

**TERI SCHOOL OF ADVANCED STUDIES  
NEW DELHI**

**MINUTES OF THE FIFTH MEETING OF THE ACADEMIC COUNCIL  
HELD ON WEDNESDAY, 27 NOVEMBER 2002**



**TERI SCHOOL OF ADVANCED STUDIES  
DARBARI SETH BLOCK, INDIA HABITAT CENTRE, NEW DELHI**

**MINUTES OF THE FIFTH MEETING OF THE ACADEMIC  
COUNCIL HELD ON WEDNESDAY, 27 NOVEMBER, 2002,  
AT 15:00 HRS IN THE BOARD ROOM**

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The Fifth Meeting of the Academic Council was held on Wednesday, 27 November, 2002 at 15:00 hours in the Board Room.

**PRESENT:**

The following attended the meeting:

- i) Dr T.P. Singh - Chairman
- ii) Dr S.C. Adlakha
- iii) Prof D.K. Banerjee
- iv) Dr Leena Srivastava
- v) Dr Y.P. Abbi
- vi) Dr S.K. Sarkar
- vii) Dr Abha Agnihotri
- viii) Dr Malini Balakrishnan
- ix) Dr Ranjan K Bose
- x) Prof Subhash Chander - Special Invitee
- xi) Gp Capt Rajiv Seth (Retd.) - Secretary

The Chairman welcomed the members. Before taking up the Agenda, he informed the members that the School had been allotted two acres of land in Vasant Kunj, New Delhi, for developing a campus.

**ITEM No. 1 To confirm the minutes of the Fourth Meeting of the Academic Council held on 26<sup>th</sup> July, 2002**

The minutes of the Fourth Meeting of the Academic Council held on 26<sup>th</sup> July, 2002 were confirmed, as circulated.

**ITEM No. 2 To report the matters arising from the Fourth Meeting of the Academic Council held on 26<sup>th</sup> July, 2002**

The members noted the action taken by the School on Item 9 of the last meeting. The matter has been taken up as Item No. 7 of this meeting.

**ITEM No. 3 To approve decisions taken on behalf of the Academic Council by the Executive Committee of the Academic Council**

**Action**

- |  |   |
|--|---|
| Head,<br>Centre for<br>Bioresources<br>and Biotechnology | (a) Proposed changes in Course Module BBT 251 were discussed. It was suggested that practicals need to be held along with theory classes. In view of this, it was decided that the proposed changes be put up again in the Academic Council after approval by the Board of Studies.                                 |
| Registrar,<br>Heads of<br>Centres                        | (b) Decision on Rules regarding financial assistance to Ph.D. students was approved. However, a minor correction has been made clarifying that the assistance required to be provided by a student to a project would be on work not related to his/her Ph.D. project (revised rules are attached as Annexure 3.1). |
| Registrar,<br>Heads of<br>Centres                        | (c) Decision on guidelines for use of Contingency Grant was approved.   |
| Registrar,<br>Finance<br>Officer                         | (d) The decision to take group medical insurance cover for students, subject to their willingness, on payment of premium, was approved. It was also decided that from the next academic session, premium towards medical insurance cover could be built into the fee structure.                                     |

**ITEM No. 4 To consider and approve the Second Semester schedule for the academic session 2002-03**

The Second Semester schedule was approved, as circulated.

**ITEM No. 5 To consider and recommend names of outside experts for constitution of Selection Committee for appointment of new faculty**

The following names of outside experts, with area of specialisation indicated, for constitution of Selection Committee for appointment of new faculty were recommended for approval by the Board of Management:

Forestry

- |  |  |
|--|--|
| 1. Dr J S Rawat<br>Director<br>Herbal Research & Development Institute (HRDI)<br>Gopeshwar, Dist. Chamoli<br>Uttaranchal | 2. Dr Brij Gopal<br>Professor<br>School of Environment Science<br>Jawaharlal Nehru University<br>New Delhi – 110 067 |
| 3. Prof. G.S. Paliwal<br>216, Vaishali<br>Pitampura<br>Delhi – 110 034   |  |

GIS/RSA

- |   |  |
|---|--|
| 1. Prof. A.K. Roy<br>(Retired from I I R S)<br>815/13, Indira Nagar<br>Dehradun – 248 006 | 2. Prof. A.K. Gosain<br>Dept of Civil Engineering<br>Indian Institute of Technology<br>New Delhi – 110 016 |
|---|--|

Economics

- |  |   |
|--|---|
| 1. Prof. J.P. Bhatti<br>Professor & Project Director<br>Univ. of Himachal Pradesh<br>Dept of Economics<br>Shimla – 171 005         | 2. Prof. Kanchan Chopra<br>Professor<br>Institute of Economic Growth<br>University Enclave<br>Delhi – 110 007 |
| 3. Prof. D.N. Rao<br>Centre for Economics & Planning,<br>School of Environmental Science,<br>Jawaharlal Nehru University, N. Delhi |   |

**ITEM No. 6 To consider and approve the procedure for conduct of  
Sponsored Research & Development Programmes**

The procedure for approving and implementing Sponsored Research Development Programmes was discussed. It was decided these be circulated to members of the Academic Council for their comments and suggestions.

The comments/suggestions received from the members would be incorporated and put up to the Council for approval in the next meeting.

**ITEM No. 7 Any other item**

New courses proposed by the Centre for Energy & Environment were tabled and discussed. It was suggested that as far as possible the number of faculty for each course be restricted to two.

The courses were approved by the Council, but it was decided that they also be circulated to members who could not attend, for their comments/suggestions, if any.

The meeting ended with a vote of thanks to the Chair.

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**TERI School of Advanced Studies**  
**Darbari Seth Block, India Habitat Centre, New Delhi**

No. 2001/Aa1/004

28<sup>th</sup> Nov., 2002

Copy forwarded to all members of the Academic Council.

It is requested that comments, if any, may be forwarded to the undersigned.

  
Gp Capt Rajiv Seth (Retd.)  
Registrar

### **Financial Assistance to Ph.D. Students**

The School does not award any scholarship to students. However, some assistantships are available in TERI's projects. Those students who wish to be considered for the award of assistantship from TERI's projects should give their option in the application form for admission.

The amount of such assistantship will be governed by the terms & conditions of the project. The students, who accept these assistantships, are required to provide assistance to the project for up to 8 hours per week on work not related to their Ph.D. project during the first year or end of comprehensive examination, whichever is later. On completion of the comprehensive examination, they can opt to work for up to 12 hours per week on work not related to their Ph.D. project to receive enhanced assistantship.

It is to be noted that admission to the programmes and award of assistantship are not linked. Those who are not awarded assistantship can continue with the programme as self-financing students.



## **IMPLEMENTATION OF SPONSORED RESEARCH PROGRAMMES**

### **SPONSORED RESEARCH**

The School of Advanced Studies encourages academic staff to undertake sponsored projects. The entire expenditure for the operation of the project is required to be met by the sponsoring agency. In case additional space is required, the expenditure for the same is to be budgeted in the proposal and sanctioned by the funding agency.

#### **Project budgeting**

The project proposal should be formulated according to the format prescribed by the funding agency. While making an estimate of funds required for the project the following budget heads should be taken into account.

##### ***a. Staff salary***

- i. Yearwise funding/staff to be specifically appointed for the project. All appointments in the project should be in approved pay slabs; except short-term appointments which may have consolidated salary. Appointments in faculty designation/position are not permitted in the sponsored research projects.

##### ***b. Service benefits for project staff***

Additional allocation of 20% of the salary budget is required to be provided towards service/fringe benefits of the project staff.

**c. *Equipment***

Funds for the purchase of non-recurring type of equipment, major equipment needed for the project should be listed in detail.

**d. *Supplies and materials***

Funds for recurring expenses on laboratory supplies, chemicals, stationery, and other consumables.

**e. *T.A./D.A.***

- i. Funds to meet expenditure on likely travel cost of Principal Investigator (PI), other School staff and outside experts - within the country.
- ii. Provision for foreign travel is separately demanded if there is requirement of foreign travel.

**f. *Contingencies***

Funds needed for meeting contingent expenses during the operation of project.

**g. *Administrative overheads***

School overheads of 10% of the project cost subject to a maximum Rs one lakh per project.

**h. *Use of school computer facilities***

Cost towards the use of computer and internet facilities have to be provided for.

### **Forwarding of project proposals**

The project proposal formulated by the academic staff of the School should be submitted to the concerned Department Research Committee (DRC)/Centre Research Committee (CRC) for its recommendations. Proposals duly recommended by DRC/CRC will then be forwarded to the sponsoring organisation after obtaining the approval of the Competent Authority. The Competent Authority for approving the submission of the project to various funding agencies is as under:

- a. **Dean SRD** - Research and development project proposal, funding grant from national funding agencies.
- b. **Director** - Project proposals seeking financial grants or cooperation from international bodies/foreign organisations.

### **Approval for operation of sponsored project**

#### ***Processing at the Registrar's level***

On receipt of the sanction of the sponsoring agency for a particular project, the Registrar will obtain approval of the Director for the operation of the project at the School and creation of sanctioned posts.

The approval of the School will be notified by the Registrar along with details such as: the project code no., title, name of the PI, Co-PI and other special terms and conditions, if any, details of the posts created, detailed project budget and the sanctioned tenure of the project etc.

### *Operation of the project*

The responsibility for operation of the project lies with the PI. It is his/her responsibility to prepare/submit regular progress reports and contingent bills wherever required by funding agency through the Registrar. The Registrar's office will provide necessary administrative support to the PI.

#### a. Requirement of the staff for the projects

The Registrar appoints staff and research fellows on temporary basis in the sponsored projects through regular selection, ad hoc selection or on daily wage basis. The procedure for such appointments is provided in Annexure A. General service conditions of the staff employed in the sponsored projects are provided in Annexure B.

#### b. Purchases

All purchases for the project will be made in accordance with the purchase rules of the TERI School of Advanced Studies.

#### c. T.A./D.A.

Heads of the Department/Centre have been delegated the power to sanction travel to the project staff, the PI and the Co-PI as per their entitlement within the country for the purpose of project work. In case relaxation of entitled norms is desired, the approval of the competent authority, presently Dean SRD, is required. Such request on the prescribed form should be sent for processing to the Registrar with proper justification. Travel abroad for project associated activities is allowed only if such provisions exist in the budget approved by the sponsoring agency of the project. Prior formal approval of the Director is required for travel abroad.

d. Temporary Advance/Permanent Imprest

In order to meet day-to-day expenses of the project, the PI can draw permanent imprest from project fund in his/her own name with the approval of the Dean SRD. Temporary advance for specific purchases can also be drawn by the PI with the approval of the Head of the Department/Centre.

e. Administrative overheads

School administrative overheads charges sanctioned by the funding agency in the project budget are required to be credited to SRD funds head "Administrative Overheads" and are used by the School towards providing administrative infrastructure support for the operation of the project.

f. Payment for services of Regular Staff of TERI/TERI School of Advanced Studies

The PI can engage regular staff of TERI School of Advanced Studies/TERI for project work and their salary entitlement for the period be credited to TERI School of Advanced Studies/TERI from the project budget provisions under staff salary and contingencies. The PI can also engage students at hourly rate approved by the School.

g. Progress report

The PI is required to submit a progress report of the project to funding agency at an interval specified by it. The Registrar/Finance Officer will send to the PI the quarterly statement of Receipts and Payment of Account.

h. Auditing of Funds

The Finance Officer will get the accounts of all the project funds audited every year and send the audited statements of accounts to the PI for onward submission to the sponsoring organisations.

**Completion report**

The PI is responsible for submitting the final report on the work done on the project within one month of the completion along with statement of expenditure. Copies of the report will be submitted by the PI directly to the sponsoring organisation with a copy to the Registrar for record. The unspent funds of the grant will be refunded to the funding agency within three months by the Finance Officer through the Registrar. The PI is to ensure that all pending bills/payments and imprest are settled/adjusted within one month of the completion of the project.

### Recruitment Procedure

The staff at all levels for sponsored projects could be recruited by the Registrar under any one of the following procedures:

- a. Regular selection for the duration of the project
- b. Ad hoc selection for a maximum period of 12 months.
- c. Daily-wage appointment for a maximum period of 06 months.

In recruitment through regular selection, posts are advertised through the School website. For ad hoc selection, the posts are advertised internally only. The advertisements include the title of the post, the pay scale attached to the post, the project title and duration, minimum and desirable qualifications and experience, how and whom to apply, with the last date of receipt of applications.

The candidates selected by the Selection Committee are appointed with the approval of the Competent Authority. The composition of the Selection Committee for both regular and ad hoc selections would be as under:

- a. In the case of Research Associates and above:
  - i. Director's nominee (from approved panel) Chairman
  - ii. One outside expert nominated by the Head of Department/Centre Member
  - iii. Two expert nominees who are members of the Academic Council from within the School Member
  - iv. Head of the Department/ Centre Member
  - v. Project Investigator Member

b. Selection Committee for posts other than the Class IV and those mentioned at (a) above

- |      |   |          |
|------|---|----------|
| i.   | Dean SRD/Nominee of Dean SRD  | Chairman |
| ii.  | Project Investigator  | Member   |
| iii. | Head of the Department/ Centre or an expert professor of the School | Member   |
| iv.  | An expert from outside the School                                   | Member   |

c. Selection Committee for Class IV

- |      |                               |          |
|------|-------------------------------|----------|
| i.   | Nominee of Dean SRD           | Chairman |
| ii.  | Project Investigator          | Member   |
| iii. | Head of the Department/Centre | Member   |

Other relevant rules/norms related to the recruitment are given below:

1. Where a post is to be filled on contract basis or by invitation, the Director may, at his discretion, constitute an ad hoc Selection Committee.
2. The Selection Committee will consider all applications received within the date specified in the advertisement.
3. The Selection Committee will examine the credentials of all persons who have applied and may also consider other suitable names suggested, if any, by the members of the Selection Committee. The Selection Committee may interview any of the candidates, as it thinks fit, and may hold a written test or tests for all or some of the candidates. The selection committee may draw the panel of the selected candidates arranged in order of merit.

4. The absence of any member or members of the Selection Committee does not vitiate the recommendation of the rest of the members.
5. All appointments made in the projects will be reported to the SRD Board at the next meeting.

## **GENERAL SERVICE CONDITIONS OF PROJECT STAFF**

The School appoints Research, Technical and Non-technical Support Staff in the sponsored research and consultancy projects and the staff thus appointed is called Project Staff. These appointments are made purely on temporary basis for the duration of the particular sponsored/consultancy project. Sponsored research projects are largely funded by various national and international funding agencies. Although project staff work directly under the Principal Investigators of the respective projects, administratively they are governed by the Central Administration.

Service conditions for project staff are approved by the Board of Management of the TERI School, from time to time.

### **Terms and conditions of service of the Project Staff**

#### ***Appointment***

1. All appointment of project staff are made purely on a temporary basis and are tenable only for the duration of the project in which the staff is placed. In case a given project is terminated earlier than originally envisaged, either by the funding agency or the School, the services of the project staff attached to this particular project shall stand terminated either with one month's notice from the School or on the payment of one month's salary in lieu thereof.

A project employee can also resign from the post either by giving a month's notice or by paying one month's salary in lieu thereof.

2. All project appointments shall normally be in the pay scale applicable for the particular post against which the appointment is made.
3. All appointments shall be subject to the individual appointees being certified in sound health and physically fit for service in India by the designated Medical Officer of the School or by any other Medical Authority nominated by the Board of Management of the School; however, the Board may, for sufficient reasons, relax the medical requirements in any particular case or class of cases.
4. A regular School employee could also be appointed against a project post at a starting basic pay as approved by the appointing authority. In addition to the basic pay, such employees shall also be entitled to allowances as admissible to regular School employees from time to time.
5. Appointment in the sponsored research project does not give the project employees any claim whatsoever for appointment to/regularisation against a School post.

## **PROVIDENT FUND**

All project staff are covered under the Contributory Provident Fund-cum-Gratuity Scheme as applicable to other regular school employees.

## **LEAVE PROVISION**

A member of the project staff is entitled to avail various kinds of leave as summarised below: the Principal Investigator of the Project/Head of Department/ Centre is the Competent Authority to sanction/recommend the leave.

The provisions of the leave rules are briefly described in the following paragraphs:

### **Kinds of Leave**

- a. Casual leave
  - b. Earned leave
  - c. Leave without pay
  - d. Maternity leave
  - e. Sabbatical leave
- 
- a. **Casual leave:** An employee can avail casual leave up to 8 days in a calendar year at the discretion of the Principal Investigator of the project. In his absence, the Co-Principal Investigator/Head of Department may sanction such leave. Casual leave cannot be claimed as a matter of right and it cannot be combined with any other kind of leave.
  - b. **Earned Leave:** Leave account of project staff shall be credited with 15 days EL at the end of the half year period finishing on June 30 and December 31. (i.e. 30 days in a

calendar year). The balance of leave in any half year is carried forward to the next year subject to a maximum accumulation of 90 days.

- c. **Leave without pay:** An employee can be sanctioned leave without pay when no other kind of leave is admissible in extraordinary circumstances only upto a maximum of 30 days.
- d. **Maternity leave:** Women members of the staff are entitled to avail maternity leave for a period of 90 days on full pay. In case of a miscarriage including abortion, leave can be availed up to 6 weeks. Any other kind of leave except casual leave, can be combined with maternity leave on medical grounds.
- e. **Sabbatical Leave:** Not applicable

#### **Leave encashment to the Project Staff**

The Project employees appointed on temporary basis whose services are terminated concurrently with the termination of the project will granted leave or paid full cash equivalent in respect of Earned Leave at his/her credit on the date of cessation of the service i.e. date of the termination of the Project subject to maximum of 90 days. However, in case of resignation before termination of the Project, he/she be paid half cash equivalent in respect of Earned Leave at his/her credit on the data of cessation of service subject to a maximum of 45 days.

#### **CONDUCT RULES**

All project employees, unless otherwise stated in terms of their individual appointment, are full time employees of the project and may be called upon by the Competent Authority to perform such duties as assigned to them, at any hour of any day of the year. During the scheduled hours of work, an employee must be present at his/her place of duty and, except for

unforeseen contingencies, shall not be absent from duty without prior permission. An employee can only leave station, even during period of duly sanctioned leave or vacation, with prior permission of the officer to whom he/she reports. No employee is allowed to take part in any political activity whatsoever except to exercise his/her right to vote during a national and/or state election.

No employee shall communicate any matter through the Press or Television or Radio in whatsoever form without the prior sanction of the Competent Authority unless such communication is of a purely literary, artistic or scientific character. Even for such communication, prior sanction is required if the employee wishes to indicate his/her official designation. Any statement of adverse criticism of the School through any medium is prohibited unless such statements or views expressed by the employee are in his/her official capacity or in due performance of the duties assigned to him/her.

No employee shall give any evidence in connection with any enquiry without prior permission of the Competent Authority unless it is to be conducted by any authority/committee appointed by the School itself, or by a state legislature or by Parliament or a judicial enquiry.

Accepting of gifts of more than trifling value requires prior sanction of the School. Indulgence in private trade, investments, lending and borrowing by the staff member himself/herself or by any member of his/her family during the discharge of duty by the employee is prohibited. An employee shall so manage his/her private affairs as to avoid habitual indebtedness or insolvency or criminal proceedings.

An employee who is detained in police custody whether on a criminal charge or otherwise for a period longer than 8 hours shall not join his duties without written permission of the School.

All employees are required to declare their movable, immovable and valuable property on first appointment in the project service or at any time afterwards whenever asked to do so.

**Marriages etc.**

An employee intending to marry a person who holds citizenship of a foreign country shall seek prior permission of the competent authority.

No employee who has a wife living shall contract another marriage without first obtaining the permission of the Board of Management notwithstanding that a subsequent marriage is permissible under the personal and/or religious law for the time being applicable to the employee. Violation of this rule will lead to immediate dismissal from the service.

**Representations**

Whenever an employee wishes to put forth any claim, or seeks redressal of any perceived grievance or of the wrong done to him/her, he/she must forward his/her case for consideration through proper channel, and shall not forward an advance copy of the application to any higher authority, unless the lower authority has rejected the claim, or refused relief, or the disposal of the matter is delayed by more than three months.

**Scheme for providing various services/fringe benefits and facilities to the members of the staff appointed under outside sponsored research schemes and the methodology of meeting the additional expenditure involved**

For meeting the expenditure involved on service benefits, an additional provision of 20% of the gross salaries may be made in the budget of the project while sending the project proposal for funding. The aforementioned amount of 20% on each scheme be pooled in a fund called the "Research Scheme Staff Benefit Fund" regardless of the actual staff employed or actual expenditure incurred under the head "Staff Salaries".

Out of the amount credited to the "Research Scheme Staff Fringe Benefit Fund", a portion equivalent to 15% of the pay (drawn during the year by the staff employed in the Research Scheme) will be passed on to the School account as Miscellaneous Receipts. Thereafter, the concerned staff of the Research Scheme may be admitted to the CPG scheme from the School like other School employees.

Staff members appointed under Sponsored Research Schemes may be provided the following facilities/fringe benefits:

1. **Medical Insurance:**
2. **Leave Travel Concession (LTC):** LTC benefits to project staff are not admissible.
3. **Children Education Allowance and Tuition Fee Reimbursement:** School rules on the subject are not applicable to staff appointed in the research schemes.
4. **Leave and Leave Salary:** Project employees employed on temporary basis whose services are terminated concurrently with the termination of the project will be granted leave or paid cash equivalent to the earned leave at his/her credit on the date

of cessation of service, i.e. the date of termination of the project subject to a maximum of 90 days.

The project employees who resign from the project before termination of the project will be paid cash equivalent to the earned leave at his or her credit on the date of cessation of service to the extent of half of such leave at his or her credit subject to a maximum of 45 days.

The benefits will be paid to a project employees from the funds of the project under which he or she is employed. However, in cases where sufficient funds are not available, the same shall be paid from the accumulated funds under the Research Schemes Benefit Fund.

**Pensionary Benefits:** All employees under Research Scheme being temporary, are entitled only to CPG scheme. A staff member is required to opt for the scheme on prescribed form. By virtue of this option, the employee becomes a member of the scheme from the date of joining. A minimum subscription of 12% of the basic pay is deducted every month.

**Advance Allowable:** Project staff are allowed to draw advances for Medial Expenses, Leave Salary and CPG as admissible to TERI School employees.



## **Course / Modules**

**Centre of Energy and Environment**

### List of Courses for Centre of Energy & Environment

S.No.	Course No.	Course Title
1.	ENE 211	Energy and environment engineering (concepts and applications)
2.	ENE 213	Energy efficiency concepts and techniques
3.	ENE 215	Power generation and distribution
4.	ENE 222 (M1 and M2)	Biomass utilization technologies
5.	ENE 228 (M1 and M2)	Introduction to solar thermal technologies
6.	ENE 241	Introduction to waste treatment technologies
7.	ENE 242	Physical and chemical waste treatment technologies
8.	ENE 244	Biological methods of waste utilization
9.	ENE 246M1 ENE 246M2	Properties of materials Selection of materials for energy and environment applications
10.	ENE 243	Materials in sustainable development

**ENE 211: Two Credits (19\*-9\*\*-0\*\*\*)**  
**Energy & Environment Engineering (Concepts & Applications)**

Student's background: Engineering / Science

**Faculty**

V.V.N. Kishore (Coordinator)  
 Somnath Bhattacharjee  
 Amit Kumar  
 Sanjay Mande

**Course outline**

This course is basically to provide background knowledge required for taking up research / field assignments in the area of energy (conventional & renewable) and its environmental implications.

S.No	Topic	Allotted time (Hrs)	
		L	T
1.	Principles of mass & energy conservation	1	
2.	Fuels and combustion / gasification technology	2	1
3.	Heat Transfer & Fluid Flow principles	2	1
4.	Fossil fuel resources and conversion	4	2
5.	Renewable Energy Resources (Solar thermal, PV, wind, mini-hydro, hydrogen & fuel cells) & technologies to harness these	8	4
7.	Environmental consequence of energy use	2	1
	<b>Total</b>	<b>19</b>	<b>9</b>

**Suggested reading**

1. S.P. Sukhatme. A text book of heat transfer, Orient Longman, 1979.
2. J.P. Holman. Thermodynamics, McGraw Hill, 1980.
3. Handbook of Energy Systems Engineering Production and Utilization, Edited by Leslie C Wilbur, John Wiley and Sons, 1985
4. D.O. Hall and R.P. Overend. Biomass: regenerable energy, John Wiley and Sons, New York, 1987.
5. J.A. Duffie and W.A. Beckman. Solar engineering of thermal processes, John Wiley, 1980.
6. F. Kreith and J.F. Kreider. Principles of solar engineering. McGraw Hill, 1978.
7. V.V.N. Kishore (Ed). Renewable Energy Utilisation – scope, economics and perspectives, TERI, 1993.

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\*Lectures per Semester / \*\*Tutorials per Semester / \*\*\*Practicals per Semester

**ENE 213: One Credit (9\*-6\*\*-0\*\*\*)**  
**Energy efficiency concepts & techniques**

Student's background: Engineering / Science

**Faculty**

Y.P. Abbi (Coordinator)

Amit K Tyagi

**Course outline**

The course content will cover theoretical concepts and procedures for thermal and electrical audits, and evolving systems for energy efficiency improvements based on techno-economic analysis. Few case studies will be taught in the tutorials

S.No	Topic	Allotted time (Hrs)	
		<i>Lectures</i>	<i>Tutorials</i>
1	Energy efficiency concepts	1	-
2	Energy audit (Thermal)	3	4
3	Energy audit of electrical drives & driven equipment	3	2
4	Techno-economic analysis of energy efficiency	2	-
	<b>Total</b>	<b>9</b>	<b>6</b>

**Suggested reading**

1. Handbook on energy audits and management, edited by Amit K Tyagi, Published by TERI, July 2000
2. Energy audit handbook by Turner
3. Variable speed drives Fundamental Phipps
4. Energy saving lighting system, P C Sorcar
5. Energy efficient electric motors – Andreas
6. Motor Generators Transfer and Energy, Pesicles Emanuel

**ENE 215: One Credit (15\*-4\*\*-0\*\*)**  
**Power Generation & Distribution**

Student's background: Engineering / Science

**Faculty**

Y.P. Abbi (Coordinator)

K. Ramnathan

M. S. Bhalla

**Course outline**

The course content will cover design concepts for thermal (coal and natural gas/oil) and hydro electric power generation, and the transmission and distribution of power. Environmental pollution and related issues for these technologies will also be covered.

S.No	Topic	Allotted time (Hrs)	
		Lectures	Tutorials
1	Thermodynamic principles of thermal power generation	1	-
2	Boiler design and testing	4	2
3	Steam turbine and auxiliaries	2	-
4	Hydro power generation	4	1
5	Transmission and distribution of power	4	1
	<b>Total</b>	<b>15</b>	<b>4</b>

**Suggested reading**

1. "Steam: Its generation and use", 40<sup>th</sup> edition, Handbook of Babcock & Wilcox, Barberton, Ohio, USA, 1992
2. "Turbines, Compressors and Fans", S M Yahya, 2<sup>nd</sup> edition, Tata McGraw Hill Publishing Company, New Delhi
3. Power systems by I J Nagrath and D P Kothari
4. Transmission and distribution – A reference book by Westinghouse
5. Climate Change Post- Kyoto Perspectives from the South, Tata Energy Research Institute, 1998
6. Air quality overview status and trends in India, Central Pollution Control Board, 2000-2001
7. Pollution Control Acts, Rules and Notifications Issues thereunder, Central Pollution Control Board, 2001
8. W F Stoecker, "Design of thermal systems", McGraw-Hill International Edition, Engineering Series, 1989
9. Singiresu S Rao "Engineering optimisation – Theory and Practice" John Wiley and Sons, Inc and New Age International (P) Ltd, 1998

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\*Lectures per Semester / \*\*Tutorials per Semester / \*\*\*Practicals per Semester

**ENE 222-M1: One Credit (14\*-0\*\*-0\*\*\*)****Biomass Utilization Technologies**

Prerequisite: Consent of teacher

**Faculty**

V V N Kishore (Coordinator)

Sanjay Mande

**Course outline**

The major objective of this course is to help a student to understand the importance of the available biomass as eco-friendly source of energy and to give him the enough knowledge in order to assess possible potential, technological options for its exploitation with variety of possible end-use applications and associated techno-economic analysis as well as environmental benefits.

No.	Topic	No. of lectures
1.	Biomass resource assessment	1
2.	Characterization of biomass	1
3.	Biomass briquetting	1
4.	Fundamentals of fuel combustion	2
5.	Fundamentals of gasification, pyrolysis, combustion	3
6.	System component design principles	3
7.	Environmental aspects	1
8.	End-use applications and economics	2
	<b>Total</b>	<b>14</b>

**Suggested reading**

1. D.O Hall and R.P. Overend. Biomass: regenerable energy, John Wiley and Sons, New York, 1987.
2. S.P. Sukhatme. A textbook of heat transfer, Orient Longman, 1979.
3. V.V.N. Kishore (Ed). Renewable Energy Utilization – scope, economics and perspectives, TERI, 1993.
4. Ravindranath N H , Hall D O. Biomass, energy, and environment: a developing country perspective from India. Oxford: Oxford University Press. 1995
5. Iyer PV R, Rao, TR, Grover PD. Biomass: Thermo-chemical characterization, 3<sup>rd</sup> Edition, MNES-GARP, IIT Delhi, 2002
6. Kaupp A, Goss J R. 1984. Small Scale Gas Producer-Engine Systems. Germany: GTZ/GATE.
7. Overend R P. Fundamentals of thermochemical biomass conversion. Elsevier Applied Science, London. 1985
8. Bridgwater A V. Thermochemical Processing of biomass. Butterworths. London.

**ENE 222-M2: One Credit (0\*-0\*\*-28\*\*\*)****Minor Project on Biomass Utilization Technologies**

Prerequisite: ENE 222-M1

\*Lectures per Semester / \*\*Tutorials per Semester / \*\*\*Practicals per Semester

**ENE 228 M1: One Credit (16\*-0\*\*-0\*\*\*)**  
**Introduction to Solar Thermal Technologies**

Prerequisite: Consent of teacher

**Faculty**

V.V.N. Kishore (Coordinator)

Shirish Garud

Amit Kumar

Mahesh Vipradas

**General Introduction**

India is endowed with very good solar energy resource. The average intensity of solar radiation received on India is 200 MW/km<sup>2</sup>. However, only 12.5% of the land area amounting to 0.413 million km<sup>2</sup> can, in theory, be used for solar energy installations. Even if 10% of the available area can be used, the available solar energy would be 8 million MW, which is equivalent to 5909 mtoe (million tons of oil equivalent) per year. Considering the ever increasing energy demands of the country, this resource can be gainfully for meeting thermal energy requirements of domestic, industrial, and commercial sectors.

On the applications side, the range of solar thermal energy is very large. While at the high end there are megawatt level solar thermal power plants, at the lower end there are domestic appliances such as solar cooker and solar water heater. Then, in between there are applications such as industrial process heat, desalination, refrigeration and air-conditioning, drying, large-scale cooking and passive solar architecture.

**Course outline**

Introduction to conversion of solar radiation in to thermal energy; Different types of solar collection and storage devices; Active and passive solar thermal systems; Applications and potential of solar thermal energy, especially in the Indian context, in domestic, industrial, rural sectors etc; Utilization of solar thermal energy for power generation, both in the decentralized mode and in grid-connected mode; Economic evaluation of various solar thermal systems.

S. No.	Topic	No. of lectures
1.	Solar radiation	2
2.	Flat plate collectors	2
3.	Concentrating collectors	2
4.	Energy storage	1
5.	Solar cookers	2
6.	Solar water and space heating	1
7.	Solar cooling	2
8.	Solar thermal electricity generation	1
9.	Solar industrial process heating	1
10.	Salt gradient solar ponds	2
	<b>Total</b>	<b>16</b>

\* Each lecture will be of one-hour duration

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\*Lectures per Semester / \*\*Tutorials per Semester / \*\*\*Practicals per Semester

**Suggested reading**

Duffie John A and Beckman William A  
**Solar Engineering of Thermal Process**

Krieth F and Kreider J F  
**Principles of Solar Engineering**

Sukhatme S P  
**Solar Energy: Principles of Thermal Collection and Storage**

**ENE 228-M2: One Credit (0-0-28)**  
**Minor Project on Solar Thermal Technologies**

Prerequisite: ENE 228 M1

**Course outline**

This module pertains to application of the knowledge gained through module ENE 228 M1 (Introduction to Solar Thermal Technologies) in some project work. This work could be either experimental or modeling/simulation related.

**ENE 241: Two Credits (12\*-0\*\*-32\*\*\*)**  
**Introduction to waste treatment technologies**

Prerequisite: Consent of teacher

**Faculty**

Malini Balakrishnan (Coordinator)  
 V V N Kishore

K V Rajeshwari  
 R K Johri

**Course outline**

Increased industrialization and commercial activities have resulted in extensive damage to the two most important resources viz. water and land. Although various options are available for the treatment of wastewater and solid wastes, successful implementations are few owing to:

- Inability to correlate and apply academic learning to real-life applications
- Lack of awareness of appropriateness of a specific technology for a particular application
- Lack of awareness of overall impact of specific technology options.
- Lack of appreciation of how non-conventional / state-of-the-art technologies may be adapted and incorporated into existing process schemes

The goal of this course is to enable the student to understand the range of available technologies for solid & liquid waste treatment emphasizing real-life applications. This would thereby encourage him/ her to think critically about the applicability of these solutions to specific waste treatment problems.

This module will introduce the students to solid & liquid wastes, types of treatment technologies and the basis for selection, design and operation, regulatory standards. The course will have a laboratory component and field trip(s) to relevant treatment plants.

**Contents**

Topic	Allotted time (h)		
	L	T	P
1. Introduction to solid & liquid wastes including characterization and generation patterns, significance of industrial wastes as pollutants & their environmental impact	2		
2. Methodologies for sampling & analysis of water & solid waste	2		
3. Standards/disposal limits for wastes	1		
4. Characterization of wastewater (estimation of BOD, COD, suspended solids, total solids, carbon and nitrogen content, volatile fatty acids) and solid wastes (physical composition, volatile solids, ash content & calorific value, cellulose / hemicellulose content)			10
5. Types of wastewater treatment technologies viz. physical, chemical, thermal & biological	2		
6. Anaerobic digestion (Culture development, inoculum preparation, operation of demonstration unit)			12
7. Comparison & selection of treatment technologies	2		
8. Overview of system design & plant operation with reference to municipal & industrial applications	3		
9. Field trip(s) – municipal wastewater treatment plant & landfill			10
<b>Total</b>	<b>12</b>	<b>0</b>	<b>32</b>

\*Lectures per Semester / \*\*Tutorials per Semester / \*\*\*Practicals per Semester

**Suggested reading**

- APHA, Standard methods for the examination of water and wastewater. 16<sup>th</sup> edition. American Public Health Association, Washington, DC, 1985.
- Metcalf and Eddy, Wastewater Engineering: Treatment, Disposal and reuse. Tata McGraw-Hill Publishing Company Limited, New Delhi, 1993.
- CPCB Document on Standards for Waste Disposal
- Manual on municipal solid waste management, Central Public Health & Environmental Engineering Organization, New Delhi 2000.

**ENE 242: Two Credits (21\*-0\*\*-14\*\*\*)**  
**Physical & chemical waste treatment technologies**

Prerequisite: ENE 241

**Faculty**

Malini Balakrishnan (Coordinator)

V V N Kishore

K V Rajeshwari

**Course outline**

This module will provide a more detailed understanding of the principles and applications of physical & chemical treatment technologies primarily to wastewater treatment systems. Appropriate examples / field visits will be used to illustrate technologies currently in use, their limitations and future trends; further advanced treatment options will also be covered.

Topics	Allotted time (h)		
	L	T	P
Introduction to physical & chemical treatment methods	1		
Preliminary treatment methods (grit removal, oil & grease removal etc.)	1		
Physical-chemical treatment processes (coagulation, flocculation, and sedimentation, settling, dissolved air flotation)	4		
Physical treatment: Filtration (Characteristics of filter media, filtration operation parameters, particle removal mechanism, types of filters viz. pressure and gravity filters)	4		
Physical treatment processes : air stripping and carbon absorption	3		
Sludge handling and dewatering with an overview of vacuum filtration, centrifugation & sludge drying beds	4		
Field trip to local wastewater treatment plant			10
Advanced treatment concepts (membrane separation, membrane bioreactors)	2		4
Wastewater reclamation and reuse	2		
<b>Total</b>	<b>21</b>		<b>14</b>

**Suggested reading**

- Metcalf and Eddy, Wastewater Engineering: Treatment, Disposal and reuse. Tata McGraw-Hill Publishing Company Limited, New Delhi, 1993.
- Degremont (1991), Water Treatment Hand Book.
- Weber, W.J. (1972), Physico-chemical Processes for Water Quality Control, Wiley Inter Science, New York.
- Davis and Cornwell (1991) Introduction to Environmental Engineering, McGraw Hill Publishers, Second Edition.

**ENE 244: Two Credits (22\*-3\*\*-6\*\*\*)**  
**Biological methods for waste utilization**

Prerequisite: ENE 241

**Faculty**

V V N Kishore (Coordinator)  
 K V Rajeshwari

**Course outline**

The objective of this module is to expose the students to the basics of the biochemical processes, kinetics and the reactor designs for the control of environmental pollution. This module will examine biochemical processes and reactor designs, concepts of bio-oxidation processes, activated sludge, trickling filters, oxidation ponds and anaerobic digestion, design, evaluation and selection of treatment processes & application of design procedures for selected representative industrial wastewater.

**Course content**

Topic	Allotted time (h)		
	L	T	P
1. Introduction to biochemical technologies: Types of microorganisms, growth conditions, cell growth and kinetics	2		
2. Aerobic process for waste treatment: Activated sludge process, Trickling filters, RBC	4		
3. Anaerobic digestion: Kinetics of hydrolysis, fermentation, methanogenesis; Nutrition requirement; effect of external factors;	6		
4. Principles of reactor design : Types of reactors; design principles; start-up of reactors	6		
5. Improved digesters viz. UASB, EGSB, Membrane bioreactors	4		
6. Case studies on management of selected wastes and their energy potential		3	
7 Field trip to Gual Pahari and treatment plant			6
<b>Total</b>	22	3	6

**Suggested reading**

- Joseph F.Malina and Frederick G. Pohland, Design of anaerobic processes for the treatment of industrial and municipal wastes, Water quality management library- Volume 7, Technomic publishing company Ltd., 1992.
- S.M.Stronach, T.Rudd and J.N.Lester. Anaerobic digestion processes in industrial wastewater treatment. Springer-Verlag, 1986.
- Microbiological aspects of anaerobic digestion. Laboratory Manual. Edited by D.R.Ranade and R.V.Gadre. Published by Maharashtra Association for the cultivation of science, Pune, 1988.

**ENE 246-M1: One Credit (14\*-0\*\*-0\*\*\*)**  
**Properties of materials**

Prerequisite: Consent of teacher

**Faculty**

Vidya S Batra (Co-ordinator)

Malini Balakrishnan

**Course outline**

This module will introduce the students to types of materials, their processing, characterization, properties, influence of operating environment and selection and design of materials.

S. No.	Topic	Allotted time (hours) Lectures
1.	Introduction to types of materials	3
2.	Processing of materials	2
3.	Properties and characterization of materials	2
4.	Processing-microstructure-property relationship	1
5.	Environment-property relationship	3
6.	Selection and design of materials	3
	<b>Total</b>	<b>14</b>

**Suggested reading**

1. The Science and Engineering of Materials, 2nd Edition, D R Askeland, pub. Chapman & Hall, 1990.
2. Introduction to Materials Science for Engineers, 5th Ed., J. F. Shackelford (Prentice Hall, 2000).
3. Introduction to Ceramics, 2<sup>nd</sup> Edition by W. D. Kingery, H. K. Bowen, Donald R. Uhlmann, John Wiley and Sons, 1991
4. S. Avner, Introduction to Physical Metallurgy, 2<sup>nd</sup> edition, McGraw-Hill, 1974

**ENE 246-M2: One Credit (14\*-0\*\*-0\*\*\*)**  
**Selection of materials for energy and environment applications**

Prerequisite: ENE 246-M1

**Faculty**

Vidya S Batra (Co-ordinator)

Malini Balakrishnan

Akanksha Chaurey

**Course outline**

This module will examine the issues involved in the selection of materials and processes for energy and environmental applications. The current materials used, their limitations and future trends will be covered.

S. No.	Topic	Allotted time (hours)
		Lectures
1.	Biomass gasifier	4
2.	Turbines	1
3.	Gas clean-up	2
4.	Engines and boilers	2
5.	Catalytic converters	1
6.	PV Materials	4
	<b>Total</b>	<b>14</b>

**Suggested reading**

1. Materials for High Temperature Engineering Applications (Engineering Materials) by Marcel H. Van de Voorde, Geoffrey W. Meetham, Springer Verlag, 2000
2. Materials for High Temperature Power Generation and Process Plant Applications, Institute of Materials, 2000
3. Advanced Materials for 21<sup>st</sup> Century Turbines and Power Plant: Proceedings of the Fifth International Charles Parsons Turbine Conference, Institute of Materials, 2000
4. PV Engineering Handbook- F Lasnier and T G Ang, Asian Institute of Technology, Thailand
5. Solar cells- Operating principles, technology and system applications- Martin Green
6. Materials Processing theory and Practices, Vol 5 Silicon processes for PV- C P Khattak, K V Ravi
7. 2nd World Conference on PV solar energy conversion- Proc of International conference held in Vienna, Austria 6-10 July, 1998. Vol 1- Fundamentals, Novel devices and new materials, Thin film cells, technology.
8. 28th IEEE- PV Specialists Conference- Proceedings of the International Conference held at Anchorage, Alaska, USA. 15-20 September 2000

**ENE 243: One Credit (14\*-0\*\*-0\*\*\*)**  
**Materials in sustainable development (14-0-0)**

Prerequisite: Consent of teacher

**Faculty**

Vidya S Batra (Co-ordinator)

Malini Balakrishnan

**Course outline**

This module will cover the impact of processing and use of materials on the environment. The trends in reducing the impact by improving processing technologies, improving life of products through optimisation of materials, recycling materials and parts of products, minimising waste, materials substitution and miniaturisation will be discussed.

	Topic	Allotted time (hours)
1.	Green manufacturing	3
2.	Recycling and waste utilization	4
3.	Materials optimization	3
4.	Materials substitution and miniaturization	4
	<b>Total</b>	<b>14</b>

**Suggested reading**

1. Degradable Polymers, Recycling, and Plastics Waste Management by Ann-Christine Albertsson, Samuel J. Huang, Marcel Dekker, 1995
2. Waste Materials in Construction by G. R. Woolley (Editor), J. J. J. M. Goumans, P. J. Wainwright, P.J. Wainwright, Pergamon Press, 2000

