacs pa/MLD* *(Alum, Chlorine, Polymer) Costs, Tertiary Treatment*	4.00	4.00	2.00	5.00		6.00
5.3.3	**Other Chemical Cost**, *₹. Lacs pa/MLD*	0.90	0.90	0.90	0.90		1.20
5.3.4	**Total Chemical Cost**, *₹. Lacs pa/MLD*	**5.30**	**5.30**	**3.30**	**6.30**		**7.20**
5.4	**Manpower Cost (Assuming 50 MLD Plant)**						
5.4.1	**Manager**, ₹. pa (1 No.)	3.60	3.60	3.60	3.60		3.60
5.4.2	**Chemist/Engineer**, *₹. pa (1 No.)*	3.60	3.60	3.60	3.60		3.60
5.4.3	**Operators**, *₹. Pa (@₹. 12000 pm)*	8.64	5.76	4.32	8.64		4.32
5.4.4	**Skilled technicians**, *₹. pa (@₹. 10000 pm)*	7.20	4.80	3.60	7.20		1.20
5.4.5	**Unskilled personnel**, *₹. pa (@₹. 7000 pm)*	5.04	2.88	2.16	5.04		8.64
5.4.6	**Total Salary Costs**, *₹. Lacs pa*	28.08	20.64	17.28	28.08		21.36
5.4.7	**Benefits (50% of total salary)**, *₹. Lacs pa*	14.04	10.32	8.64	14.04		10.68
5.4.8	**Salary + Benefits**, *₹. Lacs pa*	**42.12**	**30.96**	**25.92**	**42.12**		**32.04**
5.4.9	**Total annual O&M costs**, *₹. Lacs pa*	**629.26**	**638.11**	**451.22**	**618.96**	**832.55**	**504.86**

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Table 2: Comparison of Treatment Costs of Various Technologies for Sewage Treatment in India

S. No.	Assessment Parameter/Technology	ASP*,a	MBBR*,c	SBR*,a	UASB+EA*,b	MBR*,a	WSP**,b
1.0	Performance after Secondary Treatment						
1.1	**Effluent BOD**, *mg/L*	<20	<30	<10	<20	<5	<40
1.2	**Effluent SS**, *mg/L*	<30	<30	<10	<30	<5	<100
1.3	**Faecal coliform removal**, *log unit*	upto 2<3	upto 2<3	upto 3<4	upto 2<3	upto 5<6	upto 2<3
1.4	**T-N Removal Efficiency**, *%*	10-20	10-20	70-80	10-20	70-80	10-20
2.0	Performance After Tertiary Treatment						
2.1	**Effluent BOD**, *mg/L*	<10	<10	<10	<10	<10	<10
2.2	**Effluent SS**, *mg/L*	<5	<5	<5	<5	<5	<5
2.3	**Effluent NH_3N**, *mg/L*	<1	<1	<1	<1	<1	<1
2.4	**Effluent TP**, *mg/L*	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2.5	**Effluent Total Coliforms**, *MPN/100 mL*	10	10	10	10	10	10
3.0	Capital cost						
3.1	**Average Capital Cost (Secondary Treatment)**, *₹. Lacs/MLD*	68.00	68.00	75.00	68.00	300.00	23.00
3.2	**Average Capital Cost (Tertiary Treatment)**, *₹. Lacs/MLD*	40.00	40.00	40.00	40.00		40.00
3.3	**Total Capital Cost (Secondary + Tertiary)** *₹. Lacs/MLD*	**108.00**	**108.00**	**115.00**	**108.00**	**300.00**	**63.00**
3.4	**Civil Works**, *% of total capital costs*	60.00	40.00	30.00	65.00	20.00	90.00
3.5	**E & M Works**, *% of total capital costs*	40.00	60.00	70.00	35.00	80.00	10.00
4.0	Area Requirements						
4.1	**Average Area, m^2 per MLD** *Secondary Treatment + Secondary Sludge Handling*	900.00	450.00	450.00	1000.00	450.00	6000.00
4.2	**Average Area, m^2 per MLD** *Tertiary Treatment + Tertiary Sludge Handling*	100.00	100.00	100.00	100.00	0.00	100.00
4.3	**Total Area, m^2 per MLD** *Secondary + Tertiary Treatment*	**1000.00**	**550.00**	**550.00**	**1100.00**	**450.00**	**6100.00**

Sludge Treatment: * Thickener + Centrifuge; ** Drying

Process Type : [a] Aerobic; [b] Anaerobic-Aerobic; [c] Anoxic/Anaerobic-Aerobic

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Exhibit 1: Assessment of Technology Options for Sewage Treatment in the Ganga River Basin

Criteria	ASP	UASB+ASP	SBR	MBBR	MBR	WSP
Performance in Terms of Quality of Treated Sewage						
Potential of Meeting the RAPs TSS, BOD, and COD Discharge Standards						
Potential of Total / Faecal Coliform Removal						
Potential of DO in Effluent						
Potential for Low Initial/Immediate Oxygen Demand						
Potential for Nitrogen Removal (Nitrification-Denitrification)						
Potential for Phosphorous Removal						
Performance Reliability						
Impact of Effluent Discharge						
Potential of No Adverse Impact on Land						
Potential of No Adverse Impact on Surface Waters						
Potential of No Adverse Impact on Ground Waters						
Potential for Economically Viable Resource Generation						
Manure / Soil Conditioner						
Fuel						
Economically Viable Electricity Generation/Energy Recovery						
Food						
Impact of STP						
Potential of No Adverse Impacts on Health of STP Staff/Locals						
Potential of No Adverse Impacts on Surrounding Building/Properties						
Potential of Low Energy Requirement						
Potential of Low Land Requirement						
Potential of Low Capital Cost						
Potential of Low Recurring Cost						
Potential of Low Reinvestment Cost						
Potential of Low Level of Skill in Operation						
Potential of Low Level of Skill in Maintenance						
Track Record						
Typical Capacity Range, MLD	All Flows	All Flows	All Flows	Smaller	Smaller	All Flows

Low | Medium | High | Very High

ASP : Activated Sludge Process
MBBR : Moving Bed Biological Reactor
SBR : Sequential Batch Reactor
UASB : Upflow Anaerobic Sludge Blanket
EA : Extended Aeration
MBR : Membrane Bio Reactor
WSP : Waste Stabilization Pond

(S1)

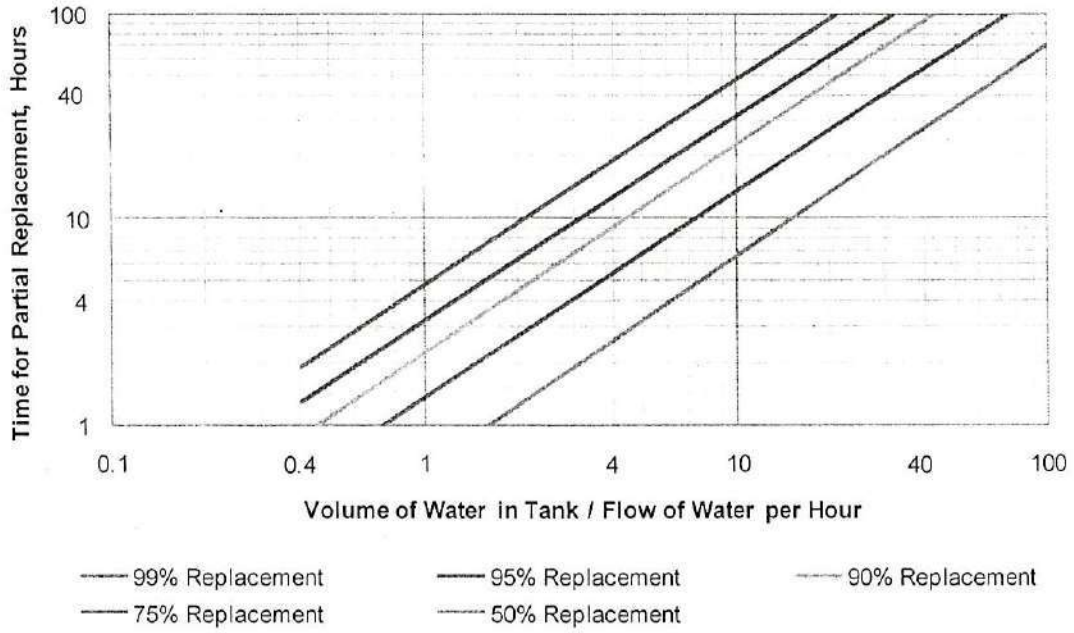


Figure 3: Approximate times required to replace water in test chambers in flow-through tests (For Example: For a chamber containing 4 L, with a flow of 2 L/h, the above graph indicates that 90% of the water would be replaced every 4.8 h. The same time period, such as hours, must be used on both axes, and the same unit of volume, such as liters, must be used for both volume and flow (Adapted from USEPA, 2002)

- Depth of flow-through system or pond: The depth of the flow-through bioassay pond should be within 1.5 to 2.5 m based on an equivalent system of wastewater-fed fish pond (aquaculture) (Costa-Pierce, 1998; Hoan and Edwards, 2005).
- Test organisms: In the bioassay pond, locally found fish, algae and daphnia should be inhabited in the bioassay pond. USEPA (2002) and APHA *et al.* (1995) have recommended following freshwater fish species when fish is the preferred form of aquatic life/test organism:
  1. *Oncorhynchus mykiss* (rainbow trout) and Salvelinus fontinalis (brook trout)
  2. *Pimephales promelas* (fathead minnow)
  3. *Lepomis macrochirus* (Bluegill sunfish)
  4. *Ictalurus punctatus* (Channel catfish)

  Based on above, following equivalent fish species are recommended under Indian conditions.
  1. *Puntias stigma*
  2. *Puntias sophore*
  3. *Anabas*
  4. *Chela bacalia*
  5. *Puntias ticto* and
  6. *Colisa faciatus*

S. No.	Assessment Parameter/Technology	ASP*,a	MBBR*,c	SBR*,a	UASB+EA*,b	MBR*,a	WSP**,b
6.0	NPV (2010) of Capital + O&M Cost for 15 years, ₹. *Lacs*	14838.92	14971.67	12518.32	14684.42	27488.27	10722.96
	Present (2010) Treatment Cost, paisa/L	0.54	0.55	0.46	0.54	1.00	0.39
7.0	Average Capital Cost, ₹. Lacs/MLD *upto Secondary Treatment*	68.00	68.00	75.00	68.00		23.00
7.1	Yearly Power Cost, ₹. *lacs pa/MLD upto Secondary Treatment*	4.04	4.87	3.34	2.73		0.10
7.2	Annual Repairs Cost, ₹. *Lacs pa/MLD upto Secondary Treatment*	1.50	1.22	1.16	1.56		1.11
7.3	Annual Chemical Cost, ₹*Lacs pa/MLD upto Secondary Treatment*	0.85	0.85	0.85	0.85		0.60
7.4	Manpower Cost, ₹. *Lacs pa for 50 mld plant upto secondary treatment*	33.70	24.77	20.74	33.70		25.63
7.5	Total Annual O&M Costs, ₹. *Lacs pa upto Secondary Treatment*	353.02	372.11	288.15	290.72		116.09
7.6	NPV (2010) of Capital + O&M Cost for 15 years, ₹. *Lacs upto Secondary Treatment*	8695.35	8981.58	8072.24	7760.85		2891.39
7.7	Present (2010) Treatment Cost, *paisa / L upto Secondary Treatment*	0.32	0.33	0.29	0.28		0.11

Sludge Treatment: * Thickener + Centrifuge; ** Drying

Process Type : [a] Aerobic; [b] Anaerobic-Aerobic; [c] Anoxic/Anaerobic-Aerobic

1. No Sludge Drying Beds. However can be provided to cater 25 % of sludge dewatering under emergency conditions
2. No FPU after UASB, only Extended Aeration (EA Process)
3. UASB not Recommended for influent SO_4> 25 mg/L
4. No Biological Phosphorus Removal, Coagulants are necessary
5. No Energy Recovery system recommended only if BOD <250 mg/L
6. Less than 5h HRT MBBR is not acceptable
7. Less than 14 h HRT SBR is not acceptable for plants with peak factor 2.5
8. Repair + Chemical + Manpower Cost of MBR is ₹. 500 Lac per 50 MLD
9. O&M of MBR includes all chemical (Cleaning, Polymer etc.,) cost
10. Capital cost of MBR includes membrane replacement cost for 15 years
11. All WSP,s should have mechanical pretreatment works (All types of screens & Grit chambers)
12. SBR data is based on data collected from working Indian SBR with bio selector, OUR control, RAS, Nitrogen removal
13. Manpower cost is assumed to be 20 percent less for treatment only upto secondary stage

ASP : Activated Sludge Process **UASB** : Upflow Anaerobic Sludge Blanket **WSP** : Waste Stabilization Pond

MBBR : Moving Bed Biological Reactor **EA** : Extended Aeration

SBR : Sequential Batch Reactor **MBR** : Membrane Bio Reactor

9. References

APHA, AWWA, WEF (1995) Standard Methods for the Examination of Water and Wastewater, 19th ed. American Public Health Association, American Water Works Association, Water Environment Federation, Washington, DC.

Arceivala, S. J. and Asolekar, S. R. (2006) Wastewater Treatment for Pollution Control (3rd Edition), McGraw Hill Education (India) Pvt. Ltd., New Delhi

Asolekar, S. R. and Gopichandran, R. (2005) Preventive Environmental Management – An Indian Perspective", Foundation Books Pvt. Ltd., New Delhi (the Indian associate of Cambridge University Press, UK)

Costa-Pierce, B.A. (1998) Preliminary investigation of an integrated aquaculture - wetland ecosystem using tertiary-treated municipal wastewater in Los Angeles County, California. Ecol. Eng. 10, 341–354.

Hoan, V.Q., Edwards, P. (2005) Wastewater reuse through urban aquaculture in Hanoi, Vietnam: Status and prospects, in: Costa-Pierce, B.A., Desbonnet, A., Edwards, P. (Eds.), Urban Aquaculture, CABI Publishing, Wallingford, UK, pp. 103–117.

Kumar, R. (2010) Draft Unpublished Report entitled: Status of Sewage Wastewater and Technology Review In India, NEERI Zonal Office, Mumbai

Tare, V. and Bose, P. (2009) Compendium of Sewage Treatment Technologies, National River Conservation Directorate, Ministry of Environmental and Forests, Government of India

USEPA (2002) Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms. Fifth ed. EPA-821-R-02-012. Washington DC, U.S.A.

6. Sludge Management

The sludge dewatering should be done using thickener followed by filter press or centrifuge or any other equivalent mechanical device. Sludge drying beds (SDB) should be provided for emergency only. SDBs should be designed only for 25% of the sludge generated from primary and secondary processes. The compressed sludge should be converted into good quality manure using composting and/or vermi-composting processes. Energy generation through anaerobic digestion of sludges in the form of biogas and subsequent conversion to electrical energy as of now is viable only when sewage BOD > 250 mg/L. Single fuel engines should be used for conversion of biogas to electrical energy. Hazardous sludge, if any should be disposed of as per the prevailing regulations.

7. Flow Measurement

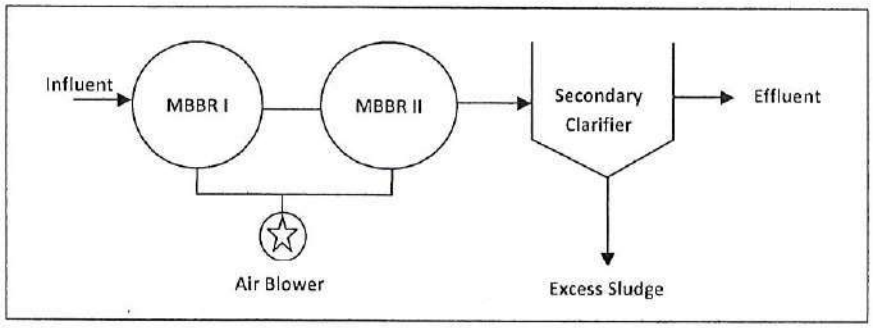
Flow measuring devices should be installed after the Stage I Treatment as well as at the outlet of the sewage treatment plant. These flow devices should be of properly calibrated V notch with arrangements for automatic measurement of head. Additional electronic or other type of flow meters may also be installed. Arrangements should be made for real time display of measured (both current and monthly cumulative) flows at prominent places.

8. Bioassay Test

The bioassay test is gaining importance in wastewater treatment plant design and operation as the whole effluent toxicity (WET) test. This test uses a standard species of aquatic life forms (like fish, algae) as a surrogate to measure the effect of the effluent on the receiving stream. The flow-through method employing continuous sampling is recommended for on-site tests.

- Flow rate (retention time): For a flow-through system, the USEPA Manual for Acute Toxicity Test of Effluents (USEPA, 2002) specifies that the flow rate through the proportional dilutor must provide for a minimum of five 90% replacements of water volume in each test chamber every 24 h (i.e. a retention time of 4.8 h) (see Figure 3). This replacement rate should provide sufficient flow to maintain an adequate concentration of dissolved oxygen (DO). This implies a maximum HRT of 5.3 h (i.e. 0.9V/Q = 4.8) for a flow-through system. Therefore, a flow-through pond with a maximum HRT of 5 h for 100% exposure is recommended for bioassay test of tertiary-treated effluent.
- Total flow requirement: 10% of the flow (subjected to maximum 1 MLD) is required to pass through the bioassay pond.

Exhibit 2: MBBR - Moving Bed Biofilm Reactor



Schematic Diagram of a Moving Bed Bio-Reactor

Moving Bed Biofilm Reactor is an aerobic attached biological growth process. It does not require primary clarifier and sludge recirculation. Raw sewage, after screening and de-gritting, is fed to the biological reactor. In the reactor, floating plastic media is provided which remains in suspension. Biological mass is generated on the surface of the media. Attached biological mass consumes organic matter for their metabolism. Excess biological mass leaves the surface of media and it is settled in clarifier. Usually a detention time of 5 to 12 h is provided in the reactors.

MBBR were initially used for small sewage flow rates and because of less space requirement. In large plant, media quantity is very high and it requires long shut down period for plant maintenance. In fact, it may not be successful for large capacity plants. Moreover the plastic media is patented and not available in the open market, leading to single supplier conditions which limit or deny price competition. In addition, due to very less detention time and other engineering factors, functional Moving Bed Biofilm Reactor in India do not produce acceptable quality effluent.

Merits

- Moving Bed Biofilm Reactor needs less space since there is no primary clarifier and detention period in reactor is generally 4-5 h.
- Ability to withstand shock load with equalization tank option
- High operator oversight is not required

Demerits

- High operating cost due to large power requirements
- Not much experience available with larger capacity plants (>1.5 MLD)
- Skilled operators needed
- No energy production
- Effluent quality not up to the mark in India
- Much less nutrient removal
- Designed criteria not well established

(56)

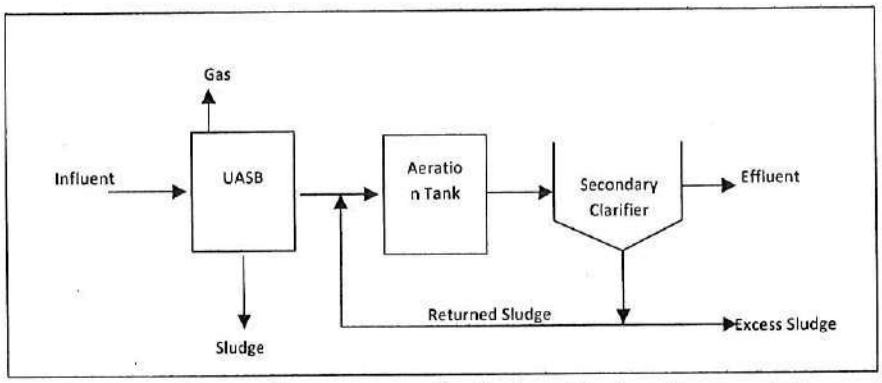
Other freshwater fish species like *Gambusia affinis* (mosquito fish) can also be considered. *Daphnia pulex* and *D. magna* (daphnids), *Selenastrum sp., Scenedesmus aculeala, Scenedesmus guadacanda* are also recommended similar to the recommendations made by USEPA (2002) for bioassay test.

- Stocking density and number of test organisms: For flow-through tests, the live weight of test organisms in the system must not exceed 7.0 g/L (i.e. 7.0 kg/m^3) of volume at 15°C, or 2.5 g/L (i.e. 2.5 kg/m^3) at 25°C (USEPA, 2002). A minimum of 20 organisms of a given species are required for the test.
- Feeding requirement: Considering the bioassay of tertiary-treated sewage effluent and fish as the preferred form of aquatic life/test organism, 32% protein feed at 1% of the stocking biomass/d in two daily slots (preferably morning and evening) with a floating system need to be fed (Costa-Pierce, 1998). The feeding regime for fish mentioned in USEPA (2002) can also be adopted.
- Aeration and oxygen requirements: Sufficient DO (4.0 mg/L for warm water species and 6.0 mg/L for cold water species) should be maintained in the pond for proper environment for test organisms. The DO depletion is not a problem in case of a flow-through system because aeration occurs as the water pass through the system. If DO decreases to a level that would be a source of additional stress, the turnover rate of the water volume must be increased (i.e. the HRT of the system must be decreased) sufficiently to maintain acceptable DO levels (USEPA, 2002). Alternatively fountain or cascade aeration arrangements may be provided.
- Requirement of Dechlorination: Dechlorinated effluent only should be passed through the bioassay pond. If the effluent from the STP is chlorinated, the total residual chlorine in the effluent should be non-detectable after dechlorination.
- Bioassay test acceptability criterion: No mortality (100% survival) of test organisms under any condition.

Salient Features of Recommended STPs

- Continuous measurement of flow at the inlet and outlet
- Excellent preliminary treatment
- Treatment up to tertiary level
- Online bioassay test
- Designed and built as modular units
- Pumping and STPs to be taken together for contracting/bidding

Exhibit 4: UASB+ASP - Upflow Anaerobic Sludge Blanket Followed by Activated Sludge Process



Schematic Diagram of an Upflow Anaerobic Sludge Blanket Process followed by ASP

It is an anaerobic process in which influent wastewater is distributed at the bottom of the UASB reactor and travels in an up-flow mode through the sludge blanket. Critical components of UASB design are the influent distribution system, the gas-liquid-solid separator (GLSS) and effluent withdrawal design. Compared to other anaerobic processes, UASB allows the use of high hydraulic loading.

Merits

- Relatively simple operation and maintenance
- No external energy requirement and hence less vulnerable to power cuts
- No primary treatment required
- Energy production possible but generally not achieved
- Low sludge production
- No special care or seeding required after interrupted operations
- Can absorb hydraulic and organic shock loading

Demerits

- Post treatment required to meet the effluent standard
- Anoxic effluent exerts high oxygen demand
- Large Land requirement
- More man-power require for O&M
- Effluent quality is not up to the mark and poor fecal and total coliform removal
- Foul smell and corrosion problems around STP area
- High chlorine dosing required for disinfection.
- Less nutrient removal

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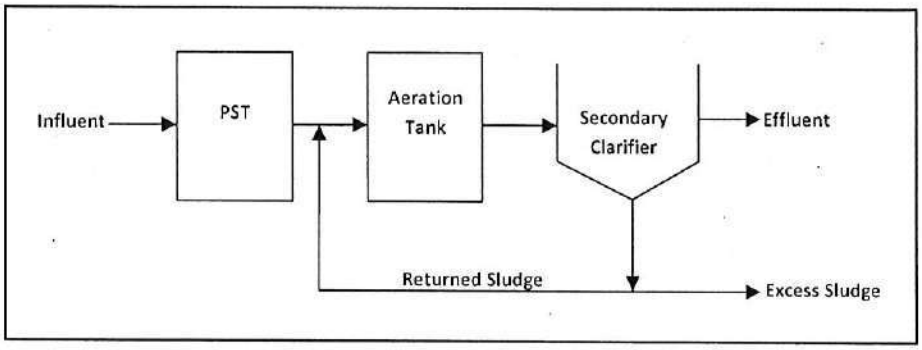
Appendix I: Exhibits on Options for Secondary Treatment

Exhibit 1: ASP - Conventional Activated Sludge Process



Schematic Diagram of a Conventional Activated Sludge Process

Activated Sludge Process (ASP) is a suspended growth aerobic process. It is provided with primary clarifier to reduce the organic load in biological reactor (aeration basin). About 40% of organic load is intercepted in primary clarifier in the form of sludge, decreasing the loading in the aeration tank. Detention period in aeration tank is maintained between 4-6 h. After aeration tank, the mixed liquor is sent to secondary clarification where sludge and liquid are separated. A major portion of the sludge is re-circulated and excess sludge is sent to a digester.

Sludge generated in primary clarifier and excess sludge from secondary clarifier are not matured, digestion of such sludge is essential before disposal. In anaerobic sludge digestion, such sludge produces biogas which can be used for power generation by gas engines. Generated power can be used for operation of plant.

Merits

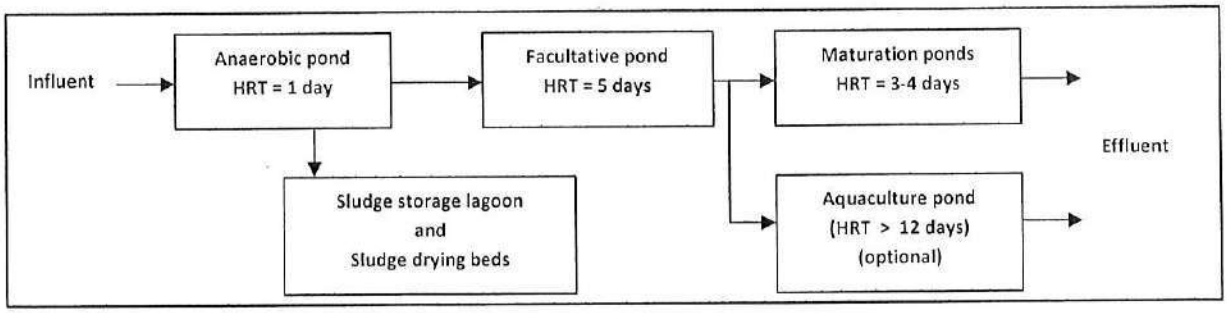
- Good process flexibility
- Reliable operation
- Proven track record in all plant sizes
- Less land requirements
- Low odor emission
- Energy production
- Ability to withstand nominal changes in water characteristics

Demerits

- High energy consumption
- Skilled operators needed
- Uninterrupted power supply is required
- Requires sludge digestion and drying
- Less nutrient removal

(59)

Exhibit 6: WSP - Waste Stabilization Pond (Combination of Anaerobic and Aerobic Pond)



Schematic Diagram of a Waste Stabilization Pond

Sewage is treated in a series of earthen ponds. Initially after screening and de-gritting it is fed to an anaerobic pond for initial pretreatment; depth of anaerobic pond is usually 3 to 3.5 m; as a result the lower section of pond does not get oxygen and an anaerobic condition is developed. BOD reduction takes place by anaerobic metabolism and gases like ammonia and hydrogen sulphide are produced creating odor problems. After reduction of BOD by 40% it enters the facultative/aerobic pond, which is normally 1 - 1.5 m in depth. Lesser depth allows continuous oxygen diffusion from atmosphere; in addition algae in the pond also produces oxygen.

Though BOD at the outlet remains within the range, sometimes the effluent has green color due to presence of algae. The algae growth can contribute to the deterioration of effluent quality (higher total suspended solids) from time to time. Moreover, coliforms removal is also in 1-2 log order. The operating cost of a waste stabilization pond is minimum, mostly related to the cost of cleaning the pond once in two to three years. A waste stabilization pond requires a very large land area and it is normally used for small capacity plant, especially where barren land is available.

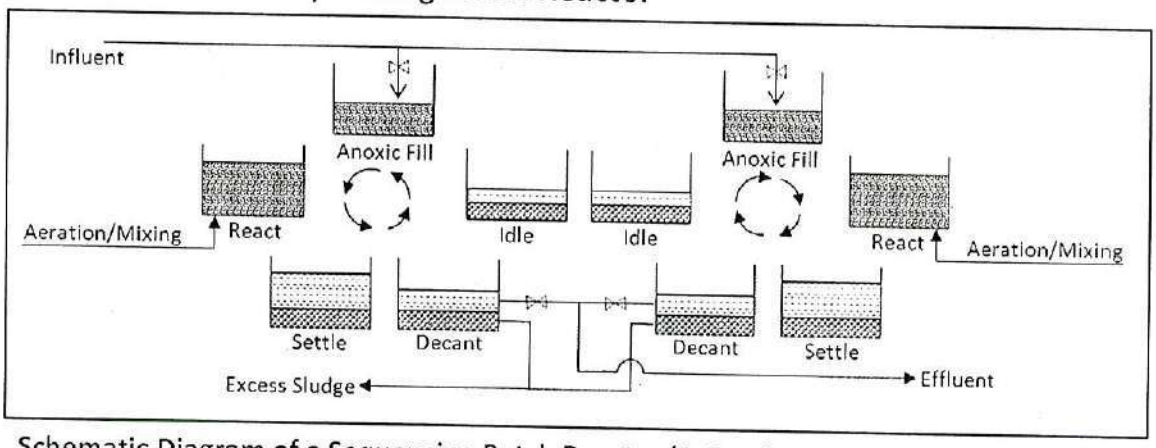
Merits

- Simple to construct and operate and maintain
- Low operating and maintenance cost
- Self sufficiency, ecological balance, and economic viability is greater
- Possible recovery of the complete resources
- Good ability to withstand hydraulic and organic load fluctuations

Demerits

- Requires extremely large areas
- Large evaporation loss of water
- If liner is breached, groundwater is impacted
- Effluent quality may vary with seasons
- No energy production
- Comparatively inferior quality of effluent
- Less nutrient removal
- High chlorine dosing for disinfection
- Odor and vector nuisance
- Loss of valuable greenhouse gases to the atmosphere

Exhibit 3: SBR - Sequencing Batch Reactor



Schematic Diagram of a Sequencing Batch Reactor (A Continuous Process "In Batch")

It is a fill-and-draw batch aerobic suspended growth (Activated Sludge) process incorporating all the features of extended aeration plant. After screening and de-gritting, sewage is fed to the batch reactor. Reactor operation takes place in certain sequence in cyclic order and in each cycle, following operations are involved

- Anoxic Filling tank
- Aeration
- Sedimentation/clarification
- Decantation
- Sludge withdrawal

A number of large-scale plants exist around the world with several years of continuous operation. In India also, there are large scale plants operating efficiently since more than a year. Hundreds of full-scale plants operated on Sequencing Batch Reactor Technology are under successful operation in Japan. Some parts are patented and not available in the open market, leading to single supplier conditions which limit or deny price competition.

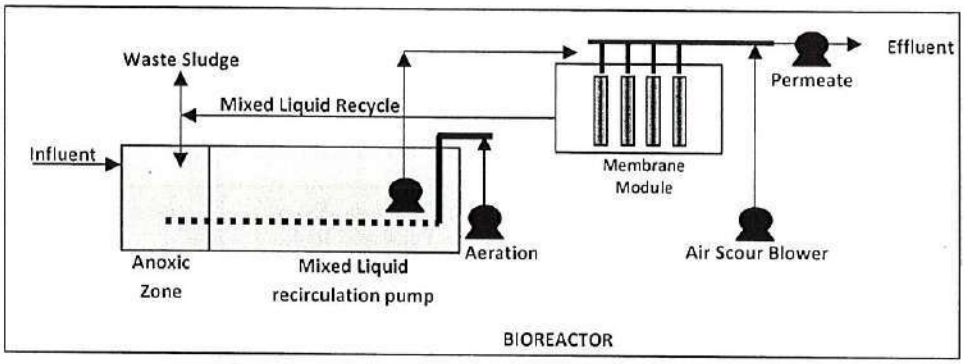
Merits

- Excellent effluent quality
- Smaller footprint because of absence of primary, secondary clarifiers and digester
- Recent track record available in large applications in India also
- Biological nutrient (N&P) removal
- High degree of coliform removal
- Less chlorine dosing required for post disinfection
- Ability to withstand hydraulic and organic shock loads

Demerits

- Comparatively high energy consumption
- To achieve high efficiency, complete automation is required
- Highly skilled operators needed
- No energy production
- Uninterrupted power supply required

Exhibit 5: MBR - Membrane Bioreactor



Schematic Diagram of a Membrane Bioreactor

It is a biological reactor with a suspended biomass. The solid-liquid separation in membrane bioreactor is achieved by a microfiltration membrane with pore sizes ranging from 0.1 to 0. 4 µm. No secondary clarifier is used and has the ability to operate at high MLSS concentrations. Membranes are patented and not available in the open market, leading to single supplier conditions which limit or deny price competition.

Merits

- Low hydraulic retention time and hence low foot print (area) requirement
- Less sludge production
- High quality effluent in terms of low turbidity, TSS, BOD and bacteria
- Stabilized sludge
- Ability to absorb shock loads

Demerits

- High construction cost
- Very high operation cost
- Periodic cleaning and replacement of membranes
- High membrane cost
- High automation
- Fouling of membrane
- No energy production

Exhibit 7: CW - Constructed Wetlands

Wetlands are natural processes similar to stabilization ponds. Wetlands are shallow ponds comprising of submerged plants and floating islands of marshy species. Natural forces including chemical, physical, biological and solar is involved in the process to achieve wastewater treatment. Thick mats of vegetation trap suspend solids and biological process takes place at the roots of the plants. It produces the desired quality of treated sewage but land requirement is very high, though it is less compared to waste stabilization pond. Running cost is comparatively low.

Wetland process have not yet established compared to other processes. There are two types of systems; surface and subsurface distribution of sewage. The type of vegetation grown varies, in some cases there is regular tree cutting and plantation as a part of maintenance work. Plants like Typha, Phragamites, Kattail can be used in India. Another type of wetlands use a plant called duckweed for treatment. This weed has a very fast metabolic rate and absorbs pollutants very quickly.

Merits

- Simple to construct and operate and maintain
- Low operating and maintenance cost
- Self sufficiency, ecological balance, and economic viability is greater
- Possibility of complete resource recovery
- Good ability to withstand hydraulic and organic load fluctuations

Demerits

- Requires large area
- Large evaporation loss of water
- Not easy to recover from massive upset
- If liner is breached, groundwater is impacted
- Effluent quality may vary with seasons
- No energy production
- No nutrient removal
- Odor and vector nuisance
- Loss of valuable greenhouse gases to the atmosphere

ANNEXURE-I

EFFLUENT DISCHARGED STANDARDS FOR SEWAGE TREATMENT PLANT

Sl. No.	Parameters	Parameters Limit (Standards for New STPs Design after notification date) *
1.	pH	6.5-9.0
2.	BOD (mg/l)	Not more than 10
3.	COD (mg/l)	Not more than 50
4.	TSS (mg/l)	Not more than 20
5.	NH_4-N (mg/l)	Not more than 5
6.	N-total (mg/l)	Not more than 10
7.	Fecal Coliform (MPN/100ml)	Less than 100

Note:

(i) These standards will be applicable for discharge in water resources as well as for land disposal. The standards for Fecal Coliform may not be applied for use of treated sewage in industrial purposes.

(ii) * Achievements of Standards for existing STPs within 05 years from the date of notification.

FC 13.05 Professional Development Fund for the Trainee Teachers.

The Trainee Teacher Scheme was adopted in Year 2013. Total 39 Trainee Teachers were recruited in the Institute in the year 2014, 2015 & 2016. At present only 16 Trainee Teachers are on Institute roll. As per Annexure 1 and para IV (A) of Trainee Teachers Scheme, there is a provision for Trainee Teachers to be paid funds i.e 10% of the Gross Annual Salary, for professional development related expenditure like membership of professional societies, attending conferences etc.

Annual Gross Salary of Trainee Teachers is ₹ 6.22 Lakh hence the Gross Salary of 16 Trainee Teachers is ₹99.90 Lakh and 10% of this gross salary comes to ₹9.90 Lakh. It is proposed to reimburse the said Professional Development Fund as per the Trainee Teachers Scheme to the Trainee Teachers as per utilization guidelines issued by the Ministry for CPDA.

Finance Committee is requested to approve the above proposal.

FC 13.06 Any other item with the permission of the Chair.

Registrar

TABLE AGENDA

BoG 13.06 (A) Approval for Memorandum of Understanding with Ministry Of Human Resource Development.

As per MHRD directives, "all autonomous organizations with a budgetary support of more than Rupees Five Crores per annum, are required to enter in to a Memorandum of Understanding with the respective Administrative Ministry or Department ".

A draft MoU proposed by the Ministry and prepared by the Institute is placed at **Annexure FC 13.03**, for the kind perusal of Finance Committee.

Finance Committee is requested to approve the same for onward submission to the MHRD through Board of Governors for execution of MoU.

BoG 13.06 (B) Approval of Fee Structure for B.Tech & M.Tech programme for the academic year 2018-19.

As per Finance Committee directives vide agenda item No 12.04, revised fee structure of B.Tech & M.Tech programme for the academic year 2018-19 is placed as **Annexure FC 13.04.**

Finance Committee is requested to approve the same for implementation in the academic year 2018-19.

BoG 13.06 (C) Permission regarding collaboration with Siemens for establishment of "Centre Of Excellence for Skill Development Initiative for Industry" at NIT Uttarakhand.

National Institute Of Technology, Uttarakhand is planning to collaborate with Siemens for developing industry relevant skills for engineering students at the Institute. This collaboration envisages setting up of ultra-modern facilities, which includes state-of-art machines, robots, control systems, software, hardware, etc. at NIT Uttarakhand. The funding for the same is proposed to come primarily from Siemens as a grant, including absorption of costs by – Siemens partner for this project (Approximately 90%), and NIT Uttarakhand (Approximately 10%). Detail concept note is placed at **Annexure FC 13.05.**

Finance Committee is requested to deliberate upon and give directives to proceed further to formulize the proposal with Siemens.

Registrar

MEMORANDUM OF UNDERSTANDING

Between

National Institute of Technology, Uttarakhand

And

Department of Higher Education Ministry of Human Resource Development Government of India

For

2018-2019

Memorandum of Understanding (MoU) between Department of Higher Education, Ministry of Human Resource Development, Government of India & the National Institute of Technology Uttarakhand for 2018-2019 in pursuance of the Rule 229(xi) of the GFR, 2017

This Memorandum of Understanding (hereinafter referred to as MoU) is entered into at New Delhi on this ____ day of _____, 2018 between Department of Higher Education, Ministry of Human Resource Development, Government of India, Shastri Bhawan, Rajendra Prasad Road, New Delhi-110011 (hereinafter referred to as MHRD)

And

The **National Institute of Technology, Uttarakhand** (hereinafter referred to as the Institute) having its Headquarter at **Srinagar (Garhwal), Dist: Pauri Garhwal, Uttarakhand-246174** and represented by its Director (hereinafter referred to as the Institute) which term and expression shall mean and include, unless repugnant to the context, its successors, assignees, administrators of the Institute.

WHEREAS

1. This MoU is executed in terms of Rule 229 (xi) of the General Financial Rules, 2017 (hereinafter referred to as GFR, 2017) and the subsequent instructions issued by the Ministry of Finance, Department of Expenditure, (hereinafter referred to as MoF) with the objective of improving efficiency of the expenditure, making the action plan outcome oriented, maintaining financial discipline and measuring performance of the Institution on key parameters against the targets set so as to improve its performance.

2. The Institute has the pre-defined Vision, Mission and Objectives as outlined hereunder:-

(A) Vision:

(i) To contribute to society through excellence in scientific and technical education and research

(ii) To serve as a valuable resource for industry and society

(B) Mission:

(i) To generate new knowledge by engaging in cutting-edge research and to promote academic growth by offering state-of-the-art undergraduate, postgraduate and doctoral programmes.

(ii) To identify, based on an informed perception of Indian, regional and global needs, areas of specialization upon which the institute can concentrate.

(iii) To undertake collaborative projects which offer opportunities for long-term interaction with academia and industry.

(iv) To develop human potential to its fullest extent so that intellectually capable and imaginatively gifted leaders can emerge in a range of professions.

(C) Objectives:

(i) To provide the best educational infrastructure for imparting high class education in science and technology and a creative atmosphere for inter-disciplinary research both by the students and the faculty.

(ii) To increase the student capacity to meet the growing demands for industry

(iii) To maintain global standards in student-faculty ratio, research output, publications in journals and placement of students

(iv) To participate in and contribute to nation building through various flagship schemes of the Government of India/State Governments requiring technological interventions thereby spurring economic growth for the welfare of the masses

(v) To provide research and development consultancy, which will foster healthy industry-academia partnership, thereby providing a competitive edge to the indigenous manufacturing

NOW, THEREFORE, the parties here to express their common understanding as under:

(A) MHRD shall

(i) Provide financial support to the Institute to meet its recurring and non-recurring liabilities in such manner and on such conditions as prescribed by the Government of India (hereinafter referred to as GoI) from time to time,

(ii) Help raise other resources, including loan from HEFA for expansion of infrastructural facilities, which has a direct bearing on the performance of the Institute as committed in this MOU.

(iii) Provide guidance and advice in administrative, financial, legal and such other matters as the Institute may require in fulfilling its mandate.

(iv) Provide support in obtaining necessary clearances and approvals, as and when required, from various Ministries, Departments, and Agencies of the Central/State Governments.

(v) Provide support in resolving any dispute with any other authority of the Central/State Government or a private party, as and when required.

(B) THE INSTITUTE shall comply with:

(i) Without prejudice to what has been stipulated in the National Institutes of Technology, Science Education and Research Act, 2007, as amended from time to time and the Statutes framed thereunder, the institute is expected to recover user charges at rates not lower than cost recovery norms

(ii) Specific provisions as contained in the OM No.1/1/2016-EIIIA dated 13.01.2017 in relation to revision of pay scales in accordance with the recommendations of the 7th CPC and any other instruction issued by MHRD from time to time on issues pertaining to the Institute.

(iii) The provisions of the GFR, 2017, including the instructions on financial advice for autonomous bodies, as mentioned in Rule 229(viii) and those concerning release of grants-in-aid, submission of audited accounts, performance report etc.

(iv) Guidelines issued by the Central Vigilance Commission (CVC) in matters of vigilance and disciplinary proceedings etc.

(v) Instructions issued by the MoF/DoE vide OM dated 15.01.2016 or any other instructions issued from time to time with regard to foreign travel as well as those issued by the Ministry of Home Affairs (hereinafter referred to as MHA) with regard to availing/extending foreign hospitality.

(vi) Uniform accounting procedure in accordance with the guidelines issued by MoF.

(vii) Instructions issued by MHRD/MoF/DOP&T with regard to creation of posts and framing of Recruitment Rules.

(C) THE INSTITUTE shall also ensure to:

(i) Finalize any understanding or MoU with any other party including similar organizations abroad with prior approval of the competent authority in the Government.

(ii) Frame Rules for its corpus fund indicating clearly the IRG that can be transferred to such fund or utilized from such fund and items for which such expenditure can be incurred. It shall be the endeavor of the institute to increase IRG by focusing on the Research, consultancy etc. in addition to fees.

(iii) Have clearly defined 'Delegation of Powers' for deciding all administrative and financial matters.

(iv) Shall run courses, to the extent possible, to be self supporting without the need for cross subsidization as well as over-charging from students for flagship courses.

(v) Ensure that the post of Registrar is filled up by a person having sufficient experience as prescribed under the Recruitment Rules and should preferably be an appropriate level official from the Government/CFTIs on deputation to ensure neutrality and transparency.

(vi) Ensure that the Recruitment Rules for the posts of Registrar and the Finance Officer are framed and the selection must follow the Recruitment Rules.

(vii) Ensure that all its accounts are audited by internal auditors regularly and formal audit by the C&AG.

(viii) Ensure that all financial operations are done under PFMS system with the purpose of avoiding parking of funds.

(ix) Present an outcome budget along with annual action plan so that it can be dovetailed in the outcome budget of MHRD.

(x) Comply strictly with the timelines for submission of annual reports and annual audited accounts to the MHRD for the purpose of being tabled in Parliament by the stipulated date.

(xi) Forward to MHRD any information required by it to satisfy any requirement related to Parliamentary Matter, RTI, Public Grievances, VIP References, Court Cases, Notices from Commissions and Statutory Authorities and also inputs for formulation of any policy.

(D) FINANCIAL POSITION:

Details of funds available with the Institute in the last three years are as under:-

Nature of Funds	2014-15 (in ₹lacs)	2015-16 (in ₹lacs)	2016-17 (in ₹lacs)
Government Grants	2,396.00	2,300.00	699.98
Internal Resource Generation	320.48	472.45	620.25
Corpus Funds	593.23	1,054.78	1,865.23
Any other Source (Indicate)	–	–	–
Total	**3,309.71**	**3,827.23**	**3,185.46**

(E) RECEIPT AND EXPENDITURE POSITION:

Estimates of Receipt and Expenditure for the period of MoU, i.e. 2017-18 are as under:-

Nature of Receipt	Amount (in ₹lacs)	Heads of Expenditure	Amount (in ₹lacs)
Government Grants	2,200.00	31	438.85
Internal Resource	516.59	35	235.99
Corpus Funds	1,865.23	36	877.79
Any other Source	–	–	–
Total	**4,581.82**	**–**	**1,552.63**

(F) ANNUAL TARGETS FOR PHYSICAL OUTPUTS/DELIVERABLES:

(As per Annexure I)

(G) PERFORMANCE EVALUATION PARAMETERS:

(i) The performance will be evaluated using the criteria listed at Annexure I. The weightage to be attached to each criterion and the criterion value corresponding to different performance ratings are also given therein. The overall score will be calculated through the formula given in the Annexure based on the scores obtained in each parameter.

(ii) There would also be a negative marking by which the overall score obtained through Annexure I will be reduced based on penalties listed out in Annexure II

(iii) The Consolidated score would be arrived at by reducing the negative score obtained in Annexure II from the overall score obtained under Annexure I.

(iv) The overall rating of the organization would be as given in Annexure III based on the Consolidated score obtained in Para (iii) above.

(H) IMPLEMENTATION AND MONITORING OF THE MoU:

(i) Performance Evaluation against MOU parameters shall be carried out every quarter and monitored by the Institution.

(ii) The performance evaluation shall be submitted to the Board of Governors on quarterly basis during the Board meetings for consideration & review. After the review by the Board, the same shall be sent to MHRD along with the recommendations and the comments, if any, of the Board.

(iii) A Joint review by the Institution and the MHRD shall be carried out within 90 days of completion of the financial year. The result of the Joint Review shall be placed before the Board. The Director of the Institute shall ensure compliance of the issues raised or pointed out in the review and shall cause the MoU report and the review comments prominently hosted on the website of the Institute.

(Prof. Shyam Lal Soni)
Director
National Institute of Technology,
Uttarakhand

(.....)
Secretary
Department of Higher Education
Ministry of Human Resource
Development
Government of India

Place:

Date:

Annexure I

NIT Uttarakhand

PERFORMANCE EVALUATION PARAMETERS AND TARGETS 2017-18

						Criteria Value				
Sl.	Criteria	Existing Levels	Targeted Levels	Unit	Weight age	1	2	3	4	5
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
No.		Average of years 2014-15, 2015-16 & 2016-17 (X)	2017-18 (Y)			Excellent (10 pts)	Very Good (8 pts)	Good (6 pts)	Fair (4 pts)	Poor (2 pts)
						Reached the figure Y, i.e. Target as given in Col. (4)	Less than Y but Reached Figure = X + 0.8*(Y-X)	Less than Figure in Col. 8 but Reached Figure = X + 0.6*(Y-X)	Less than Figure in Col. 9 but Reached Figure = X + 0.4*(Y-X)	Less than Figure = X + 0.4*(Y-X)
1.	**Student strength**				**(30)**					
1.1	UG students intake	253	300	No.	10	-	8	-	-	-
1.2	PG students intake	69	75	No.	10	-	-	-	-	2
1.3	Ph.D. intake	5	10	No.	5	-	8	-	-	-
1.4	Dual Degree, if any, during the year	Not Applicable			0	-	-	-	-	-
1.5	Teacher student ratio	1:12	1:12	ratio	5	10	-	-	-	-
2	**Research and Professional practice**				**(22)**					
2.1	Combined Metric for Publications	50	60	Metric parameter	5	10	-	-	-	-
2.2	Combined Metric for Quality of Publications	20	23	Metric Parameter	5	10	-	-	-	-
2.3	No. of patents filed	NIL	3	No.	5	-	-	-	-	2
2.4	No. of patents granted and licensed	NIL	3	No.	5	-	-	-	-	2
2.5	Total revenue accruing to the Institution (as distinct from to individual faculty) through Research / Consultancies	NIL	1 lac	Rs.	2	-	-	-	-	2
3	**Graduation Outcome**				**(13)**					

3.1	Combined % of placements, higher studies and entrepreneurship	43.38	80	%	5	-	-	-	-	2
3.2	Median salary achieved in placements	4.31 LPA	6.00 LPA	Rs.	5	-	-	6	-	-
3.3	No. of Ph. D students graduated	NIL	1	No.	3	-	-	-	-	2
4	**Financial parameters**				**(10)**					
4.1	% of total cost recovery by means of fees and other resources, except MHRD funds (Sum of Item 3 in Annexure IV)	33.33	100	%	4	-	-	6	-	-
4.2	Incremental growth in amount of Corpus Fund as on 1st July of the year compared to 1st July of previous year	326.62 lacs	1000 Lacs	Rs.	2	-	-	6	-	-
4.3	% Utilisation of funds received from MHRD w.r.t to BE/RE	68.69	100	%	4	-	-	-	-	2
5	**Outreach and inclusivity**				**(10)**					
5.1	Percent students from other countries	NIL	17	%	1	-	-	-	-	2
5.2	Percentage of girl students	18.34	14	%	2	10	-	-	-	-
5.3	% of faculty from SC, ST, OBC	50	50	%	2	10	-	-	-	-
5.4	% of students from SC, ST, OBC	54.18	49.5	%	2	10	-	-	-	-
5.5	No. Of cases reported related to sexual harassment	NIL	NIL	No.	2	10	-	-	-	-
5.6	No. Of ragging cases reported	NIL	NIL	No.	1	10	-	-	-	-
6	**Infrastructure creation (where applicable, in other cases weightage will be zero)**				**(10)**					
6.1	Infrastructure created during the year (In sq. Meter)	2060	365	Sq. Meter	10	10	-	-	-	-
7	**Overall Performance**				**(20)**					
7.1	NIRF Ranking	*Not in top 100*	In to top 100	Rank	20	-	-	-	-	2
	Total				**115**				**Overall Score**	**55.30**

1. If any parameter is not applicable to any Institution, the same may be substituted/ modified/ deleted from this list. The overall weightage obtained by adding Column 6, will be the denominator for calculation of % performance
2. Existing level will be decided by taking the average values of last three years from 2014-15, 2015-16 and 2016-17, except in case of NIRF, where it will be the Rank in 2016-17. If the 2016-17 parameter is not yet available at the time of signing of MoU then average of two years 2014-15 and 2015-16 would be taken. If the Institution did not participate in NIRF Ranking in 2016-17, a notional ranking of 500 would be given for the year 2016-17 for calculation purposes.
3. The Institution and the Ministry would arrive at an agreement on which NIRF Ranking category should be applied for the Institution and then the evaluation would be done on performance in that category only. A change in category would be permitted during the course of the year only if the chosen category is not being taken up by NIRF for categorisation in the year 2017-18.
4. For parameters like ragging cases, anti-sexual harassment cases and NIRF ranking, a lesser value than existing level would be taken as successful achievement, and achievement parameter would be accordingly modified.
5. Score given on each parameter would be as follows: Excellent – 10; Very Good – 8; Good – 6; Fair – 4; Poor – 2
6. If an Institution does not participate in NIRF Ranking exercise in the current year, the weightage would remain at 20 for the NIRF parameter and the Institution would get a zero score on it.
7. Overall Score of an Institution would be calculated as follows: Sum (Score of each Parameter* Parameter weightage) * 100/Total weightage

Annexure II

PARAMETERS FOR NEGATIVE MARKINGS

There will be negative marking from the overall score, obtained in Annexure-I, as follows:

i) Laying of Annual Report in Parliament
   a. If Annual Report of 2016-17 submitted to MHRD before the start of Winter session, 2017 – Less 0%
   b. If Annual Report of 2016-17 submitted to MHRD after 1/1/2018 but before 31/3/18 – Less 1% **-Applicable**
   c. If Annual Report of 2016-17 not submitted to MHRD by 31/3/18 – Less 3%

ii) Submission of data for AISHE
   a. If submitted in 2017-18 within the last date fixed for the same – Less 0% -Applicable
   b. If submitted in 2017-18 but after last date fixed for the same but before 31.3.18 – Less 1%
   c. If not submitted in 2017-18 by 31.3.18 – Less 3%

iii) Holding of Meeting of Board at least once a quarter (*Other Institutions may mention their own Management bodies)*
   a. If Board meeting held once in a quarter, with at least 4 meetings in a year– less 0% **-Applicable**
   b. If Board meeting not held in any quarter, but 4 meetings held in a year– less 1% for each quarter when Board meeting not held
   c. If total number of Board Meetings held in year less than 4 – less 4%
      Quarters for this parameter means the periods: Quarter I: April-June; Quarter II: July-September; Quarter III: October – December; Quarter IV: January - March

iv) Counselling system in the Institution.
   a. When a robust counselling system exists and there is no suicide or attempt to suicide – less 0% **-Applicable**
   b. When no robust system exists but there no suicide or attempt to suicide – less 1%
   c. When a robust counselling system exists but there is at least one suicide or attempt to suicide – less 3%
   d. When no robust counselling system exists but there is at least one suicide or attempt to suicide – less 4%

v) Signing of MoU
   a. When MoU for 2018-19 signed before 31/3/18 – less 0% **-Applicable**
   b. When MoU for 2018-19 finalized by MHRD and Institution jointly but not signed by 31/3/18 – Less 0.5%
   c. When MoU for 2018-19 neither finalized by MHRD and Institution jointly nor signed – Less 2%

vi) Vigilance cases
   a. Where Disciplinary cases ordered by CVC – less 1% per case **-Applicable**
   b. Where criminal prosecution or CBI enquiry ordered by CVC – Less 2% per case
      For this purpose, each case would mean each separate incident on which an enquiry has been done by CVC

Total Deduction in score is of 2%. **Final Score is 53.30%.**

Annexure III

RATING OF INSTITUTION BASED ON CONSOLIDATED SCORES

Performance of the Institution would be graded based on overall score less the negative score to get the Consolidated Score. The performance based on the consolidated score would be as follows:

Consolidated Score		Rating
More than	Equal to or less than	
90	100	Excellent
70	90	Very Good
50	70	Good
33	50	Fair
Less than or equal to 33%		Poor

The consolidated score is 53.30. Accordingly the rating for the performance is Good.

Annexure IV

NIT Uttarakhand

Financial Commitment of MHRD and Other Sources of Revenue

1. The MHRD would allocate the following funds to be released through Consolidated Fund of India in the year 2017-18:
   Budget Estimate (BE): Revenue – Rs. 16 crore
   Capital – Rs. 6 crore
2. The Institution would apply for grant of funds under HEFA as follows:
   HEFA Loan application: Rs...NIL.....crore
3. The Institution will raise funds from other sources as follows:
   i. User charges in form of fees
   ii. User Charges other than fees
   iii. Alumni donation
   iv. Extra mural funding from other Departments/ Ministries of Government of India
   v. Extra Mural funding from other sources:
   vi. Other resources not covered above

Fees Structure of B.Tech. Programme for the Academic Year 2018-19

1. Institute Fees:

(I) For General/OBC category students whose annual family income is more than ₹5.00 Lacs.

Particulars	1st Sem. (₹)	2nd Sem. (₹)	3rd Sem. (₹)	4th Sem. (₹)	5th Sem. (₹)	6th Sem. (₹)	7th Sem. (₹)	8th Sem. (₹)
Tuition Fees	62,500/-	62,500/-	62,500/-	62,500/-	62,500/-	62,500/-	35,000/-	35,000/-
Student Related Activity Fees	2,500/-	2,500/-	2,500/-	2,500/-	2,500/-	2,500/-	2,500/-	2,500/-
Development Fees	2,000/-	2,000/-	2,000/-	2,000/-	2,000/-	2,000/-	2,000/-	2,000/-
Alumni Association Fees	500/-	0	0	0	0	0	0	0
Institute Security Deposit (Refundable)	3,000/-	0	0	0	0	0	0	0
Hostel Security Deposit (Refundable)	5,000/-	0	0	0	0	0	0	0
Book Bank Caution Money (Refundable)	500/-	0	0	0	0	0	0	0
Additional Security Deposit (Refundable)**	5,000/-	0	0	0	0	0	0	0
Security Services##	6,000/-	0	0	0	0	0	0	0
Other Hostel Charges***	3,400/-	0	0	0	0	0	0	0
Convocation Fees (Refundable if left without degree)	500/-	0	0	0	0	0	0	0
Medical Insurance#	600/-	0	600/-	0	600/-	0	600/-	0
Total	**91,500/-**	**67,000/-**	**67,600/-**	**67,000/-**	**67,600/-**	**67,000/-**	**40,100/-**	**39,500/-**

***Additional security deposit to be charged at the time of admission, irrespective of any fees paid earlier or later.*

**** This amount will be refunded to a student if he/she does not avail the hostel facility any time during the entire duration of the Academic Programme.*

 # It shall be charged as actual.

There shall be an annual increase of 10% in this amount.

(II) For General/OBC category students whose annual family income is between ₹1.00 Lac to ₹5.00 Lacs. (Tuition Fee remission is applicable for the students of first semester to fourth semester only).

Particulars	1st Sem. (₹)	2nd Sem. (₹)	3rd Sem. (₹)	4th Sem. (₹)	5th Sem. (₹)	6th Sem. (₹)	7th Sem. (₹)	8th Sem. (₹)
Tuition Fees	20,834/-	20,833/-	20,834/-	20,833/-	20,834/-	20,833/-	35,000/-	35,000/-
Student Related Activity Fees	2,500/-	2,500/-	2,500/-	2,500/-	2,500/-	2,500/-	2,500/-	2,500/-
Development Fees	2,000/-	2,000/-	2,000/-	2,000/-	2,000/-	2,000/-	2,000/-	2,000/-
Alumni Association Fees	500/-	0	0	0	0	0	0	0
Institute Security Deposit (Refundable)	3,000/-	0	0	0	0	0	0	0
Hostel Security Deposit (Refundable)	5,000/-	0	0	0	0	0	0	0
Book Bank Caution Money (Refundable)	500/-	0	0	0	0	0	0	0
Additional Security Deposit (Refundable)**	5,000/-	0	0	0	0	0	0	0
Security Services##	6,000/-	0	0	0	0	0	0	0
Other Hostel Charges***	3,400/-	0	0	0	0	0	0	0
Convocation Fees (Refundable if left without degree)	500/-	0	0	0	0	0	0	0
Medical Insurance#	600/-	0	600/-	0	600/-	0	600/-	0
Total	**49,834/-**	**25,333/-**	**25,934/-**	**25,333/-**	**25,934/-**	**25,333/-**	**40,100/-**	**39,500/-**

Note: Student, who wants remission in Tuition Fee, needs to submit his/her annual family income certificate, issued by the Competent Authority, in the Institute at the time of admission/enrolment.

***Additional security deposit to be charged at the time of admission, irrespective of any fees paid earlier or later.*

**** This amount will be refunded to a student if he/she does not avail the hostel facility any time during the entire duration of the Academic Programme.*

 # It shall be charged as actual.

There shall be an annual increase of 10% in this amount.

(III) For (a) SC/ST/PH category students.

(b) General/OBC category students whose annual family income is below ₹1.00 Lac.

(Tuition Fee remission is applicable for the students of first semester to fourth semester only. SC/ST category students of fifth semester to eighth semester are exempted to pay the tuition fee at the time of admission, however they have to deposit their tuition fee in the Institute before the end of the semester through scholarships /bank loan / any other means.)

Particulars	1st Sem. (₹)	2nd Sem. (₹)	3rd Sem. (₹)	4th Sem. (₹)	5th Sem. (₹)	6th Sem. (₹)	7th Sem. (₹)	8th Sem. (₹)
Tuition Fees	0	0	0	0	0	0	35,000/-	35,000/-
Student Related Activity Fees	2,500/-	2,500/-	2,500/-	2,500/-	2,500/-	2,500/-	2,500/-	2,500/-
Development Fees	2,000/-	2,000/-	2,000/-	2,000/-	2,000/-	2,000/-	2,000/-	2,000/-
Alumni Association Fees	500/-	0	0	0	0	0	0	0
Institute Security Deposit (Refundable)	3,000/-	0	0	0	0	0	0	0
Hostel Security Deposit (Refundable)	5,000/-	0	0	0	0	0	0	0
Book Bank Caution Money (Refundable)	500/-	0	0	0	0	0	0	0
Additional Security Deposit (Refundable)**	5,000/-	0	0	0	0	0	0	0
Security Services##	6,000/-	0	0	0	0	0	0	0
Other Hostel Charges***	3,400/-	0	0	0	0	0	0	0
Convocation Fees (Refundable if left without degree)	500/-	0	0	0	0	0	0	0
Medical Insurance#	600/-	0	600/-	0	600/-	0	600/-	0
Total	29,000/-	4,500/-	5,100/-	4,500/-	5,100/-	4,500/-	40,100/-	39,500/-

Note: Student, who wants remission in Tuition Fee, needs to submit his/her Caste Certificate/PH Certificate (in Central Government format) /annual family income certificate, issued by the Competent Authority, in the Institute at the time of admission/enrolment.

***Additional security deposit to be charged at the time of admission, irrespective of any fees paid earlier or later.*

**** This amount will be refunded to a student if he/she does not avail the hostel facility any time during the entire duration of the Academic Programme.*

 # It shall be charged as actual.

There shall be an annual increase of 10% in this amount.

2. Hostel Fees:

Particulars	1st Sem. (₹)	2nd Sem. (₹)	3rd Sem. (₹)	4th Sem. (₹)	5th Sem. (₹)	6th Sem. (₹)	7th Sem. (₹)	8th Sem. (₹)
Seat Rent##	3,200/-	3,200/-	3,200/-	3,200/-	3,200/-	3,200/-	3,200/-	3,200/-
Mess Fees Advance*	14,000/-	14,000/-	14,000/-	14,000/-	14,000/-	14,000/-	14,000/-	14,000/-
Electricity and Water Charges##	2,000/-	2,000/-	2,000/-	2,000/-	2,000/-	2,000/-	2,000/-	2,000/-
Total	19,200/-	19,200/-	19,200/-	19,200/-	19,200/-	19,200/-	19,200/-	19,200/-

**Mess Charge is taken as advance and after payment of actual amount remaining balance amount will be deposited in student's accounts. Students (except First Year) may opt out of Mess at the beginning of any month; however balance Mess Advance shall be refunded at the end of semester and only after no dues certificate. Seat Rent, Mess fee Advance and Electricity and Water Charges are to be paid separately and will not be adjusted against amount paid to CSAB. Once the hostel facility is availed, the Seat Rent and Electricity and Water Charges will not be refunded after cancellation.*

There shall be an annual increase of 10% in this amount.

3. Library Fees:

Particular	1st Sem. (₹)	2nd Sem. (₹)	3rd Sem. (₹)	4th Sem. (₹)	5th Sem. (₹)	6th Sem. (₹)	7th Sem. (₹)	8th Sem. (₹)
Book Bank Fees	500/	500/-	500/-	500/-	500/-	500/-	500/-	500/-

Note: Availing of Book Bank facility is optional. SC & ST Students are exempted from payment of Book Bank Fees to avail this facility. Once the Book Bank facility is availed in a semester, a student cannot opt out of the book bank for that semester. If a student does not avail Book Bank facility in a semester, Book Bank Fees shall be refunded to student.

Director

राष्ट्रीय प्रौद्योगिकी संस्थान,
उत्तराखण्ड
National Institute of Technology,
Uttarakhand

Fees Structure of B.Tech. Programme for the students taking admission through DASA for Academic Year 2018-19

1. Institute Fees:

(I) For Non-SAARC Category.

Particulars	1st Sem.	2nd Sem.	3rd Sem.	4th Sem.	5th Sem.	6th Sem.	7th Sem.	8th Sem.
Tuition Fees	US$4000	US$4000	US$4000	US$4000	US$4000	US$4000	-	-
Student Related Activity Fees	INR2500	INR2500	INR2500	INR2500	INR2500	INR2500	-	-
Development Fees	INR2000	INR2000	INR2000	INR2000	INR2000	INR2000	-	-
Alumni Association Fees	INR500	0	0	0	0	0	-	-
Institute Security Deposit (Refundable)	INR3000	0	0	0	0	0	-	-
Hostel Security Deposit (Refundable)	INR5000	0	0	0	0	0	-	-
Book Bank Caution Money (Refundable)	INR500	0	0	0	0	0	-	-
Additional Security Deposit (Refundable)**	INR5000	0	0	0	0	0	-	-
Security Services##	INR6000	0	0	0	0	0	-	-
Other Hostel Charges***	INR3400	0	0	0	0	0	-	-
Convocation Fees (Refundable if left without degree)	INR500	0	0	0	0	0	-	-
Medical Insurance#	INR600	0	INR600	0	INR600	0	-	-
Total	**US$4000+ INR29000**	**US$4000+ INR4500**	**US$4000+ INR5100**	**US$4000+ INR4500**	**US$4000+ INR5100**	**US$4000+ INR4500**	-	-

***Additional security deposit to be charged at the time of admission, irrespective of any fees paid earlier or later.*
**** This amount will be refunded to a student if he/she does not avail the hostel facility any time during the entire duration of the Academic Programme.*
 # it shall be charged as actual.
There shall be an annual increase of 10% in this amount.

(II) For SAARC Category.

Particulars	1st Sem.	2nd Sem.	3rd Sem.	4th Sem.	5th Sem.	6th Sem.	7th Sem.	8th Sem.
Tuition Fees	US$2000	US$2000	US$2000	US$2000	US$2000	US$2000	-	-
Student Related Activity Fees	INR2500	INR2500	INR2500	INR2500	INR2500	INR2500	-	-
Development Fees	INR2000	INR2000	INR2000	INR2000	INR2000	INR2000	-	-
Alumni Association Fees	INR500	0	0	0	0	0	-	-
Institute Security Deposit (Refundable)	INR3000	0	0	0	0	0	-	-
Hostel Security Deposit (Refundable)	INR5000	0	0	0	0	0	-	-
Book Bank Caution Money (Refundable)	INR500	0	0	0	0	0	-	-
Additional Security Deposit (Refundable)**	INR5000	0	0	0	0	0	-	-
Security Services##	INR6000	0	0	0	0	0	-	-
Other Hostel Charges***	INR3400	0	0	0	0	0	-	-
Convocation Fees (Refundable if left without degree)	INR500	0	0	0	0	0	-	-
Medical Insurance#	INR600	0	INR600	0	INR600	0	-	-
Total	**US$2000+ INR29000**	**US$2000+ INR4500**	**US$2000+ INR5100**	**US$2000+ INR4500**	**US$2000+ INR5100**	**US$2000+ INR4500**	-	-

***Additional security deposit to be charged at the time of admission, irrespective of any fees paid earlier or later.*
**** This amount will be refunded to a student if he/she does not avail the hostel facility any time during the entire duration of the Academic Programme.*
 # It shall be charged as actual.
There shall be an annual increase of 10% in this amount.

(III) For CIWG Category.

Particulars	1st Sem. (₹)	2nd Sem. (₹)	3rd Sem. (₹)	4th Sem. (₹)	5th Sem. (₹)	6th Sem. (₹)	7th Sem.	8th Sem.
Tuition Fees	62,500/-	62,500/-	62,500/-	62,500/-	62,500/-	62,500/-	-	-
Student Related Activity Fees	2500	2500	2,500/-	2,500/-	2,500/-	2,500/-	-	-
Development Fees	2000	2000	2,000/-	2,000/-	2,000/-	2,000/-	-	-
Alumni Association Fees	500	0	0	0	0	0	-	-
Institute Security Deposit (Refundable)	3000	0	0	0	0	0	-	-
Hostel Security Deposit (Refundable)	5000	0	0	0	0	0	-	-
Book Bank Caution Money (Refundable)	500	0	0	0	0	0	-	-
Additional Security Deposit (Refundable)**	5000	0	0	0	0	0	-	-
Security Services##	6000	0	0	0	0	0	-	-
Other Hostel Charges***	3400	0	0	0	0	0	-	-
Convocation Fees (Refundable if left without degree)	500	0	0	0	0	0	-	-
Medical Insurance#	600	0	600/-	0	600/-	0	-	-
Total	**91,500/-**	**67,000/-**	**67,600/-**	**67,000/-**	**67,600/-**	**67,000/-**	-	-

***Additional security deposit to be charged at the time of admission, irrespective of any fees paid earlier or later.*

**** This amount will be refunded to a student if he/she does not avail the hostel facility any time during the entire duration of the Academic Programme.*

 # It shall be charged as actual.

There shall be an annual increase of 10% in this amount.

2. Hostel Fees:

Particulars	1st Sem. (₹)	2nd Sem. (₹)	3rd Sem. (₹)	4th Sem. (₹)	5th Sem. (₹)	6th Sem. (₹)	7th Sem.	8th Sem.
Seat Rent##	3,200/-	3,200/-	3,200/-	3,200/-	3,200/-	3,200/-	-	-
Mess Fees Advance*	14,000/-	14,000/-	14,000/-	14,000/-	14,000/-	14,000/-	-	-
Electricity and Water Charges ##	2,000/-	2,000/-	2,000/-	2,000/-	2,000/-	2,000/-	-	-
Total	**19,200/-**	**19,200/-**	**19,200/-**	**19,200/-**	**19,200/-**	**19,200/-**	-	-

**Mess Fees is taken as advance and after payment of actual amount remaining balance amount will be deposited in student's accounts. Students (except First Year) may opt out of Mess at the beginning of any month; however balance Mess Fees Advance shall be refunded at the end of semester and only after no dues certificate. Seat Rent, Mess fees Advance and Electricity and Water Charges are to be paid separately and will not be adjusted against amount paid to DASA. Once the hostel facility is availed, the Seat Rent and Electricity and Water Charges will not be refunded after cancellation.*

There shall be an annual increase of 10% in this amount.

3. Library Fees:

Particular	1st Sem. (₹)	2nd Sem. (₹)	3rd Sem. (₹)	4th Sem. (₹)	5th Sem. (₹)	6th Sem. (₹)	7th Sem.	8th Sem.
Book Bank Fees	500/-	500/-	500/-	500/-	500/-	500/-	-	-

Note: Availing of Book Bank facility is optional. SC & ST Students are exempted from payment of Book Bank Fees to avail this facility. Once the Book Bank facility is availed in a semester, a student cannot opt out of the book bank for that semester. If a student does not avail Book Bank facility in a semester, Book Bank Fees shall be refunded to student.

Director

राष्ट्रीय प्रौद्योगिकी संस्थान,
उत्तराखण्ड
National Institute of Technology,
Uttarakhand

Fees Structure of M.Tech. Programme for the Academic Year 2018-19

1. Institute Fees :

Particulars	1st Sem. (₹)	2nd Sem. (₹)	3rd Sem. (₹)	4th Sem. (₹)
Tuition Fees *	35,000/-	35,000/-	35,000/-	35,000/-
Student Related Activity Fees	2,500/-	2,500/-	2,500/-	2,500/-
Development Fees	2,000/-	2,000/-	2,000/-	2,000/-
Alumni Association Fees	500/-	0	0	0
Institute Security Deposit (Refundable)	3,000/-	0	0	0
Hostel Security Deposit (Refundable)	5,000/-	0	0	0
Book Bank Caution Money (Refundable)	500/-	0	0	0
Additional Security Deposit (Refundable)**	5,000/-	0	0	0
Security Services##	6,000/-	0	0	0
Other Hostel Charges***	3,400/-	0	0	0
Convocation Fees (Refundable if left without degree)	500/-	0	0	0
Medical Insurance#	600/-	0	600/-	0
Total	**64,000/-**	**39,500/-**	**40,100/-**	**39,500/-**

** SC & ST students are exempted to pay the tuition fee at the time of admission, however they have to deposit their tuition fee in the Institute before the end of the semester through scholarships /bank loan / any other means.*

***Additional security deposit to be charged at the time of admission, irrespective of any fees paid earlier or later.*

**** This amount will be refunded to a student if he/she does not avail the hostel facility any time during the entire duration of the Academic Programme.*

#It shall be charged as actual.

##There shall be an annual increase of 10% in this amount.

2. Hostel Fees :

Particulars	1st Sem. (₹)	2nd Sem. (₹)	3rd Sem. (₹)	4th Sem. (₹)
Seat Rent##	3,200/-	3,200/-	3,200/-	3,200/-
Mess Fees Advance*	14,000/-	14,000/-	14,000/-	14,000/-
Electricity and Water Charges##	2,000/-	2,000/-	2,000/-	2,000/-
Total	**19,200/-**	**19,200/-**	**19,200/-**	**19,200/-**

**Mess Charge is taken as advance and after payment of actual amount remaining balance amount will be deposited in student's accounts. Students (except First Year) may opt out of Mess at the beginning of any month; however balance Mess Advance shall be refunded at the end of semester and only after no dues certificate. Seat Rent, Mess fee Advance and Electricity and Water Charges are to be paid separately and will not be adjusted against amount paid to CCMT. Once the hostel facility is availed, the Seat Rent and Electricity and Water Charges will not be refunded after cancellation.*

There shall be an annual increase of 10% in this amount.

3. Library Fees :

Particulars	1st Sem. (₹)	2nd Sem. (₹)	3rd Sem. (₹)	4th Sem. (₹)
Book Bank Fees	500/-	500/-	500/-	500/-

Note: *Availing of Book Bank facility is optional. SC & ST Students are exempted from payment of Book Bank Fees to avail this facility. Once the Book Bank facility is availed in a semester, a student cannot opt out of the book bank for that semester. If a student does not avail Book Bank facility in a semester, Book Bank Fees shall be refunded to student.*

Director

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SIEMENS

CoreEL Technologies

Enabling Excellence

Siemens Skill Development Initiative – Concept Note

Siemens Centre of Excellence Relevant Skill Development for Industry At NIT Uttarakhand

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1.1 CoreEL Technologies

CoreEL Technologies is a Customer Application Specific Product & Solutions (CASPS) company offering innovative solutions from its diverse portfolio that includes Intellectual Property (IP) cores, System Design, Prototype development, Manufacturing, Sustenance, EDA tools, COTS products and Technology training. CoreEL's strength lies in its ability to blend deep domain knowledge with the right ingredients across its portfolio of offerings. It is a leading developer of advanced electronic system level products and solutions to three primary markets – Aerospace & Defence, Digital Media Broadcast, and Universities & Institutions of higher learning.

Focused on the Defense, Education and Digital Video businesses, CoreEL is well known in the broadcast industry for providing scalable, modular and flexible IP core solutions targeted towards FPGA devices. CoreEL is considered a leader in the design and development of customized products for the Indian Aerospace and Defense industry. This has been made possible by the deep knowledge and expertise of CoreEL in systems design, complex high-speed boards, real time mission critical firmware/software, FPGA-RTL, DSP, RF, mechanical enclosures and design, manufacturing processes, and reliability engineering. CoreEL products have been incorporated in several of India's Radars, Sonars and Electronic Warfare Systems. CoreEL is the winner of Innovation Award by CII in 2015, as " one of the top 25 innovative companies " in India and also top 6 Innovative Manufacturing companies in India.

CoreEL's education foray is aimed at providing a complete eco-system support to improve the quality of higher education among the Indian Universities. We achieve this by providing a solution platform which comprises of products, support, faculty & student training and by sharing industry viewpoints on the technology and skill requirements of the industry, thereby bridging the Industry-academia gap.

CoreEL Technologies Patents and Product Snap short:

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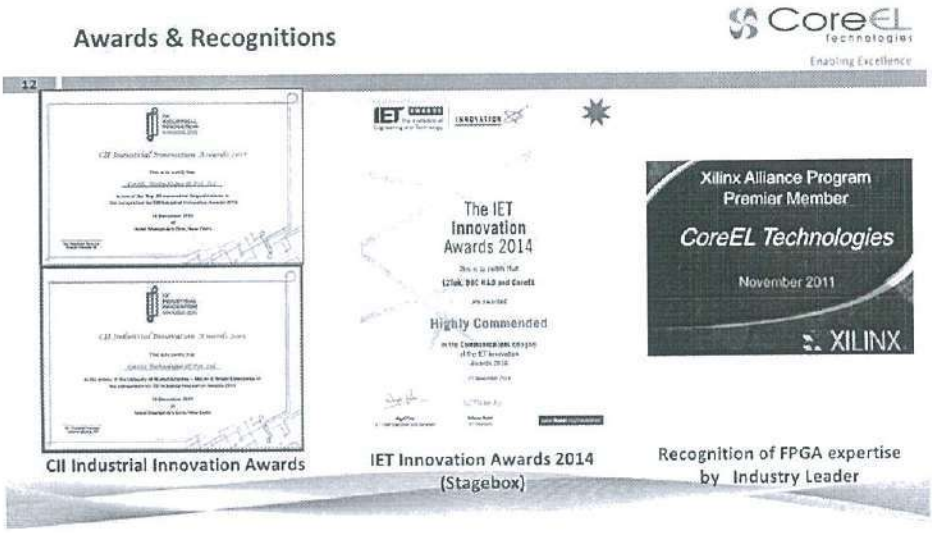
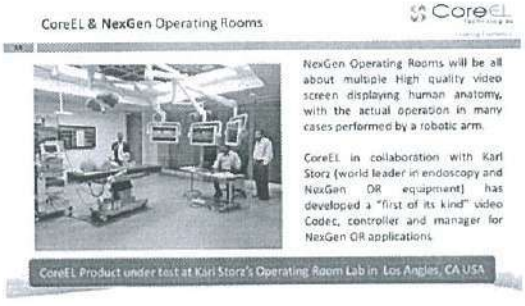
Digital Beam Former Product was identified as the "Most Innovative Technology Award of the Year" & AGNI Award of Excellence in Self Reliance at Defence Research and Development Organization, India.
CoreEL holds a joint Patent on DBF technology

Arudhra (featuring CoreEL's DBF Technology) at Republic Day Parade, 2017

CoreEL Technologies Awards & Recognitions:



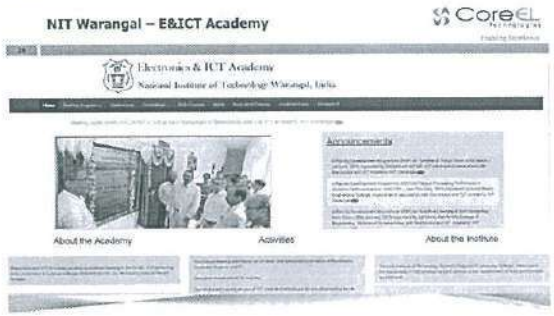
CoreEL Technologies Product Innovations in use:



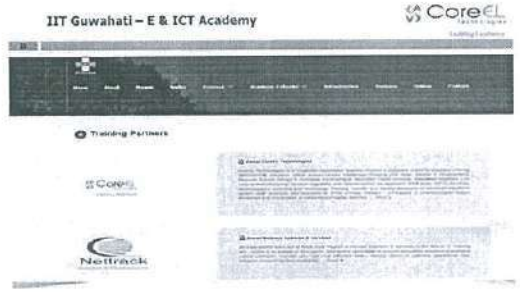
CoreEL Technologies University & Skill Development tie-ups and associations:

Andhra Pradesh - SSDC

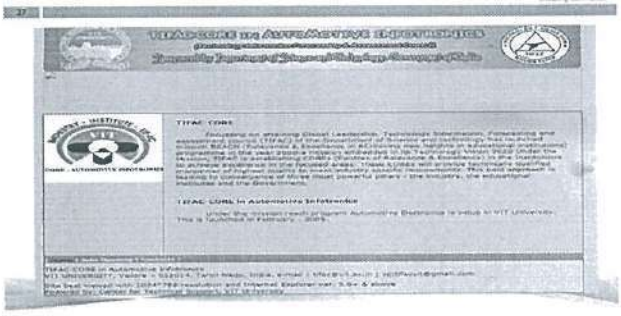
NIT Warangal – E&ICT Academy



IIT Guwahati – E & ICT Academy



VIT University – TIFAC CORE



Association with Universities and Education Institutes

CoreEL Technologies
Enabling Excellence

IIT's	NIT's	CSIR Labs	IIITDM's	NIELIT's	Central & Deemed Universities
IIT, Bombay	NIT, Warrangal	NAL	IIITDM, Jabalpur	NIELIT, Chennai	Amity University in Delhi
IIT, Gowhati	NIT, Suratkal	CEERI	IIITDM, Kanchipuram	NIELIT, Aurangabad	KL University in Vizakhapatnam
IIT, Kharagpur	NIT, Calicut	NPL	IIIT, Allahabad	NIELIT, Chandigarh	Amrita University in Coimbatore
IIT, Delhi	NIT, Allahabad	CFTRI	IIIT, Bangalore	NIELIT, Delhi	Central Univ, Gulbarga
IIT, Kanpur	NIT, Trichy	CMRI	IIIT, Hyderabad	NIELIT, Gorakhpur	Central Univ, Kerala
IIT, Chennai	...	...	...	...	Central Univ, Gowhati
...	...	...	...	...	PES University
...	...	...	...	...	VIT University
...	...	...	...	...	...
...	...	...	...	...	...

CoreEL Technologies Limited and Siemens Industry Software has entered into partnership to foray into Skill Development for Manufacturing Sector. To make this effective Siemens has designated CoreEL Technologies as its Alliance cum reseller partner.

The designated partner for enabling Siemens Centre of Excellence (COE) will be identified by SISW. SISW proposes name of M/s. CoreEL Technologies Limited, CoreEL Technologies is one of the largest alliance cum reseller partner of SISW and has vast experience of undertaking university project with SISW.

CoreEL Technologies is engaged in the business of marketing and system integrating software applications, hardware and providing associated value-added IT services. CoreEL Technologies has agreed to set-up skill development center at NIT Kurukshetra campus, in active collaboration and assistance from SISW, whereby they will supply software, hardware and courseware, and operate the skill development center for 2years and 1 year of handholding to NIT designated staff.

---

1 Preamble

1.1 This proposal

This proposal aims to develop industry relevant skills for engineering college students at National Institute of Technology (NIT) Uttarakhand. It envisages setting up of ultra-modern facilities, which includes state-of-art machines, robots, control systems, software, hardware, etc. at NIT Uttarakhand. The funding for the same is proposed to come primarily from Siemens as a grant, including absorption of costs by – Siemens partner for this project (Approximately 90%), and NIT Uttarakhand (Approximately 10%).

1.2 Intended Outcomes of the Project and Benefits to Stakeholders

The intended outcomes of the project are:

1. Build a world-class integrated skill development infrastructure at NIT Uttarakhand.
2. Improved faculty competency.
3. Attract better faculty and students.
4. Updated Technical Education curriculum that is more aligned with Industry needs.
5. Centres of Excellence to train students and working professionals with latest and futuristic Industry relevant skills.
6. Improved employability and assist better placements of students. Students can compete in national/international employment market for better remuneration and growth.
7. Benefits to various stakeholders in the proposed Industry-academia partnership.

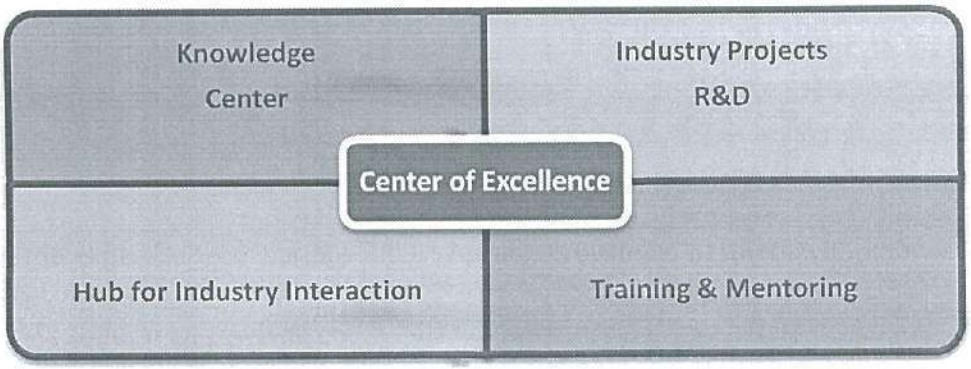
Stakeholders	Outcomes
Central and State Governments	• Larger skilled and employable persons in the sector • Create industry friendly environment to setup and expand
NIT Uttarakhand (Academic Institutes in the vicinity ITIs, Polytechnics and Engineering Colleges)	• Attract more industries • Attract better faculty and improved quality of education • Setting-up of ultra-modern teaching/research facilities to foster and promote cutting edge research. • Create an opportunity for revenue generation. • Continuous refinement of the curriculum content for Skill Excellence to meet industrial demands. • Creation of robust technical education eco-system through best practices. • Continuous up gradation/ modernization of existing laboratories to reflect industries' ever changing processes.

	• To perform capacity building activities and networking with other Institutes. • To motivate faculty and students towards promising innovations.
Industry	• Shorter employee enablement time period • Increased competitiveness due to more productive employee • Skill enhancement of existing employees on latest technology • Innovation projects with academia
Students	• The regular Laboratory classes for B.Tech (Production, Mechanical, ICE, EEE and ECE) branches of undergraduate and postgraduate studies can be conducted in the CoE. • Innovative projects can be performed leading to new product development. • The various learning tracks designed by Siemens will be practiced out of the regular class hours on payment basis for knowledge enrichment. • Enhanced opportunity for placement. • Improvement in employable skills widely accepted by Industry • Opportunity to work on Innovation projects with the Industry
Faculty	• Providing real-world experience and skills to the students through active training in state of the art facilities • Creating Skill awareness among students of NITK and nearby technical institutes through organization of skill development program • Engaging in consultancy for enhanced industrial participation and collaboration • Avenues for introduction of new courses/electives • Support for value added research themes in cutting-edge technologies • Attainment of improvement in the standards of publication

The proposed "Centre of Excellence" is an interdisciplinary, industry backed, centre focused on developing skill excellence for the Automotive, Aerospace & Defence, Industrial Machinery, Marine and Factory Automation Industry Sector. Through the training and implementation of Industry – relevant technology and processes, the centre aims to facilitate a multi-disciplinary learning environment across Science, Technology, Engineering and Management faculties. It is designed to meet the demands of the industries' ever changing processes and help build skills around collaboration and innovation. The centre will leverage Siemens' integrated platform to

draw upon the expertise from various Industries and provide its partners with knowledge and tools.

The centre aims to bridge the skill gap of students vis-à-vis Industry needs and impart state-of-the-art industry oriented training to help foster significant innovation and learning in technical education. The mission of Siemens Centre of Excellence is to promote advancement and implementation of industrial skill development in the areas of Design, PLM, Manufacturing Planning, Manufacturing Execution, MRO, Plant Automation & Robotics, and advanced digital manufacturing-factory concepts through research and education partnership with the industry.



1.3 Source of Grant: Siemens Skill Development Initiative

Siemens has been supporting various education initiatives under its Global Fund for Technical Education to create a robust technical education eco-system through its experience in industrial products and services. These initiatives are intended to bridge today's gap between industry requirements and technical education, and provides solution that makes technical institutes be more aligned with industry needs and make graduate students industry ready. It fosters and promotes engineering discipline by providing real-world experience and skills. Today, this program supports more than 11,100 partners globally that collectively train over 1,135,000 students every year.

1.4 Modalities of Grant Approval and Disbursement by Siemens

Siemens will allocate the grant based on consent from NIT Uttarakhand. Once the Agreement is signed between NIT Uttarakhand and Siemens Partner, this grant will be approved on the Siemens P2O ordering system for Siemens Partner and will be kept valid for 15 days. This amount will be automatically applied once Siemens Partner logs in the products in the Siemens P2O system.

1.5 Siemens Centers of Excellence

"Siemens Centre of Excellence" is an interdisciplinary, industry backed, centre focused on developing "Skill Excellence" for Industry. Through training and implementation of industry-relevant technology and processes, the centre aims to facilitate a multi-disciplinary learning environment across Technology, Engineering, and Science and Management faculties. It is designed to meet the demands of the industries' ever changing processes and help build skills around collaboration and innovation. The center will leverage Siemens' integrated platform to draw upon the expertise from various areas of Industry community and provide with knowledge and tools.

Siemens has proposed to set up the Siemens center of excellence at NIT Uttarakhand.

1.6 Proposal to set up Siemens Centre of Excellence (COE) at NIT Uttarakhand

These COEs are proposed to be setup at NIT Uttarakhand. Each COE has nine (10) Labs and require about 15,000 square feet area in the host institute as per below details:

- Product Design & Validation Lab
- Advanced Manufacturing Lab
- Automation Lab
- Electrical & Energy Studies Lab
- Process Instrumentation Lab
- Mechatronics Lab
- Test and Optimization Lab
- Internet of Things (IOT) Lab
- Metrology Lab
- Machine Lab
    - CNC Controller Lab
    - CNC Machine Lab
    - Robotic Lab
    - RPT Lab
- Siemens & Industry Partner IP (Content)

Host Institute will provide following for the COE:

1. Space for Labs
2. Flooring, Furniture and Fixtures
3. Workstation class computers (Dell/ HP/ Lenovo)
4. Air Conditioning

5. Projectors
6. Power supply (incl. Backup)

2 Laboratories to be set up at the Siemens COE

2.1 Design and Validation lab

The Design and Validation Lab consists of the Siemens solution for Computer Aided Design (CAD) and Computer Aided Engineering (CAE). These Solutions assist the students to understand engineering design and analysis. The examples in this lab are industry examples from Automotive, Aerospace, Industrial Machinery & Renewable Energy Industry segments.

2.2 Advanced manufacturing lab

The Advanced Manufacturing Lab consists of the Computer Aided Manufacturing (CAM) which enables students to learn how to create CNC Programs and validate the Machine Tool cutting operations and parameters. Digital Manufacturing Solutions which assist the students to understand manufacturing planning and validation. The lab also consists of the Product Lifecycle Management Solution which allows the students to learn the enterprise solutions of product development from end to end.

2.3 Automation lab

The Automation Lab allows the students to understand the requirement and functioning of Programmable Logic Controllers (PLCs). This is the first step toward Internet of Things (IOT). Here the students learn how to Program Industrial PLCs, work with Industrial Human Machine Interface (HMI), Industrial SCADA (Supervisory Control & Distributed Acquisition) and PLC networking using profibus and profinet.

2.4 Electrical & Energy Saving lab

The Electrical & Energy Saving Lab focus on the following areas;

1) AC/ DC Drives: Students are introduced to the usage of drives from the industries where they are used to how to vary the speed as per process/application requirement and how it controls the various motor parameters.
   Siemens Innovative design provides the right frequency converter suitable for every drive application. Siemens drive portfolio represents uniform engineering, extremely high efficiency and convenient operation.
2) Switchgears: Students are introduced to how in power system switchgears are used to control, protect and isolate electrical equipment's. Low voltages switchgears also used in residential, industrial and commercial segments. Siemens switchgear is widely used in industry because of their compliance with standard, precise design , operational benefits and wide range.

2.5 Mechatronic LAB

The Mechatronic lab brings together four departments of engineering, namely Mechanical, Electrical, Electronics & Communication and Computer Science. This allow students to work on a mini factory like setup and on areas such as Pneumatics & Hydraulics, Sensors, Communication Protocol, PLC programming, PLC Networking using profibus and profinet.

2.6 Process Instrumentation LAB

The Process Instrumentation Lab enables students to work on Advance Automation using Distributed Control Systems (DCS) and understanding the working of the following equipment's in a plant:

- Temperature
- Flow
- Level
- Pressure
- Sensors/Measurements & Communications

2.7 Test and Optimization lab

The Test and Optimization Lab addresses complex engineering challenges safeguarding the balance between technological design options and functional performance. From testing and mechanical simulation to model-based systems engineering it enables engineers to understand the functional performance engineering of mechatronic systems to solve noise, vibration and harshness (NVH), acoustics, durability, dynamics, performance, fuel economy and controls development issues.
The Test and Optimization Lab includes:

- Imagine Lab
- Virtual Lab
- Test Lab

2.8 CNC Controller lab

The CNC Controller Lab enables students to understand the concept of CNC Programming and work real Sinumerik 808D controller for Turning and Milling applications. The students will also get to work on the Sinumerik 840 Dsl rack which supports programming upto 31 Axis. This would enable students to program complex jobs. The students can learn how to program and test the CNC Program using the Sinutrain software.

2.9 CNC Machine lab

The Logical step after learning CNC Programming would be to execute the CNC Program on an industrial CNC Machine. The CNC Machine Lab consists of two industrial grade CNC Machines:

- CNC Lathe
- Vertical Machining Centre – 3 Axis

2.10 Robotics lab

Robots play an important role in the manufacturing industry, ensuring that the quality of the product is not compromised and the production volumes are met. In the Robotics Lab we would teaching the students to understand the working principals of a Robot, how to program it and apply it to an application. There would be three (3) robotics cells catering different applications, they are:

- Pick and Place Robotic Cell
- Spot Welding Robotic Cell
- MIG Welding Robotic Cell

2.11 Rapid prototyping lab

Rapid prototyping is a group of techniques used to quickly fabricate a scale model of a physical part or assembly using three-dimensional computer aided design (CAD) data. Construction of the part or assembly is usually done using 3D printing or "additive layer manufacturing" technology.
This is a fast emerging technology which is finding its way into manufacturing addressing various industries. In the Rapid Prototyping (RPT) Lab the students are though how to design and manufacture using the RPT Machine.

2.12 Metrology lab

Metrology is the science of measurement. Metrology includes all theoretical and practical aspects of measurement. Quality is an important aspect of the manufacturing Industry in India and globally today. In the Metrology Lab we focus on quality measurement using the Coordinate Measuring Machine (CMM) and some of the advance digital measuring gages.

2.13 Internet of things (IOT) lab

The Internet of Things, or IoT, is emerging as the next technology mega-trend, with repercussions across the business spectrum. By connecting to the Internet billions of everyday devices – ranging from fitness bracelets to industrial equipment – the IoT merges the physical and online worlds, opening up a host of new opportunities and challenges for companies, governments and consumers.

In order to meet the growing demand of IOT in the industrial or manufacturing segment we cover the following topics for the students in the Internet of Things (IOT) Lab:

- Connecting Things
- Data Analytics
- Application Development
- Enterprise Development

3 Program Costing

3.1 Capital Expenditure in Setting up of Siemens COE

Table 1: Budget for Siemens Center of Excellence – CAPEX

S. No.	Particulars of Laboratories Per Centre	No of labs	Price	Grant in-Kind by Siemens and Siemens Partner	Contribution by NIT Uttarakhand
1	Design & Validation Lab	1	₹ 1,936,778,346	₹ 1,727,923,863	₹ 208,854,483
2	Advanced Manufacturing Lab	1			
3	Automation Lab	1			
4	Mechatronics Lab	1			
5	Process Instrumentation Lab	1			
6	Electrical & Energy Studies Lab				
7	Test and Optimisation Lab	1			
8	Machine Lab • CNC Controller Lab • CNC Machine Lab • RPT Lab • Robotic Lab	4			
9	Metrology Lab	1			
10	Internet of Things (IOT) Lab	1			
11	Siemens & Industry Partner IP (Content)	1			
Total CAPEX			**₹ 1,936,778,346**	**₹ 1,727,923,863**	**₹ 208,854,483**

*Applicable Taxes would be charged at actuals at the time of invoicing.

Table 2: Budget for Siemens Center of Excellence – OPEX

S. No.	Particulars	Price	Grant in-Kind by Siemens and Siemens Partner	Contribution by NIT Uttarakhand
1	Training of NIT Uttarakhand Trainers			
2	Trainers for 2 years + Handholding NIT Uttarakhand trainers for 1 year			
3	Industry Seminar			
4	Industry Partner Academia Conference			
5	Centre Setup and Branding			
6	Project Management + Operational			

	Contingency			
Total OPEX		**₹ 4,37,05,000**	**₹ 4,37,05,000**	**₹ 0**

Table 3: Budget for Siemens Center of Excellence – CAPEX & OPEX

S. No.	Particulars	Price	Grant in-Kind by Siemens and Siemens Partner	Contribution by NIT Uttarakhand
1	CAPEX	₹ 1,936,778,346	₹ 1,727,923,863	₹ 208,854,483
2	OPEX	₹ 43,705,000	₹ 43,705,000	₹ 0
Total		**₹ 1,980,483,346**	**₹ 1,771,628,863**	**₹ 208,854,483**

Table 4: Siemens COE - CAPACITY UTILIIZATION

SIEMENS COE - CAPACITY UTILIZATION									REVENUE SIMULATION IN INR (Lakhs)											
Sl.No	Lab Details	Capacity	Avg. Course Duration (Days)	Working Days / Mth.	Batches/ Mth.	Training Capacity/ Mth.	Training Capacity / Yr.	No of COE's	Average Fee per student per year	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
										20%	40%	60%	70%	70%	70%	70%	70%	70%	70%
1	Product Design & Validation	30	10	24	2	90	1080	1	10000	21.60	43.20	64.80	75.60	75.60	75.60	75.60	75.60	75.60	75.60
2	Advance Manufacturing	30	10	24	2	90	1080	1	20000	43.20	43.20	64.80	75.60	75.60	75.60	75.60	75.60	75.60	75.60
3	Test & Optimization	24	12	24	2	48	576	1	20000	23.04	43.20	64.80	75.60	75.60	75.60	75.60	75.60	75.60	75.60
4	Automation	24	15	24	1	24	288	1	15000	8.64	43.20	64.80	75.60	75.60	75.60	75.60	75.60	75.60	75.60
5	Mechatronics	24	12	24	2	48	576	1	20000	23.04	43.20	64.80	75.60	75.60	75.60	75.60	75.60	75.60	75.60
6	Process Instrumentation	24	11	24	2	48	576	1	20000	23.04	43.20	64.80	75.60	75.60	75.60	75.60	75.60	75.60	75.60
7	Electrical & Energy Saving	24	12	24	2	48	576	1	15000	17.28	43.20	64.80	75.60	75.60	75.60	75.60	75.60	75.60	75.60
8	Internet Of Things (IOT) Lab	20	15	24	1	48	576	1	20000	23.04	43.20	64.80	75.60	75.60	75.60	75.60	75.60	75.60	75.60
9	Metrology Lab	20	12	24	2	48	576	1	20000	23.04	43.20	64.80	75.60	75.60	75.60	75.60	75.60	75.60	75.60
10	CNC Controller Lab	24	10	24	2	48	576	1	10000	11.52	43.20	64.80	75.60	75.60	75.60	75.60	75.60	75.60	75.60
11	CNC Machine Lab	20	12	24	2	40	480	1	10000	9.60	43.20	64.80	75.60	75.60	75.60	75.60	75.60	75.60	75.60
12	Robotics	20	12	24	2	40	480	1	20000	19.20	43.20	64.80	75.60	75.60	75.60	75.60	75.60	75.60	75.60
13	RPT Lab	20	12	24	2	40	480	1	15000	14.40	43.20	64.80	75.60	75.60	75.60	75.60	75.60	75.60	75.60
	TOTAL NUMBER OF STUDENTS TRAINED					876	10512			260.64	561.60	842.40	982.80	982.80	982.80	982.80	982.80	982.80	982.80

3.2 Applicable taxes

Taxes (GST) would be charged at actuals, at the rates applicable at that point in time, while billing.

3.3 Additional Expenditure to NIT Uttarakhand

The additional expenditure that NIT Uttarakhand would have to make in providing the infrastructure to setup the Siemens COE is as per the table below:

S. No.	Requirements for all Labs in the CoE	Units	Estimated cost to NIT Uttarakhand
1	Flooring, Furniture and Fixtures	-	₹ 10,000,000
2	Workstation class computers	100	₹ 8,100,000
3	Air Conditioning	40	₹ 2,800,000
4	Projectors	10	₹ 1,000,000
5	Power supply (incl. Backup)	-	₹ 1,000,000
	Total		₹ 22,900,000

3.4 Proposed Sustainability and Expansion Plan for each Centre

One of the key activities of Siemens Centers of Excellence is to create a sustainable operating model that can continue to offer courses for Students and working professionals with minimum support from the NIT Uttarakhand and Siemens in the long run. The following are the proposed modalities:

- NIT Uttarakhand Centre to earn revenue by offering training & certification to students and working professionals.
- Number of students shown here should come from the hosting college as well as from other colleges in vicinity.
- Capacity calculations are based on the assumption that each center would be running for six hours on each working day; 2 Hours in the morning before the commencement of the regular classes and 4 hours in the evening after the completion of regular college classes

SIEMENS COE - CAPACITY UTILIZATION											
Sl. No.	Lab Details	Capacity	Avg. Course Duration (Days)	Working Days / Mth.	Batches/ Mth.	Training Capacity/ Mth.	Training Capacity / Yr.	No of COE's	Capacity Utilization		
									50%	70%	90%
1	Design & Validation	30	10	24	2	60	720	1	360	504	648
2	Advance Manufacturing	30	10	24	2	60	720	1	360	504	648
3	Test & Optimization	30	15	24	1	30	360	1	180	252	324
4	Automation	24	12	24	2	48	576	1	288	403	518
5	Mechatronics	24	11	24	2	48	576	1	288	403	518
6	Process Instrumentation	24	12	24	2	48	576	1	288	403	518
7	Electrical & Energy Saving	24	10	24	2	48	576	1	288	403	518
8	Internet of Things (IOT)	24	12	24	2	48	576	1	288	403	518
9	Metrology Lab	20	15	24	1	20	240	1	120	168	216
10	Machine Lab										
10 (A)	RPT	20	12	24	2	40	480	1	240	336	432
10 (B)	CNC Controller	20	12	24	2	40	480	1	240	336	432
10 (C)	CNC Machine	20	10	24	2	40	480	1	240	336	432
10 (D)	Robotics	20	10	24	2	40	480	1	240	336	432
	TOTAL NUMBER OF STUDENTS TRAINED					570	6,840		3,420	4,788	6,156

The schedule above excludes civil maintenance and routine operating charges towards electricity, water and such other facility running costs.

Given the fast improvement of technology life-cycle, we recommend NIT Uttarakhand to consider refreshing the entire technology stack, with the then latest technology based equipment and system anytime post 7 years.

3.5 Industry benchmarking for likely fees structure:

We have benchmarked fees charged for various courses pertaining to tool design and engineering, CNC machines, CAD/CAM etc. at the above mentioned advanced training institutes. We have taken mix of long term, medium term and short term courses offered at these institutes and normalized them to 1 year duration program.

- Delhi Institute of Tool Engineering, Delhi (DITE – Del)
- Central Institute of Tool Design, Hyderabad (CITD – Hy'bd)
- Indo-German Tool Room, Aurangabad (IGTR-Aurangabad)
- Indo-Danish Tool Room, Jamshedpur (IDTR-Jamshedpur)
- Indo-German Institute of Advanced Technology, Vizag (IGIAT-Vizag)

Apart from the IGIAT-Vizag, rest all the institutes are public sector institutes.

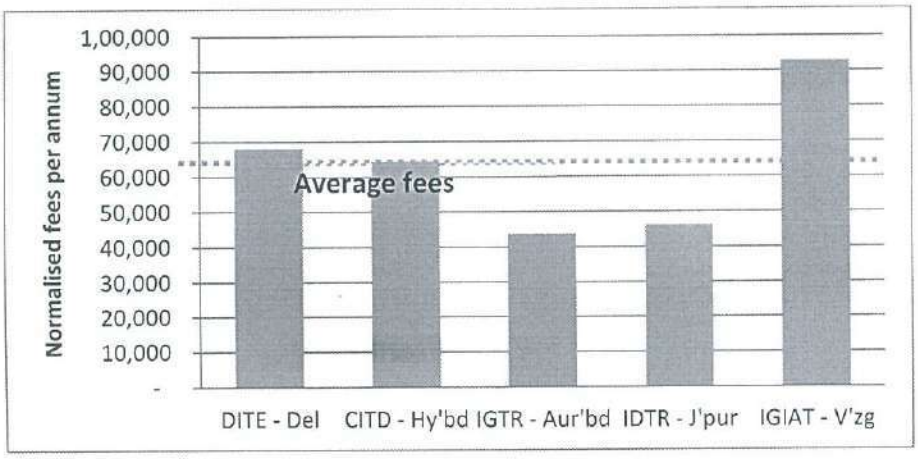


Exhibit above illustrates average fees per student annually for a skill development program currently amounts to about INR 64,000. However there are evidences of growing acceptability of industry certification (in case of Indo-German Institute of Advanced Technology, Vizag) and increased willingness to pay higher fees provided a placement is guaranteed with commensurate salary. Hence we assume that if the private sector partner can demonstrate a guaranteed placement along with an internationally recognized certification, then the course fees can go up-to INR 70,000 per annum level.

These institutes offer a mix of short term (0-6 month duration), Medium term (6 months – 2 years) and long term (2 years and more). As per our analyses, more than 70% of the trades offered are either short term or medium term. This share increases even further in case of IGIAT – Vizag, with no long term trade offered at all and most of the trades offered (60%) falling in the short term category. These short terms offered generally have fees of about 10,000 to 15,000 per month.

4 Timelines

Tentative timelines for implementation of the Siemens CoE at NIT Uttarakhand:

Sl. No.	Activities	Tentative Timeline
1	Initial Presentation to Director & Registrar	1st March 2018
2	Submission of Concept Note by Siemens	5th March 2018
3	Technical & Space Planning Meeting @ NITUK	
4	Presentation to Board of Governance (BoG)	
5	In principal Approval by the BoG	
6	Submission of Commercial Proposal by Siemens	
7	Approval by the BoG	
8	Release of Letter of Consent by NIT Uttarakhand	
9	MOU Signing between NIT Uttarakhand & Siemens Partner	
10	Purchase Order & Release of Funds by NIT Uttarakhand	
11	Completion of Commissioning of CoE by Siemens and Siemens Partner	
12	Inauguration of CoE at NIT Uttarakhand	