ALL INDIA COUNCIL FOR TECHNICAL EDUCATION, NEW DELHI

**MODEL SCHEME OF INSTRUCTION AND SYLLABI FOR
UG ENGINEERING DEGREE PROGRAMMES**

(Computer Science & Engineering)

Prepared by
All India Board for UG Studies in Engineering & Technology

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CONTENTS

FOREWORD

It is with great pleasure and honour that I write a foreward for the Model Scheme of Instruction and Syllabi for the Undergraduate Engineering Degree Programmes prepared by the All India Board of Undergraduate Studies in Engineering & Technology with Prof. B.S. Sonde as its Chairman and other members. All India Council for Technical Education has the responsibility for uniform development and qualitative growth of the Technical Education system and preparation of syllabi to maintain uniform standards throughout the county. In pursuance to clause 10 (2) of the AICTE Act 1987, AICTE has the objective of bringing about uniformity in the curriculum of Engineering. In that direction, the effort of the All India Board of UG Studies in Engineering & Technology has been quite commendable and praiseworthy. A good effort was made by the Chairman, members of the Board and various Working Groups composed of experts from leading institutions in framing of the Scheme of Instruction and Syllabi. The Board was ably assisted by the official of the Academics Bureau in successfully organizing the meetings, making available necessary documents and follow up action on the minutes of the meetings.

Prof. S. S. Mantha

Chairman
New Delhi   **All India Council for Technical Education**

PREFACE

For centuries, Universities have been established worldwide as institutions providing higher education and research opportunities to the youth for shaping their future. They have also been recognized as the most important indicators of a nation's progress. More recently, the UNESCO World Conference on Higher Education (Paris, 1998) has observed that higher education and research act as essential components of culture, socio-economic and environmentally sustainable development of individuals, communities and nations, since the society is now becoming increasingly *knowledge-based.* As University education in *Engineering and Technology (E&T)* has a significant role in enhancing their capabilities and competitiveness, the developed nations have been attaching much importance to this sector. This is no exception in India, which has prepared a time table to become a developed nation by the year 2020 and already launched a strategy for this.

Thus, for past some time, India has been laying much emphasis on *E&T* disciplines at the Universities and also on the setting up of Universities exclusively for *E&T* and the system has been expanding at a remarkable pace. As a result, many Universities having the Faculty of *E&T* and *E&T* Universities themselves have become common in India. These Universities are either *unitary,* with their academic activities like, Departments/Constituent Colleges restricted to their campuses or *affiliating,* having their Colleges such as, Affiliated/Autonomous/Constituent, spread out in their jurisdiction areas. Besides, India has established many *elitist* institutions of national importance, such as, *Indian Institutes of Technology (IITs)* and *National Institutes of Technology (NITs)* having University level functions in *E&T* with some of international acclaim.

While these initiatives have enabled the country to provide better *access* to the youth for higher education in *E&T,* the diversities in the current University system have inhibited reaching superior levels of *quality and standard* in the education imparted in most cases, except *IITs/NITs* and select institutions. It is now a matter of concern that the *E&T Curriculum* in the Indian University system has not been able to keep pace with the current technological advances on the world scene and a large percentage of *E&T* graduates are observed to need further education/training to be effective.

Considering this, the *Chairman, All India Council for Technical Education (AICTE)* had advised the *All India Board for UnderGraduate Studies in E&T (AIB UGS (E&T))* to formulate *Model Scheme of Instruction and Syllabi* for the UG *Programmes of Study in E&T* at Indian Universities. As over 80% of UG students' annual intake is mainly for *six branches, viz., EC, EE, CS, ME, CE and IT,* the framing of *Model Scheme/Syllabi* was taken up for these in the first instance and the same have been presented in this document. It is hoped that the *Model Scheme of Instruction and Syllabi* would be of help in revitalizing *UG E&T* education in the country.

The *AIB UGS (E&T)* expresses its appreciation at the fine work done and the contribution made by Coordinators/Members of the *Working Groups,* who have adhered to the guidelines provided and enabled the detailed framing of the *Model Scheme of Instruction and Syllabi* and also thanks them for their excellent cooperation and mature/learned inputs. The assistance received from the *AICTE Academic Bureau* in this assignment is also gratefully acknowledged.

Bangalore, October 2012   Prof. B. S. Sonde, Chairman, on behalf of *AIB UGS (E&T)*

CHAPTER I
INTRODUCTION

1. Background:

The engineering education system in India has witnessed rapid progress in recent years under the guidance, direction and leadership of the *All India Council for Technical Education (AICTE)* to become one of largest in the world. About 3400 colleges with widely varying governance structures and their locations spread in metro, urban, semi-urban and rural areas, opportunities for studies in over thirty branches of *Engineering and Technology (E&T)* disciplines and an annual intake of over 1.2 million students constitute its status in 2011-12. Considering the wide diversities in the system and the need to enhance its *quality, standard and relevance* so that the *E&T* graduates passing out from the system can meet the 21st century challenges ahead of them, the Chairman, *AICTE* had desired that a *Model Scheme of Instruction and Syllabi* for the various programmes of study be proposed by the *All India Board for Under Graduate Studies in E&T (AIB UGS (E&T))* of *AICTE*. The *AIB UGS (E&T),* after detailed deliberations and associating senior experts from leading institutions in the country, has proposed in this document, a *Model Scheme of Instruction and Syllabi* for *UGS (E&T)* for six of the most popular programmes of study now enrolling over 80% of UG *(E&T)* students in the country. It is expected that the experience gained in implementing the *Model Scheme of Instruction and Syllabi* as proposed, would be of help to the *AIB UGS (E&T)* to take up the drafting of *Model Scheme of Instruction and Syllabi* for the remaining programmes of study.

2. Engineering Education:

It is well known that *E&T* professionals are key personnel in any country responsible for its economic progress and prosperity, leading to increased comfort and satisfaction levels of its people and the society at large. The developed countries have already benefitted from their *knowledge and skills* and have demonstrated the crucial role played by these professionals in strengthening their R&D, industries and economies. As India is now engaged in such an endeavour and has prepared a road map for becoming a developed nation by the year 2020, serious efforts are now going on in the country in this direction. In this context, the education and training of *E&T* professionals are now receiving much attention here. But, there are challenges being faced by these professionals in the on-going 21st century, recognized as the *Knowledge Age,* like:

1) *Rapidly changing technological scene worldwide, with a shrinking time scale for new developments and for obsolescence of old practices, leading to:*
- Increase in investment on R&D in industry and other sectors;
- Demand for innovative products and services, based on contemporary technologies; and,
- Growing need for enhancement of abilities to manage change, so frequent, now a days;

2) *Globalization and liberalization of Indian industry, leading to:*
- Comprehensive restructuring of industry sector for enhancing efficiency;

- Increase in world-wide mobility of *E&T* professionals; and,

- Growth of competitive environment globally and also in the country;

3) Emergence of new career opportunities for E&T professionals, leading to:

- Demand for broad-based, flexible education in multi/inter- disciplinary subjects;

- Emphasis on PG courses, research training and institute-industry interaction; and,

- Advances in learner-centric programmes and life-long learning opportunities;

4) Penetration of IT in all sectors of the E&T profession, leading to:

- Increased demand for IT-based solutions to industrial and societal problems;

- Expertise in emerging IT developments to solve complex, *E&T* problems; and,

- Improved access to worldwide information/data bases and *knowledge* centres.

5) Increased social/environmental concerns in the E&T context, leading to:

- Effectivee means for protection of endangered environment and depleting energy sources;

- Seeking environment- and energy- friendly solutions to *E&T* problems; and.

- Wealth generation using environmentally benign and energy efficient techniques;

These challenges require appropriate orientation of *E&T* education and research in the country at all levels, particularly at UG and revitalizing the same as outlined below, so that *E&T* professionals of the 21st century are equipped to face the challenges with determination and courage becoming ready in a short time to contribute to national development.

3. Approach to Curriculum:

As a major objective of *E&T* education in India now is to develop *E&T* professionals having competencies, intellectual skills and knowledge equipping them to contribute to the society through productive and satisfying careers as *innovators, decision makers and leaders* in the national and global economies of the 21st century, the *Approach to Curriculum* for *UG E&T Degree Programmes* needs to lay special emphasis on educating/preparing the students well for being able to demonstrate the following abilities:

(a) Effective application of *knowledge* of mathematics, science and technical subjects;

(b) Planning and design to conduct scientific and technical experiments;

(c) Analysis and interpretation of scientific, technical and economic data collected;

(d) Design of parts, subsystems, systems and/or processes to meet specific needs;

(e) Identification, formulation and solving of problems using simulation or otherwise;

(f) Use of techniques/tools including software in all disciplines, as may be required;

(g) Effective communication skills and leadership/participation in team work;

(h) Fulfillment of professional, social and ethical responsibilities;

(i) Sensitivity to environmental and energy issues and concerns;

(j) Planning, development and implementation of strategies for life-long learning.

These requirements call for the following objectives to the *Approach to Curriculum* relating to *UG* students at *E&T Degree Programmes* in the country:

1) *Preparation:* To prepare the students to excel in various educational programmes or to succeed in industry / technical profession through further education/training;

2) *Core Competence:* To provide the students with a solid foundation in mathematical, scientific and *E&T* fundamentals required to solve *E&T* related problems;

3) *Breadth:* To train the students with a breadth of scientific and *E&T* knowledge to comprehend, analyze, design & create novel products and solutions for real life problems;

4) *Professionalism:* To inculcate in the students professional/ethical attitude, effective team work skills, multidisciplinary approach and to relate *E&T* issues to a broader context;

5) *Learning Environment:* To provide the students with academic environment of excellence, leadership, ethical guidelines and life-long learning needed for a long/peoductive career.

4. Definitions/Descriptions:

Thus, in framing a suitable curriculum for the *UG E&T Degree Programmes,* the following definitions/descriptions have been followed for the different terms used. This is expected to help in maintaining uniformity of presentation in the *Model Scheme of Instruction and Syllabi* for the various *Programmes* covered here*:*

1. **Semester Scheme:** Each *UG E&T Degree Programme* to be ordinarily of 4 academic years (=8 Semesters), with the year being divided into two Semesters of ~ 20 weeks (>=90 working days) each for course work, followed by Continuous Internal Evaluation *(CIE)* in the Semester & Semester End Examination *(SEE)* as reforms in Achievement Testing;

2. **Credit System:** A system enabling quantification of course work, with *one credit being assigned to each unit* after a student completes its teaching-learning process, followed by passing in both *CIE & SEE;* Further, *Choice Based Credit System (CBCS)* to be helpful in customizing the course work for a student, through *Core & Electives*;

3. **Credit Courses:** All Courses registered by a student in a *Semester* to earn *credits*; In a widely accepted definition, students to earn *One Credit* by registering and passing:
   - One hour/week/Semester for *Theory/Lecture (L) Courses;* and,
   - Two hours/week/Semester for *Laboratory/Practical(P) Courses* or *Tutorials (T);*
   NOTE: Other student activities not demanding intellectual work or enabling proper assessment like, practical training, study tour and guest lecture not to carry *Credits;*

4. **Credit Representation:** *Credit* values for different academic activities to be represented by following the well accepted practice, as per the example in Table 1:

Table 1: Credit Representation

Lectures (hrs/wk/Sem.)	Tutorials (hrs/wk/Sem.)	Practical Work (hrs/wk/Sem.)	Credits (L: T: P)	Total Credits
3	0	0	3:0:0	3
2	2	0	2:1:0	3
2	0	2	2:0:1	3
2	2	2	2:1:1	4
0	0	6	0:0:3	3

5. **Course Load:** Every student to register for a set of *Courses* in each *Semester,* with the total number of their *Credits* being limited by considering the permissible *weekly Contact Hours (typically: 30/Week);* For this, an average *Course Load* of 22 *Credits/Semester* (e.g., 6-7 *Courses*) generally acceptable; To include also 3 *Units of Non-Credit Mandatory Courses* in some Semesters, as per the example in Table 2:

Table 2: Typical Course Load in a Semester

No. of Courses	Credits/Course	Total Credits	Contact Hours/Week *
Two Lecture Courses	3:0:0	6	6
Two Lec +Tut Courses	3:1:0	8	10
One Lec +Lab Course	3:0:1	4	5
One Lec +Lab+ Tut Course	2:1:1	4	6
One *Mandatory* Course	*Non-Credit*	3 *Units*	3
Total: Six + one	17:3:2	22	30

* Widely accepted figure ~ 30 hours/week, to enable the students to engage in home work assignments, self-learning outside the Class rooms/Laboratories, Extra/Co-Curricular activities and *add-on Courses,* if any, for their overall development;

6. **Course Flexibility:** *Course work* of students to be made flexible to enable fast, average and slow learners among them to plan and pace the same in a *Semester* as may be necessary and register for more/average/less *Credits* within limits (e.g., +/- 20%) from the prescribed value, based on their learning capacities as observed from *CIE, SEE* results in *Coursework* in the previous *Semesters;*

7. **Audit Courses:** Students to be able to register for *Courses* outside the prescribed range of *Credits* for *audit* only, when interested to supplement their knowledge/skills; Optional for students to appear/pass in *CIE, SEE* of these courses and/or seek their inclusion in the *Grade* cards or *Transcripts* issued (but, not for earning *Credit);*

8. **Mandatory Courses:** *Course work* on peripheral subjects in a programme, wherein familiarity considered mandatory; To be included as *non-Credit, Mandatory Courses,* with only a *pass* in each required to qualify for Degree award from the concerned

institution; Such *Courses* to be limited to < 5 % of the maximum permissible *Course/Credit Load;*

9. ***Course Registration:*** Every student to formally register for *Courses(Credits)* under faculty advice in each *Semester* for the Institution to maintain proper record; Helpful for monitoring the *CIE, SEE* performance in each case and to assist the students in self-paced learning by dropping/withdrawing from *Course(s)*, and to avail of *Course Flexibility;*

10. ***Course Evaluation:*** *CIE* and *SEE* to constitute the major evaluations prescribed for each *Course,* with only those students maintaining a minimum standard in *CIE* (to be fixed by the institution) being permitted to appear in *SEE* of the *Course; CIE* and *SEE* to carry 50% each, to enable each *Course* to be evaluated for 100 marks, irrespective of its *Credits;*

11. ***CIE:*** To be normally conducted by the *Course Instructor* and include mid-term/weekly/ fortnightly class tests, home work, problem solving, group discussion, quiz, mini-project & seminar throughout the *Semester*, with weightage for the different components being fixed at the institutional level; *Instructor* also to discuss on *CIE* performance with students;

12. ***SEE:*** To be normally conducted at the institutional level and cover the entire *Course Syllabi;* For this purpose, *Syllabi* to be modularized and *SEE* questions to be set from each module, with choice if any, to be confined to module concerned only. The questions to be comprehensive emphasizing analysis, synthesis, design, problems & numerical quantitites;

13. ***Grading:*** To be normally done using *Letter Grades* as qualitative measure of achievement in each *Course* like: *S(Superior), A(Excellent), B(Very Good), C(Good), D(Average), E(Poor) & F(Fail),* based on the marks(%) scored in *(CIE+SEE)* of the *Course* and conversion to *Grade* done by *Relative/Absolute Grading,*the former being more useful;

14. **Grade Point(GP):**Students to earn *GP* for a *Course* based on its *Letter Grade;* e.g., on a typial 10-point scale, *GP* to be: *S=10, A=09, B=08,C=07,D=06,E=04 & F=00;* Useful to assess students' achievement quantitatively & to compute *Credit Points (CrP)= GP X Credits* for the *Course;*Student passing a *Course* only when getting *GP>= 04 (E Grade);*

15. **Grade Point Average(GPA):**Computation of *SemesterGPA (SGPA)* to be done by dividing the sum of *CrP* of all *Courses* by the total number of *Cr* registered in a Semester, leading finally to *CGPA* for evaluating student's performance at the end of two or more *Semesters* cummulatively; This reform serving as a better performance index than total marks or %;

16. **Passing Standards:** Both *SGPA & CGPA* serving as useful performance measures in the *Semester System;* Student to be declared successful at the *Semester-end or Programme-end* only when getting *SGPA or CGPA >=5.00,* with none of the *Courses* registered in a *Semester* or for the *Degree Award* remaining with *F Grade;*

17. *Credits Required for Degree Award:* Number of *Credits* to be earned by a student for the *UG (E&T) Degree Award* fixed by Universities/Institutions to be normally in the range of 160 (20/Sem.) to 200 (25/Sem.); Widely accepted value: 176 (22/Sem.); Also, each student to be successful in the *mandatory courses* as may be prescribed to qualify for the *Degree;*

5. Curriculum Structure:

A typical *Curriculum Structure* for *UG E&T Degree Programmes* evolved as a result of the *Approach to Curriculum* and *Definitions/Descriptions* provided above can be broadly as given in Table 3. A suggested breakdown of *Credits* for use in these programmes in India is also given here.

Table 3: Typical Curriculum Structure for *UG E&T Degree Programmes*

S.No.	Course Work - Subject Area	Range of Total *Credits* (%)		Suggested Breakdown of *Credits* (for Total=176) (No.)
		Minimum	*Maximum*	
1	Humanities and Social Sciences *(HS)*, including Management;	5	10	14
2	Basic Sciences*(BS)* including Mathematics, Physics, Chemistry, Biology;	15	20	30
3	Engineering Sciences *(ES)*, including Materials, Workshop, Drawing, Basics of Electrical/Electronics/Mechanical/Computer Engineering, Instrumentation;	15	20	30
4	Professional Subjects-Core *(PC)*, relevant to the chosen specialization/branch; *(May be split into Hard (no choice) and Soft(with choice), if required;)*	30	40	50
5	Professional Subjects – Electives *(PE)*, relevant to the chosen specialization/ branch;	10	15	20
6	Open Subjects- Electives *(OE)*, from other technical and/or emerging subject areas;	5	10	12
7	Project Work, Seminar and/or Internship in Industry or elsewhere.	10	15	20
8	Mandatory Courses *(MC);*	*Non-Credit*		8 *units*

The suggested *Course Work (=176 Credits, at 22/Semester on an average with built-in flexibility of +/- 20% as indicated earlier)* in Table 3 needs to be completed successfully by a student to qualify for the award of the *UG E&T Degree* from the concerned University/Institution. A widely accepted plan for sequencing the *Course Work* can be as in Table 4:

Table 4: Typical Sequencing Plan for Courses at *UG E&T Degree Programmes*

Semesters	*Subject Area Coverage*
I –II	*HS, BS* and *ES Courses* common for all Branches; *Mandatory Courses;*

III-IV	*HS, BS* and *ES Courses* common for all Branches (to be continued); Also, *Mandatory Courses*(to be continued, if required);
	PC (Hard/Soft) *Courses* in two/three groups (like Electrical, Non-Electrical); Area wise Orientation; *Add-On Courses;*
V-VII	*PC* (Hard/Soft), *PE and OE Courses*; Branch-wise Orientation; *Add-On Courses;* Seminar;
VIII	*PE* and *OE Courses*; Project work and Dissertation, Internship, Seminar: *Add-On Courses;* Final wrap-up of Programme;

6. **Methodology Followed:**

It was decided to follow the methodology given below for preparing the *Model Scheme of Instruction and Syllabi* for the *UG E&T Degree Programmes*:

1) As a first step, after conducting a scrutiny of all the current *UG E&T Degree Programmes* in the country, six of the highest intake capacity programmes, *viz., EC, EE, CS, ME, CE and IT* were identified to be taken up for preparing their *Model Scheme of Instruction and Syllabi* in the first instance.

2) It was decided that the *Model Scheme of Instruction and Syllabi* for each *Programme* need to be well balanced covering the various subject areas listed in Table 3 and have provision for proper *achievement testing* of the students in *two parts*, viz., *CIE & SEE* (described earlier in Section 4(11.12)) as given below:

a) For proper *achievement testing* of the students so necessary in the *Semester Scheme*, good question papers need to be used as the principal tool; For this, the question papers at *CIE* and *SEE* to:

- Cover all sections of the course syllabus uniformly;

- Be unambiguous and free from any defects/errors;

- Emphasize *knowledge* testing, problem solving & quantitative methods;

- Contain adequate data/ other information on the problems assigned; and,

- Have clear and complete instructions to the students.

b) To meet these requirements, the *Syllabi* to be well drafted, be defect free and be in modular form with a provision for students to answer questions from each module from the syllabus for which the *CIE/SEE* Question Papers to have built in choice in the module;

c) Both *CIE* and *SEE* to be normally of equal (50:50) significance; and, the students' *achievement* in a subject to be judged by taking into account the results of both *CIE* and *SEE* together for awarding the *Letter Grade and the Grade Point,* as indicated earlier.

3) The following *Working Groups* comprising 3-5 Subject Experts in each case were then constituted for each subject area listed in Table 3, to take up the responsibility of framing the *Model Scheme of Instruction and Syllabi*:

a) *HS,* as required for all the programmes *(14 Credits)*;

b) *BS,* as required for all the programmes *(30 Credits)*;

c) *ES,* as required for all the programmes *(30 Credits)*;

d) *PC and PE* for each of the six identified programme *(50 + 20 Credits)*;

e) *OE,* as required for all the programmes *(12 Credits)*;

f) *Project work* and *Dissertation,* for all the programmes *(20 Credits)*;

g) *Mandatory Courses,* for all the programmes *(8 Units)*;

The composition of *Working Groups* constituted in this manner is given in *Annexure A.* The Coordinators and the Members of each *Working Group* were provided with a set of detailed guidelines to assist them in this assignment and to also ensure good uniformity in the *Model Scheme of Instruction and Syllabi* framed by the different *Working Groups.*

4) Each *Working Group* was also requested to use the following format for the *Model Syllabi* to be in accordance with the *AICTE Template*, to bring in uniformity in its presentation:

(i) **Title of the *Course, Hours/Weak (L:T:P), Credits*** (or *Non-Credit, mandatory)* in square brackets (**[ ]**) to be in line 1 *(in **bold print***)*;

(ii) *Syllabus,* in *modular or unitized form in 5-10 units* to be then given, with the number of teaching-learning hours specified for each *module (in normal letter style),* if possible*;*

(iii) References: At least *2-3 Text Books and 1-2 Reference Books* to be cited for each *Course (*Author(s), Book Title, Publisher, Edition, Year of Publication) *(in italics)*;

(iv) Pre-requisites for the *Course, if any,* such as, *knowledge of other subjects or other Courses* to be given *(in normal letter style),* if possible*;*

5) After the *Model Syllabi* were received from all the *Working Groups,* the *AIB UGS (E&T)* took into consideration the various presentations provided, subjected them to editorial corrections/improvements and finalized the *Model Scheme of Instruction and Syllabi* given in the Chapters that follow.

7. Expected Educational Outcomes:

Special attention was also paid to ensure that the *Model Scheme of Instruction and Syllabi* had built-in provision to enable the following *ten* educational outcomes from the *E&T students* passing out of the Universities/Institutions adopting them:

1. Ability to apply the knowledge acquired in subject areas like, *Mathematics, Basic Sciences, Engineering Sciences, Professional Subjects and Environmental Issues;*

2. Strong foundation in theoretical/experimental work for being able to analyze, synthesize and design engineering products, processes and systems as desired;

3. Expertise in collecting field data, designing and conducting experiments in the laboratory/elsewhere and analyzing/interpreting the results;

4. Capacity to function in multi/inter-disciplinary teams with a spirit of tolerance, patience and understanding so necessary for team work;

5. Competence to acquire *knowledge* on one's own through libraries/data bases for contributing to *knowledge assimilation, creation, dissemination & life-long learning;*

6. Better understanding and acceptance of professional, social, moral and ethical responsibilities and good *knowledge* of contemporary issues;

7. Familiarity with ICT and seeking pollution-free and/or environment- and energy-friendly solutions to day-to-day problems faced by the society at large, based on ICT;

8. Broad education necessary to get a perception of the impact of solutions provided for developmental issues in a global/societal context;

9. Capacity for rational, objective, orderly and logical thinking and ability to communicate with fellow professionals/society effectively in written/oral forms; and,

10. Good attitudes and skills in personnel management and maintenance of human relations, required in every ones working life.

8. Future Steps to be Taken:

The *Model Scheme of Instruction and Syllabi* proposed for the six chosen programmes of study are indeed at the current state of the art and they are suitable for being followed in the country at Technological/Other Universities/University level Institutions and Autonomous Colleges. Therefore, *AICTE* may take the following steps in the immediate future to ensure that the *Scheme/Syllabi* are widely adopted:

- The availability of *Model Scheme of Instruction and Syllabi* for the *six* chosen *Programmes of Study* may be publicized widely on the Web Site or otherwise;

- Selected institutions may be encouraged to adopt the *Scheme/Syllabi* on experimental basis or use them as *guidelines* and their experience utilized to make future plans;

- The experience gained may be used to initiate steps to improve and update the *Scheme/ Syllabi* to be contemporary on a continuing basis;

- The feedback received from the institutions may also form the basis for taking steps to formulate such *Schemes/Syllabi* for other *Programmes of Study;*

- Institutions following the *Scheme/Syllabi* may be facilitated with autonomy, if needed, to benefit from *CBCS* and related *Academic/Examination Reforms* in *E&T Programmes;*

The *Lists of Courses Identified* as per the Curriculum Structure discussed are now given category- wise together with the proposed *Credits* and the preferred *Semester* in each case, followed by the *Model Syllabi for Common Courses* and the *Model Scheme of Instruction and Syllabi* for each of the *five* identified *Programmes of Study,* viz., *EC, EE, CS, ME, CE* in the Chapters that follow. And, the *Model Scheme of Instruction and Syllabi* for the *sixth* identified programme, viz., *IT* is presented as *Supplement* to this Volume.

CHAPTER II
LISTS OF COURSES IDENTIFIED

1. Preamble:

The lists of courses, as identified by all the Working Groups constituted for the UG (E&T) programmes in the chosen branches and approved by AIB UGS (E&T) for their suitability to be used at Technical Universities/Institutions in India in the 21st century are given below in tabular form subject areawise, viz., *HS, BS, ES, PC/PE branchwise (EC, EE, CS, ME, CE, IT), OE, MC and Project Work.* In each case, the Course code, Course Title, suggested Instruction Hours/Week (in L:T: P format), Credits assigned and Preferred Semester for teaching/learning are indicated for ease of convenience and use by the academic community. However, the institutions may vary both L: T: P and Preferred Semester to some extent based on their experience/needs and the availanle faculty strength/competence.

2. The Lists:

(a) **Humanities and Social Sciences** *(HS)*

S. No.	Course Code	Course Title	Hrs/Wk L: T: P	Credits	Preferred Semester
1	HS 01	Sociology & Elements of Indian History for Engineers	3: 0: 0	3	I/II
2	HS 02	Economics for Engineers	3: 0: 0	3	I/II
3	HS 03	Law for Engineers	3: 0: 0	3	I/II
4	HS 04	Business Communication and Presentation Skills	2: 2: 4	5	I/II
5	HS 05	Environmental Sciences	1: 0: 2	2	I/II

(b) **Basic Sciences** *(BS)*

S. No.	Course Code	Course Title	Hrs/Wk L: T: P	Credits	Preferred Semester
1	BS 01	Elementary Mathematics for Engineers	2: 0: 0	2	I
2	BS 02	Multivariate Analysis, Linear Algebra and Special Functions	3: 0: 0	3	III
3	BS 03	Differential Equations	3: 0: 0	3	II
4	BS 04	Complex Analysis	2: 0: 0	2	IV
5	BS 05	Optimization and Calculus of Variations	2: 0: 0	2	III
6	BS 06	Probability and Statistics	2: 0: 0	2	IV

S. No.	Course Code	Course Title	Hrs/Wk L: T: P	Credits	Preferred Semester
7	BS 07	Discrete Mathematics	2: 0: 0	2	V
8	BS 08	Fuzzy Mathematics	2: 0: 0	2	VI
9	BS 09	Applied Physics I	2: 0: 0	2	I
10	BS 10	Applied Physics II	2: 0: 0	2	II
11	BS 11	Applied Physics Laboratory I	0: 0: 2	1	I
12	BS 12	Applied Physics III	2: 0: 0	2	III
13	BS 13	Applied Physics Laboratory II	0: 0: 2	1	II
14	BS 14	Chemistry I	2: 0: 0	2	I
15	BS 15	Chemistry Laboratory I	0: 0: 2	1	I/II
16	BS 16	Chemistry II	3: 0: 0	3	II/III
17	BS 17	Elementary Biology	1: 0: 2	2	I
18	BS 18	Advanced Biology I	1: 0: 2	2	II
19	BS 19	Advanced Biology II	1: 0 :2	2	III

(c) **Engineering Sciences** *(ES)*

S. No.	Course Code	Course Title	Hrs/Wk L: T: P	Credits	Preferred Semester
1	ES 01	Engineering Graphics	2: 2: 0	3	I
2	ES 02	Engineering Workshop	0: 0: 6	3	I
3	ES 03	Materials Science	2: 0: 0	2	III
4	ES 04	Basic Engineering Mechanics	2: 2: 0	3	I
5	ES 05	Basic Electrical Engineering	3: 0: 0	3	II
6	ES 06	Basic Electrical Engineering Laboratory	0: 0: 2	1	II
7	ES 07	Basic Electronics Engineering	3: 0: 0	3	III
8	ES 08	Basic Electronics Engineering Laboratory	0: 0: 2	1	III
9	ES 09	Computer Programming	2: 0: 0	2	II
10	ES 10	Computer Programming Laboratory	0: 0: 4	2	II
11	ES 11	Basic Simulation Laboratory	0: 0: 2	1	III
12	ES 12	Bassic Thermodynamics	3: 0: 0	3	IV
13	ES 13	Solid Mechanics & Fluid Mechanics	3: 0: 0	3	IV
14	ES 14	Solid Mechanics & Fluid Mechanics	0: 0: 2	1	IV

S. No.	Course Code	Course Title	Hrs/Wk L: T: P	Credits	Preferred Semester
15	ES 15	Engineering Mechanics Laboratory	2: 2: 0	3	I/II
16	ES 16	Solid Mechanics	3: 0: 2	4	III/IV
17	ES 17	Thermodynamics	2: 2: 0	3	III/IV
18	ES 18	Engineering Materials	2: 0: 0	2	III/IV

(d) **Professional Subjects-Core & Electives** *(PC, PE)*
(i) *Computer Science & Engineering(CS):*

S. No.	Course Code	Course Title	Hrs/Wk L: T: P	Credits	Preferred Semester
1	CS 01	Data Structures & Algorithms	2: 2: 0	3	III
2	CS 02	Computer Organization & Design	3: 2: 0	4	III
3	CS 03	Discrete Mathematics	2: 0: 0	2	III
4	CS 04	Digital Systems	3: 0: 2	4	III
5	CS 05	Operating Systems (Unix Programming)	3: 2: 0	4	IV
6	CS 06	Formal Languages & Automation Theory	3: 0: 0	3	IV
7	CS 07	Design and Analysis of Algorithms	3: 0: 0	3	IV
8	CS 08	Computer Networks	3: 2: 0	4	IV
9	CS 09	Data Base Management Systems	3: 2: 0	4	IV
10	CS 10	Software Engineering	2: 2: 0	3	V
11	CS 11	Compiler Design	2: 2: 0	3	V
12	CS 12	Cryptography & Information Security	3: 2: 0	4	V
13	CS 13	Object Oriented Analysis and Design	2: 2: 0	3	V
14	CS 14	Distributed Computing Systems	3: 0: 0	3	V
15	CS 15	Graph Theory	3: 0: 0	3	V
16	CS 16	Artificial Intelligence	2: 2: 0	3	V
17	CS 17	Computer Graphics and Visualization	3: 2: 0	4	VI
18	CS 18	Simulation and Modeling	3: 0: 2	4	VI
19	CS 19	Internet Web Programming	2: 0: 2	3	VI
20	CS 20	Embedded Computing Systems	2: 0: 2	3	VI
21	CS 21	Software Testing	3: 2: 0	4	VI

22	CS 22	Data Mining	3: 2: 0	4	VI
23	CS 23	Advanced Computer Architecture	3: 0: 0	3	VI
24	CS 24	Approximation of Algorithms	3: 0: 0	3	VI
25	CS 25	Mobile Computing	2: 2: 0	3	VII
26	CS 26	Pattern Recognition	2: 2: 0	3	VII
27	CS* 27	Information Retrieval	3: 2: 0	4	VII
28	CS* 28	Software Architecture	3: 2: 0	4	VII
29	CS*29	VLSI Design & Algorithms	2: 2: 0	3	VII
30	CS* 30	Soft Computing	3: 0: 0	3	VII
31	CS* 31	Game Theory	3: 0: 0	3	VII
32	CS* 32	Combinational Optimization	3: 0: 0	3	VII
33	CS* 33	Computer Vision	3: 0: 0	3	VII
34	CS* 34	Software Project Management	3: 0: 0	3	VII
35	CS* 35	Human Computer Interface	3: 0: 0	3	VII
36	CS* 36	Cloud Computing	3: 0: 0	3	VII
37	CS* 37	Web Service and Service Oriented Architecture	3: 0: 0	3	VIII
38	CS* 38	Bioinformatics	3: 0: 0	3	VIII
39	CS* 39	Script Programming	3: 0: 0	3	VIII
40	CS* 40	Multimedia Computing	3: 0: 0	3	VIII
41	CS P1	Project Work 1	0: 0: 8	4	VII
42	CS P2	Project Work II & Dissertation	0: 0:32	16	VIII

(Note: Electives in one group: CS)*

(e) **Open Electives** *(OE):*

S. No.	Course No.	Course Title	Hrs/Wk L: T: P	Credits	Preferred Semester
1	OE 01	Database Management Systems	3: 0: 2	4	V/VI
2	OE 02	Software Engineering	3: 0: 0	3	V/VI
3	OE 03	Design and Analysis of Algorithms	3: 0: 0	3	V/VI
4	OE 04	Disaster Management	3: 0: 0	3	IV/V
5	OE 05	Project Management	3: 0: 0	3	IV/V
6	OE 06	Engineering Risk–Benefit Analysis	3: 0: 0	3	VI/VII
7	OE 07	Infrastructure Systems Planning	3: 0: 0	3	VI/VII
8	OE 08	Planning for Sustainable Development	3: 0: 0	3	VI/VII
9	OE 09	Managing Innovation and Entrepreneurship	3: 0: 0	3	VI/VII
10	OE 10	Global Strategy and Technology	3: 0: 0	3	VI/VII
11	OE 11	Knowledge Management	3: 0: 0	3	VI/VII
12	OE 12	Rural Technology & Community Development	3: 0: 0	3	Vi/VII
13	OE 13	Artificial Intelligence and Robotics	3: 0: 0	3	VI/VII
14	OE 14	Cloud Computing	3: 0: 0	3	VI/VII
15	OE 15	Digital Communication	3: 0: 0	3	VI/VII
16	OE 16	Digital Signal Processing	3: 0: 0	3	VI/VII
17	OE 17	Engineering System Analysis and Design	3: 0: 0	3	VII/VIII
18	OE 18	Engineering System Design Optimization	3: 0: 0	3	VII/VIII
19	OE 19	Engineering System Modeling and Simulation	3: 0: 0	3	VII/VIII
20	OE 20	Game Theory with Engineering Applications	3: 0: 0	3	VII/VIII
21	OE 21	Supply Chain Management-Planning	3: 0: 0	3	VII/VIII

(f) **Mandatory Courses** *(MC):*

S. No.	Course No.	Course Title	Hrs/Wk L: T: P	Units	Preferred Semester
1	MC 01	Technical English	3: 0: 0	3	I/II
2	MC 02	Value Education, Human Rights and Legislative Procedures	3: 0: 0	3	I/II
3	MC 03	Environmental Studies	3: 0: 0	3	III/IV
4	MC 04	Energy Studies	3: 0: 0	3	III/IV
5	MC 05	Technical Communication & Soft Skills	3: 0: 0	3	V/VI
6	MC 06	Foreign Language	3: 0: 0	3	V/VI

CHAPTER III
MODEL SYLLABI FOR COMMON COURSES

(a) HUMANITIES AND SOCIAL SCIENCES

HS 01: Sociology & Elements of Indian History for Engineers   *3:0:0*
[3]

The objective of this course is to familiarize the prospective engineers with elements of Indian history and sociological concepts and theories by which they could understand contemporary issues and problems in Indian society. The course would enable them to analyze critically the social processes of globalization, modernization and social change. All of this is a part of the quest to help the students imbibe such skills that will enhance them to be better citizens and human beings at their work place or in the family or in other social institutions.

Module 1A: Introduction to Elements of Indian History: What is history? ; History Sources-Archaeology, Numismatics, Epigraphy & Archival research; Methods used in History; History & historiography; *(3 Lectures)*

Module 1B: Introduction to sociological concepts-structure, system, organization, social institutions, Culture social stratification (caste, class, gender, power).State & civil society; *(7 Lectures)*

Module 2A: Indian history & periodization; evolution of urbanization process: first, second &third phase of urbanization; Evolution of polity; early states to empires; Understanding social structures- feudalism debate; *(3 Lectures)*

Module 2B: Understanding social structure and social processes: Perspectives of Marx, Weber & Durkheim; *(7 Lectures)*

Module 3A: From Feudalism to colonialism-the coming of British; Modernity & struggle for independence; *(3 Lectures)*

Module 3B: Political economy of Indian society. Industrial, Urban, Agrarian and Tribal society; Caste, Class, Ethnicity and Gender; Ecology and Environment; *(9 Lectures)*

Module 4A: Issues & concerns in post-colonial India (up to 1991); Issues & concerns in post-colonial India 2nd phase (LPG decade post 1991) *(3 Lectures)*

Module 4B: Social change in contemporary India: Modernization and globalization, Secularism and communalism, Nature of development, Processes of social exclusion and inclusion, Changing nature of work and organization *(10 Lectures)*

Text/Reference Books:

    (a) History

1. Desai, A.R. (2005), *Social Background of Indian Nationalism,* Popular Prakashan
2. Guha, Ramachandra (2007), *India After Gandhi,* Pan Macmillan
3. Thapar, Romila (2002), *Early India,* Penguin
4. Sharma R.S.(1965), *Indian Feudalism,* Macmillan
5. Deshpande, Satish (2002), *Contemporary India: A Sociological View,* Viking
6. Gadgil, Madhav & Ramachandra Guha(1993), *This Fissured Land: An Ecological History of India,* OU Press

(b) Sociology:

7. Giddens, A (2009), *Sociology*, Polity, 6th edn.
8. Haralambos M, RM Heald, M Holborn (2000), *Sociology*, Collins
9. Xaxa, V (2008), *State, Society and Tribes* Pearson
10. Chandoke, Neera & Praveen Priyadarshi (2009), *Contemporary India: Economy, Society and Politics*, Pearson
11. Oommen,T.K.(ed.) (1997), *Citizenship and National Identity: From Colonialism to Globalization,* Sage.
12. Mohanty, M (ed.) (2004), *Class, Caste & Gender- Volume 5,* Sage
13. Dhanagare, D.N. , *Themes and Perspectives in Indian Sociology,* Rawat
14. Ramaswamy, E.A. and Ramaswamy,U.(1981), *Industry and Labour,* OU Press
15. Bhowmik, S (ed.) (2010), *Street Vendors in the Global Urban Economy,* Routledge
16. Rao, M.S.A. (ed.) (1974), *Urban Sociology,* Orient Longmans

HS 02: Economics for Engineers   *3:0:0*
[3]

The objective of this course is to familiarize the prospective engineers with elementary principles of economics. It also deals with acquainting the students with standard concepts and tools that they are likely to find useful in their profession when employed in the firm/industry/corporation in public or private sector. It also seeks to create and awareness about the status of the current economic parameters /indicators/ policy debates. All of this is a part of the quest to help the students imbibe soft skills that will enhance their employability.

Module 1: Basic Principles and Methodology of Economics. Demand/Supply – elasticity – Government Policies and Application.Theory of the Firm and Market Structure. Basic Macro-economic Concepts (including GDP/GNP/NI/Disposable Income) and Identities for both closed and open economies. Aggregate demand and Supply (IS/LM). Price Indices (WPI/CPI), Interest rates, Direct and Indirect Taxes *(12 Lectures)*

Module 2: Public Sector Economics –Welfare, Externalities, Labour Market.Components of Monetary and Financial System, Central Bank –Monetary Aggregates; Commercial Banks & their functions; Capital and Debt Markets. Monetary and Fiscal Policy Tools & their impact on the economy – Inflation and Phillips Curve. *(11 Lectures)*

Module 3: Elements of Business/Managerial Economics and forms of organizations. Cost & Cost Control –Techniques, Types of Costs, Budgets, Break even Analysis, Capital Budgeting, Application of Linear Programming. Investment Analysis – NPV, ROI, IRR, Payback Period, Depreciation, Time value of money. Business Forecasting – Elementary techniques. Statements – Cash flow, Financial. Case Study Method. *(11 Lectures)*

Module 4: Indian economy Brief overview of post independence period – plans. Post reform Growth, Structure of productive activity. Issues of Inclusion – Sectors, States/Regions, Groups of people (M/F), Urbanization. Employment–Informal, Organized, Unorganized,

Public, Private. Challenges and Policy Debates in Monetary, Fiscal, Social, External sectors. *(11 Lectures)*

Text/Reference Books:
1. Mankiw Gregory N.(2002), *Principles of Economics,* Thompson Asia
2. V. Mote, S. Paul, G. Gupta(2004), *Managerial Economics,* Tata McGraw Hill
3. Misra, S.K. and Puri (2009), *Indian Economy,* Himalaya
4. Pareek Saroj (2003), *Textbook of Business Economics,* Sunrise Publishers

HS 03: Law for Engineers   3:0:0
[3]

The objective of the course is to familiarize students (Prospective engineers) with elementary knowledge of laws that would be of utility in their profession. The syllabus covers Constitution of India and new areas of law like IPR, ADR, Human Rights, Right to Information, Corporate law, Law relating Elections and Gender Studies. To be supplemented by the historical development of laws wherever required.

Module 1A: Constitutional Law covering the Preamble; Fundamental Rights, Judicial Activism including Equality and Social Justice, Life and Personal Liberty and Secularism and Religious freedoms; Directive principles of State policy; Fundamental Duties; Emergency provisions – kinds, legal requirements and legal effects; *(5 Lectures)*

Module 1B: Human Rights and Public International Law covering Human   Rights   in International Law-Theoretical   foundation, human rights and international law; Historical development of human rights; Human Rights in Indian tradition and Western tradition; Covenant on Civil & Political Rights 1966 including Optional Protocol – I (Individual Complaint Mechanism) & Optional Protocol – II (Abolition of Death Penalty); Covenant on Economic, Social and Cultural Rights 1966 including Optional Protocol – I (2002); UN Mechanism and specialized agencies, (UNICEF, UNESCO, WHO, ILO, FAO, etc.); International NGOs – Amnesty International, Human Rights Watch, Greenpeace Foundation; Enforcement of Human Rights in India including Supreme Court, High Courts, Statutory Commissions – NHRC, NCW, NCM, NC-SCST etc. Public International Law, covering Introduction, Customs, Treaties, State territories including Recognition of States and governments, Law & Practice of Treaties and Law of Sea; *(5 Lectures)*

Module 2A: General Principles of Contract under Indian Contract Act, 1872 covering General principles of contract – Sec. 1 to 75 of Indian Contract Act and including Government. as contracting party, Kinds of government contracts and dispute settlement, Standard form contracts; nature, advantages, unilateral character, principles of protection against possibility of exploitation, judicial approach to such contracts, exemption clauses, clash between two standard form contracts; *(4 Lectures)*

Module 2B:Arbitration, Conciliation and ADR system covering Arbitration – meaning, scope and types – distinction between law of 1940 and 1996; UNCITRAL model law – Arbitration and expert determination; Extent of judicial intervention; International commercial arbitration; Arbitration agreements – essential and kinds, validity, reference and interim measures by court; Arbitration tribunal – appointment, challenge, jurisdiction of arbitral tribunal, powers, ground of challenge, procedure and court assistance; Award including Form and content, Grounds for setting aside an award, Enforcement, Appeal and Revision; Enforcement of foreign awards – New York Convention Awards and Geneva Convention

Awards; Distinction between conciliation, negotiation, mediation and arbitration, confidentiality, resort to judicial proceedings, costs; *(5 Lectures)*

Module 3A: Law relating to Intellectual property covering Introduction – meaning of intellectual property, main forms of IP, Copyright, Trademarks, Patents and Designs, Secrets; Other new forms such as plant varieties and geographical indications; International instruments on IP – Berne convention, Rome convention, TRIPS, Paris convention and international organizations relating IPRs, WIPO, WTO etc; Law relating to Copyright in India including Historical evolution of Copy Rights Act, 1957, Meaning of copyright – literary, dramatics and musical works, sound records and cinematographic films, computer programs, Ownership of copyrights and assignment, Criteria of infringement, Piracy in Internet – Remedies and procedures in India; Law relating to Trademarks under Trademark Act, 1999 including Rationale of protection of trademarks as Commercial aspect and Consumer rights, Trademarks, registration, procedures, Distinction between trademark and property mark, Doctrine of deceptive similarity, Passing off an infringement and remedies; Law relating to Patents under Patents Act, 1970 including Concept and historical perspective of patents law in India, Patentable inventions with special reference to biotechnology products, Patent protection for computer programs, Process of obtaining patent – application, examination, opposition and sealing of patents, Patent cooperation treaty and grounds for opposition, Rights and obligations of patentee, Duration of patents – law and policy considerations, Infringement and related remedies; *(8 Lectures)*

Module 3B: Right to Information Act, 2005 covering, Evolution and concept; Practice and procedures; Official Secret Act, 1923; Indian Evidence Act, 1872; Information Technology – legislation and procedures, Cyber crimes – issues and investigations; *(3 Lectures)*

Module 4A: Labour Laws, covering Industrial Disputes Act, 1947; Collective bargaining; Industrial Employment (Standing Orders) Act, 1946; Workmen's Compensation Act, 1923; *(3 Lectures)*

Module 4B: Corporate Law, covering Meaning of corporation; Law relating to companies, public and private (Companies Act, 1956) general provisions; Law and multinational companies – International norms for control, FEMA 1999, collaboration agreements for technology transfer; Corporate liability, civil and criminal; *(4 Lectures)*

Module 4C: Election provisions under Indian Constitution (Art.324–329), covering Representation of Peoples Act and Prevention of Corruption Act, 1988; Superintendence, directions and control of elections to be vested in Election Commission; Prohibition as to ineligibility for inclusion in electoral roll on ground of religion, race, caste or sex; Election to the house of people and to the legislative assemblies of States to be on the basis of adult suffrage; Power of parliament to make provisions with respect to elections to legislatures; Power of legislature of State to make provisions with respect to elections to such legislature; Bar to interference by courts in electoral matters; Offences relating to elections under IPC 1860 (Sec.171-A to 171-I), Definition – candidate electoral rights, Bribery, undue influence and impersonation at elections and punishments, False statement in connection with election, Illegal payment in connection with election, Failure to keep election accounts; *(4 Lectures)*

Module 5: Gender Studies, covering Meaning of gender, international perspective and national perspective; Laws relating women in India; Judicial approach and responses-

Vishaka V/s State of Rajasthan 1997 SC; Rights enforcement mechanism in India; Landmark judicial decisions of Supreme Court relating to women; *(4 Lectures)*

Text/Reference Books:

1. D.D. Basu (1996), *Shorter Constitution of India*, Prentice Hall of India
2. M.P. Jain (2005), *Indian Constitutional Law*, Wadhwa & Co.
3. M.P. Singh (1998), *Constitutional Law of India,* Eastern Book Co.
4. P.M. Bakshi (2003), *Constitution of India,* Universal Law Publishing Co.
5. H.M. Seervai (1993), *Constitutional Law of India,* Tripathi Publications
6. *Constituent Assembly Debates* (1989), Vol.1 - 12
7. Agarwal H.O.(2008), *International Law and Human Rights,* Central Law Publications
8. S.K. Awasthi & R.P. Kataria(2006), *Law relating to Protection of Human Rights*, Orient Publishing
9. S.K. Kapur(2001), *Human Rights under International Law and Indian Law,* Central Law Agency
10. Meena Rao (2006), *Fundamental concepts in Law of Contract, 3rd Edn.* Professional Offset
11. Neelima Chandiramani (2000),*The Law of Contract: An Outline, 2nd Edn*. Avinash Publications Mum
12. Avtarsingh(2002), *Law of Contract,* Eastern Book Co.
13. Dutt(1994), *Indian Contract Act,* Eastern Law House
14. Anson W.R.(1979), *Law of Contract,* Oxford University Press
15. Kwatra G.K.(2005), *The Arbitration & Conciliation of Law in India with case law on UNCITRAL Model Law on Arbitration*, Indian Council of Arbitration
16. Avtarsingh (2005), *Law of Arbitration and Conciliation,* Eastern Book Co.
17. Cornish W. R. (2008), *Intellectual Property Rights, Patents, Trademarks, Copyrights & Allied Rights*, Sweet & Maxwell
18. Wadhera (2004), *Intellectual Property Rights,* Universal Law Publishing Co.
19. P. S. Narayan (2000), *Intellectual Property Rights*, Gogia Law Agency
20. T. Ramappa (2010), *Intellectual Property Rights Law in India,* Asia Law House
21. Bare text (2005), *Right to Information Act*
22. O.P. Malhotra, *Law of Industrial Disputes*, N.M. Tripathi Publishers
23. K.M. Desai(1946), *The Industrial Employment (Standing Orders) Act*
24. Rustamji R.F.,*Introduction to the Law of Industrial Disputes*, Asia Publishing House
25. Avtarsingh (2007), *Company Law*, Eastern Book Co.
26. R.R. Pennington, *Company Law*, Butterworth Publications
27. Sethna, *Indian Company Law*
28. Ratanlal & Dhirajlal,(1994), *Indian Penal Code*, Butterworth Publications
29. B.M. Gandhi, (1990), *Indian Penal Code,* Eastern Publishers
30. P.S. Achuthan Pillai(1995), *Criminal Law,* Eastern Publishers
31. K.D. Gaur(2002),*A Text book on IPC,* Deep & Deep Publications
32. Agnes Flavia(1999), *Law and Gender Inequality - The Politics of Women's Rights in India,* OU Press
33. Shobha Saxena, *Crimes against Women and Protective Laws,* Deep & Deep Publications
34. Diwan Paras & Diwan Peeyashi(1994), *Women and Legal Protection,* Deep & Deep Publications

HS 04: Business Communication and Presentation Skills   *2:2:4*
[5]

The objective of this course is to develop communication competence in prospective engineers so that they are able to communicate information as well as their thoughts and ideas with clarity and precision. This course will also equip them with the basic skills required for a variety of practical applications of communication such as applying for a job, writing reports and proposals, facing an interview and participating in a group discussion. Further, it will make them aware of the new developments in technical communication that have become part of business organizations today.

Module 1A: Business communication covering, Role of communication in information age; concept and meaning of communication; skills necessary for technical communication; Communications in a technical organization; Barriers to the process of communication and sola; *(3 Lectures)*

Module 1B: Style and organization in technical communication covering, Listening, speaking, reading and writing as skills; Objectivity, clarity, precision as defining features of technical communication; Various types of business writing: Letters, reports, notes, memos; Language and format of various types of business letters; Language and style of reports; Report writing strategies; Analysis of a sample report; *(4 Lectures)*

Module 2A: Communication and personality development covering, Psychological aspects of communication, cognition as a part of communication; Emotional Intelligence; Politeness and Etiquette in communication; Cultural factors that influence communication; Mannerisms to be avoided in communication; Language and persuasion; Language and conflict resolution; *(3 Lectures)*

Module 2B: Language Laboratory emphasizing Listening and comprehension skills; Reading Skills; Sound Structure of English and intonation patterns; *(5 Sessions)*

Module 3A: Oral Presentation and professional speaking covering, Basics of English pronunciation; Elements of effective presentation; Body Language and use of voice during presentation; Connecting with the audience during presentation; Projecting a positive image while speaking; Planning and preparing a model presentation; Organizing the presentation to suit the audience and context; Basics of public speaking; Preparing for a speech; *(3 Lectures)*

Module 3B: Career Oriental Communication covering, Resume and biodata: Design & style; Applying for a job: Language and format of job application. Job Interviews: purpose and process; How to prepare for interviews; Language and style to be used in interview; Types of interview questions and how to answer them; Group Discussion: structure and dynamics; Techniques of effective participation in group discussion; Preparing for group discussion; *(5 Lectures)*

Module 3C: Advanced Techniques in Technical Communication covering, Interview through telephone/video-conferencing; Power-point presentation: structure and format; Using e-mail for business communication; Standard e-mail practices; Language in e-mail; Using internet for collecting information; Referencing while using internet materials for project reports; Writing for the media; *(2 Lectures)*

Module 4: Language laboratory training in speaking skills covering oral presentations, mock interviews and model group discussions through the choice of appropriate programmes; *(5 Sessions)*

Text/Reference books:
1. Fred Luthans, *Organizational Behaviour,* McGraw Hill
2. Lesikar and petit, *Report writing for Business*
3. M. Ashraf Rizvi, *Effective Technical Communication*, McGraw Hill
4. Wallace and masters, *Personal Development for Life and Work*, Thomson Learning
5. Hartman Lemay, *Presentation Success*, Thomson Learning
6. Malcolm Goodale, *Professional Presentations*
7. Farhathullah, T. M. *Communication skills for Technical Students*

8. Michael Muckian, John Woods, *The Business letters Handbook*
9. Herta A. Murphy, *Effective Business Communication*
10. *MLA Handbook for Writers of Research Papers*

HS 05: Environmental Sciences   *1:0:2 [2]*

The syllabus of Environmental sciences provides an integrated, quantitative and interdisciplinary approach to the study of environmental systems. The students of Engineering undergoing this Course would develop a better understanding of human relationships, perceptions and policies towards the environment and focus on design and technology for improving environmental quality.Their exposure to subjects like understanding of earth processes, evaluating alternative energy systems, pollution control and mitigation,natural resource management and the effects of global climate change will help the students bring a systems approach to the analysis of environmental problems;

Module 1A: Concepts of Environmental Sciences covering, Environment, Levels of organizations in environment, Structure and functions in an ecosystem; Biosphere, its Origin and distribution on land, in water and in air, Broad nature of chemical composition of plants and animals; *(3 Lectures)*

Module 1B: Natural Resources covering Renewable and Non-renewable Resources, Forests, water, minerals, Food and land (with example of one case study); Energy, Growing energy needs, energy sources (conventional and alternative); *(3 Lectures)*

Module 2A: Biodiversity and its conservation covering, Biodiversity at global, national and local levels; India as a mega-diversity nation; Threats to biodiversity (biotic, abiotic stresses), and strategies for conservation; *(3 Lectures)*

Module 2B: Environmental Pollution covering, Types of pollution- Air, water (including urban, rural, marine), soil, noise, thermal, nuclear; Pollution prevention; Management of pollution- Rural/Urban/Industrial waste management [with case study of any one type, e.g., power (thermal/nuclear), fertilizer, tannin, leather, chemical, sugar], Solid/Liquid waste management, disaster management; *(3 Lectures)*

Module 2C: Environmental Biotechnology covering, Biotechnology for environmental protection- Biological indicators, bio-sensors; Remedial measures- Bio-remediation, phyto-remediation, bio-pesticides, bio-fertilizers; Bio-reactors- Design and application*(3 Lectures)*

Module 3A: Social Issues and Environment covering, Problems relating to urban environment- Population pressure, water scarcity, industrialization; remedial measures; Climate change- Reasons, effects (global warming, ozone layer depletion, acid rain) with one case study; Legal issues- Environmental legislation (Acts and issues involved), Environmental ethics; *(5 Lectures)*

Module 3B Environmental Monitoring covering, Monitoring- Identification of environmental problem, tools for monitoring (remote sensing, GIS); Sampling strategies- Air, water, soil sampling techniques *(3 Lectures)*

Module 4: Laboratory Work including Practical and Field Work covering, Plotting of bio-geographical zones and expanse of territorial waters on the map of India; Identification of

biological resources (plants, animals, birds) at a specific location; Determination of (i) pH value, (ii) water holding capacity and (iii) electrical conductivity of different types of soils; Determination of energy content of plants by bomb calorimeter; Measurement and classification of noise pollution; Determination of particulate matter from an industrial area by high volume sampler; Determination of ico-chemical parameters (pH, alkalinity, acidity, salinity, COD, BOD) of tap water, well water, rural water supply industrial effluent and sea water & potability issues; Demonstration of Remote Sensing and GIS methods; Industrial visit for environmental biotechnology processes (e.g., any one of the fermentation, tissue culture, pharmaceutical industries); *(15 Sessions)*

(i) Mathematics

BS 01: Elementary Mathematics for Engineers   *2:0:0*
[2]

The objective of this course is to familiarize the students with elements of mathematics. It acquaints the students with standard concepts and tools that will serve as building blocks towards tackling more advanced level of mathematics that they are likely to find useful in their profession when employed in the firm/industry/corporation in public or private sector. It also seeks to help the students imbibe/inculcate analytical rigor and discipline that is essential in any scientific endeavor. This is specially designed for students to help them bring to speed with other students who have already had some training in mathematics at the 12th Standard level.

Module 1: Elements of Logic covering, necessary and sufficient conditions, theorems and proofs (direct and contra positive); Sets and Functions – elementary set theoretic operations, De Morgan's law, Convex sets, Relations and Correspondences, number systems; Modulus function (distance), sequences and series – convergence; Open and closed sets; Limits and Continuity; *(10 Lectures)*

Module 2: Differential and Integral Calculus covering, concept of a derivative, standard rules of differentiation (including elementary trigonometric and transcendental functions), total and partial derivatives, Young's theorem, homogeneous functions, trace of a curve; Maxima and Minima; Integration- basic concept, definite and indefinite integral, standard rules of integration, partial integration; Ordinary (first order) differential equation; *(10 Lectures)*

Module 3: Linear Mathematics covering, Matrices (types and operations including elementary row and column operations), inverse; Determinants (rules of computation); Linear Equations and Cramer's rule; Vector space (concepts of span/basis/dimension); Eigen values and Eigen vectors; Linear Programming (Graphical and Simplex solution); First order Difference equation (First order equations and solution); *(10 Lectures)*

BS 02: Multivariate Analysis, Linear Algebra and Special Functions   *3:0:0*
[3]

The objective of this course is to familiarize the prospective engineers with techniques in multivariate analysis, linear algebra and some useful special functions. It deals with acquainting the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their profession.

Module 1: Multivariate functions covering, limits, continuity and differentials, partial derivatives, maximum-minimum problems, Laangians, Chain rule; Double integrals, iterated integrals, triple integrals, line integrals, simple connected regions, Green's theorem; Path independence, surface integrals, Stokes theorem; Fourier series and integral, Dirichlet conditions, Parseval's identity. The convolution theorem; *(15 Lectures)*

Module 2: Vectors covering, laws of vector algebra, operations- dot, cross, triple products; Vector function – limits, continuity and derivatives, geometric interpretation; Gradient, divergence and curl – formulae; Orthogonal curvilinear coordinates; Jacobians, gradient, divergence, curl and Laplacian in curvilinear coordinates; Special curvilinear coordinates; *(15 Lectures)*

Module 3: Gama Beta and other Special Functions covering, the Gama function, values and graph, asymptotic formula for T(n)l The Beta function – Dirichlet integral; Other special functions – Error function, exponential integral, sine and cosine integrals, Bessel's differential equation and function (first and second kind), Legendre differential equation and polynomials; Some applications; *(15 Lectures)*

BS 03: Differential Equations   *3:0:0*
[3]

Differential equations play a major role in understanding many processes and systems that are of interest to the engineers in a generic sense. An in-depth understanding of the ordinary and higher order differential equation as well as partial differential equations are an absolutely essential part of the tool-kit of a well trained engineer. This course fills into this perceived need. The treatment should be informed by the fact that not only conceptual but also (and in some cases) more importantly numerical or computational methods are of essence.

Module 1: Differential equations of higher order, existence and uniqueness of solutions; Some engineering applications (mechanics and electric circuits); Numerical methods for solutions; *(15 Lectures)*

Module 2: General Linear Differential Equation of *order n;* Linear Operators; Fundamental theorem on linear differential equations; Solutions for constant coefficients; The non-operator techniques; The complementary solution of homogeneous equation, the particular solution; Method of reduction of order and inverse operators; Linear equations with variable coefficients; Simultaneous differential equations; Applications; *(15 Lectures)*

Module 3: Definitions; Linear Partial differential equations – some important equations, the heat equation, vibrating string, Laplace equation, longitudinal and transverse vibrations of a beam; Methods of solving boundary value problems; General solution, separation of variables; Laplace transform methods; *(15 Lectures)*

BS 04: Complex Analysis   *2:0:0*
[2]

The objective of this course is to familiarize the students, in some detail, about the analysis on Complex Number field. The central idea of analytic functions and the various series and ransformations will find ready application in many branches of engineering.

Module 1: Complex Numbers covering, Functions Analysis including limits and continuity, derivatives; Cauchy Riemann Equations; Integrals, Cauchy theorem and Cauchy integral formulae; Analytic Functions; Taylor's series, Singular points and poles; Laurent's Series, Residues, Residue Theorem; *(10 Lectures)*

Module 2: Evaluation of definite integrals covering, Conformal mapping, Riemann's mapping theorem; Some general transformations, mapping a half plane into a circle; The Schwarz-Christoffel transformation; The solution of Laplace equation by conformal mapping; *(10 Lectures)*

Module 3: The complex inverse formula covering, the Bromwich contour, the use of Residue theorem in finding Laplace transforms; A sufficient condition for the integral around T to approach zero; The case of infinitely many singularities; Application to boundary value problems; *(10 Lectures)*

BS 05: Optimization and Calculus of Variations   *2:0:0*
[2]

This course deals with the extremely important topics under the broad umbrella of optimization. This is synonymous with efficiency which is the underlying prime rationale for all scientific and technological advances and progress.

Module 1: First and second order conditions for local interior optima (concavity and uniqueness), Sufficient conditions for unique global optima; Constrained optimization with Lagrange multipliers; Sufficient conditions for optima with equality and inequality constraints; Kuhn Tucker conditions, duality; *(10 Lectures)*

Module 2: Linear programming covering, Basic LPP – solution techniques (Simplex, Artificial Basis); Complimentary Slackness Theorem, Fundamental theorem of Duality; Degenerate solutions, Cycling; Applications; Elements of Dynamic Programming including Hamiltonian, Bellman's Optimality Principle; *(10 Lectures)*

Module 3: Calculus of Variations covering, Basic definition, Simplest problem, Isoperimetric problem, Problems with Higher order derivatives, Euler Lagrange Equation, Weierstrass-Erdmann conditions; Pontryagin Maximum Principle; Transversality condition; Applications; *(10 Lectures)*

BS 06: Probability and Statistics   *2:0:0*
[2]

Uncertainty is ubiquitous. It is therefore essential to understand the techniques for handling and modeling it. This course is meant to provide a grounding in Statistics and foundational concepts that can be applied in modelling processes and decision making. These would come in handy for the prospective engineers in most branches.

Module 1: Mathematical Statistics covering, Population, Sample space, Events, Random Variables; Definitions of probability, conditional Probability, expectation and higher order moments, distributions (pdf), examples of (discrete and continuous) Normal, Poisson, Binomial distributions. Characteristic functions (mean and standard deviation); *(10 Lectures)*

Module 2: Regression covering, OLS (single and multivariate cases), Estimators and their properties (unbiased, consistent), Gauss-Markov Theorem; Limitations of OLS- Hetero-sckedasticity, multi-collinearity; Limit theorems and convergence of random variables; *(10 Lectures)*

Module 3: Hypothesis testing covering, Types of Error, Power of a test, Goodness of a fit, Student t and Chi square; Sufficient Statistic and MLEs; Limit theorems and convergence of random variables; Elementary concepts related to stochastic processes; Forecasting and Modeling applications; *(10 Lectures)*

BS 07: Discrete Mathematics   *2:0:0*
[2]

Whereas continuous processes are analytically tractable in an elegant manner, most real life situations present themselves as comprising of discrete variables. It is therefore essential to have knowledge of discrete mathematics in one's tool-kit. This course is meant to deeply familiarize the students with difference equations and their solution techniques. It also deals with concepts and techniques of graph theory, and Lattices apart from applications using optimal control and filters.

Module 1: Difference equations covering, first order, second order and nth order, with integer argument and their solutions; First order, second order, nth order, with continuous variables and their solutions; The state space form & Kalman-Bucy filter, Riccati Matrices (Equations) and applications; *(15 Lectures)*

Module 2: Graph theory covering, concepts and definitions, basic results, trees and cut sets; Definitions and basic results of Lattice theory; Basic Combinatorial analysis; Introduction to Number theory and applications to cryptography' Finite Markov chains; *(15 Lectures)*

BS 08: Fuzzy Mathematics   *2:0:0*
[2]

Most of the mathematics and applications are based on 'hard' concepts from set theory. However in recent times, the idea of *fuzzy mathematics* has taken roots. Some of the advances in the arena have found applications in real-life problems related to design and functioning of systems. The course introduces the students to these developments and familiarizes them with conceptual underpinning and makes them aware of some interesting applications.

Module 1: Definition of a Fuzzy set; Elements of Fuzzy logic. Relations including, Operations, reflexivity, symmetry and transitivity; Pattern Classification based on fuzzy relations; Fuzzy analysis including metric spaces, distances between fuzzy sets, area perimeter, height, width of fuzzy subsets, continuity and integrals; Applications; *(15 Lectures)*

Module 2: Paths and connectedness; Clusters including cluster analysis and modelling information systems, applications; Connectivity in fuzzy graphs, application in database theory; Applications to neural networks; Fuzzy algebra including Fuzzy substructures of algebraic structures, Fuzzy subgroups, pattern recognition and coding theory; *(15 Lectures)*

Note Regarding Text/Reference Books:

Any book on Fundamental Methods of Mathematics for Engineers will work for the first course (Semester I-2credit) and may be chosen as per the taste of the individual teacher and of course local availability. As far as the other courses are concerned, there are umpteen books available (Marsden, Thromba and Weinstein/ Kreszig/ Sean Mauch/ Andrei Polyanin & Alexander Manzhirov (which is a handbook and can serve as a source book)/

Montgomery and Runger (for Statostics)/ John Mordeson & Premchand Nair (for Fuzzy Mathematics). Given that this is a course for Engineers with emphasis on application and computation and problem solving the relevant Book in Schaum Outline Series (especially the one by Murray Spiegel on Advanced Mathematics for Engineers) will do very well. Again the local availability and individual taste could well determine the particular text to be followed by an institution, provided it has the scope and the coverage intended.

(ii) Physics

The aim of courses in *Physics* is to provide an adequate exposure and develop insight about the basic principles of physics along with the possible applications. The acquaintance of basic physics principles would help engineers to understand the tools and techniques used in the industry and provide the necessary foundations for inculcating innovative approaches. This would create awareness about the vital role played by science and engineering in the development of new technologies. The courses would provide the necessary exposure to the practical aspects, which is an essential component for learning science.

BS 09: Applied Physics I *2:0:0*
[2]

Module 1: Optics and Imaging covering, Ray Optics – Lens aberrations (chromatic, achromatic, spherical, distortion, astigmatism, coma), measures of correct aberrations; Interference – coherence (spatial, temporal) in thin films of uniform thickness (derivation); Diffraction Grating – use as a monochromator; Imaging including importance, types of imaging (microscopes, telescopes, cameras etc.); Classification (visible, IR, electron, magnetic, UV/X-rays, gamma rays, microwaves); Comparative study of different types of imaging (with respect to magnification, resolution, image quality, applications); Fiber Optics including Introduction, Optical fiber as a dielectric wave guide- total internal reflection, Numerical aperture and various fiber parameters, losses associated with optical fibers, step index and graded index fibers, application of optical fibers; *(8 Lectures)*

Module 2: Elastic Properties of materials and Waves and Vibrations covering, Relation between elastic constants, internal bending moment, bending of beams- cantilever, torsion of a cylinder, torsional rigidity; Simple harmonic motion – its expression and differential equation, superposition of two linear SHM's (with same frequency), Lissajous' figures; Damped vibration – differential equation and its solution, critical damping, Logarithmic decrement, Analogy with electric circuits; Forced vibration – differential equation, Amplitude and velocity resonance, Sharpness of resonance and Quality factor; *(7 Lectures)*

Module 3: Sound covering, Definitions: Velocity, frequency, wavelength, intensity, loudness (expression), timber, of sound, reflection of sound, echo; Reverberation, reverberation time, Sabine's formula, remedies over reverberation; Absorption of sound, absorbent materials; Conditions for good acoustics of a building; Noise, its effects and remedies; Ultrasonics – Production of ultrasonics by Piezo-electric and magnetostriction; Detection of ultrasonics; Engineering applications of Ultrasonics (Non-destructive testing, cavitation, measurement of gauge); Infrasound – Seismography (concept only); *(7 Lectures)*

Module 4: Measurements and Errors covering Measurand, precision, accuracy, certainty, resolution; Errors - types and sources of errors (definitions and examples), Systematic error, Random error, Ambiguity error, Dynamic error, Drift, Noise; Elements of statistics including precision and variance; Propagation of error with example of Wheatstone bridge; Design of instrument/experiment, Specifications including Measurand, Utility of Measurand,

Environment of instrument; Accomplishment of design including commercial availability of components, detectors, displays, energy sources etc; Estimation and minimization of errors in the design followed by implementation and testing; *(8 Lectures)*

Text/Reference Books:
1. Bottaccini M.R, C.E. Merill, *Instruments and Measurements,* Bell and Howell
2. Eisberg R, R. Resnick, *Quantum Physics of Atoms, Molecules, Solids, Nuclei & Particles*, John Wiley
3. Wehr & Richards, *Physics of the Atom*, Addison, Wesley
4. Subramanium & Brij Lal, *Text book of Sound*
5. Eugene Hecht &A.R.Ganesan (2009), *Optics,* Pearson
6. Francis A.Jenkins, Harvey E.White, *Fundamentals of Optics,* McGraw Hill

BS 10: Applied Physics II   2:0:0
[2]

Module 1: Solid State Physics covering, Free electron theory (qualitative), Fermi energy, Fermi-Dirac distribution function (with derivation), Kronig-Penny model (qualitative) – formation of allowed and forbidden energy bands, Concept of effective mass – electrons and holes, Density of states (qualitative), Electron scattering and resistance, magneto-resistance, Hall effect (with derivation); Semiconductors and insulators –direct & indirect band gaps, Fermi level for intrinsic (derivation) and extrinsic semiconductors (dependence on temperature and doping concentration). Diffusion and drift current (qualitative), Conductivity and photoconductivity, Optical response; Classification of different types of diode on the basis of doping concentration (rectifier diode, Zener diode, tunnel diode); Concept of optoelectronics, Light Emitting Diode (as direct band gap material), solar cell, avalanche and photodiode; *(7 Lectures)*

Module 2: Laser covering, Fundamentals of LASER- Energy levels in atoms, radiation-matter interaction, absorption of light, spontaneous emission of light, Stimulated emission of light – population of energy levels, Einstein A and B coefficients, Metastable state, population inversion, resonant cavity, excitation mechanisms, Lasing action; Properties of laser, characteristics of different types of laser; Types of laser- Solid State Laser: Nd –YAG, Gas Laser – He-Ne, Semiconductor Laser; Applications of Laser in Engineering – drilling, welding, micro machining, measurement of long distances, in CD write devices & printers, in Medicine as a surgical tool, in Nuclear fusion, Holography, Optical signal processing and Remote sensing of the atmosphere; Laser safety *(9 Lectures)*

Module 3: Introductory Quantum Mechanics covering, Concept of de Broglie's Matter waves, derivation of wavelength of matter waves in different forms, Heisenberg's Uncertainty principle, illustration- why an electron cannot exist in the nucleus; Concept of Phase velocity and Group velocity (qualitative); Concept of wave function Ψ and interpretation of $|\Psi|^2$; Schrödinger's Time independent equation, Applications of Schrödinger's equation (qualitative treatment) – a) Particle in one dimensional rigid box, b) Potential Barrier (emphasis on tunneling effect), tunnel diode, scanning-tunneling microscope c) Harmonic Oscillator, d) Hydrogen atom model (qualitative); Selection rules; Elements of linear vector spaces- The idea of n – dimensional vector space, use of 'bra-ket' notation, linear independence, basis, inner product, norm of a vector; Hilbert space, Ortho normality; Matrix representation of kets and linear operators; Pauli matrices; Definitions of Hermitian, Inverse and Unitary operators; Commutators; Tensor products; *(7 Lectures)*

Module 4: Thermal Physics covering, Concept of Heat: Lattice vibrations – Einstein (individual) and Debye (collective), Boltzmann's distribution; Definition of temperature in terms of Boltzmann's distribution; Concept of entropy, specific heat; Attaining low temperature by variation of parameter X (like pressure, magnetic field etc.) in two steps-isothermal increase of X followed by adiabatic decrease of X. Example: a) Liquifaction of gas with X = Pressure; b) Adiabatic demagnetization; Transfer of heat by conduction, convection and radiation - Conduction in a) solids, b) liquids, c) gases, d) interfaces; Convection - heat and mass transfer; Radiation - Stefan's law (statement and equation); Thermal diffusivity; Applications like, Insulation- Glass Dewar/Thermos flask, Superinsulation Dewar, High temperature furnaces; Heat pipes; Heat sinks and Forced cooling/Radiators; Heat exchangers; Solar water heater; *(7 Lectures)*

Text/Reference Books:

1. Kittel C., *Introduction to Solid State Physics,* Wiley Eastern
2. Laud B.B., Lasers and Non-Linear Optics, New Age Publications
3. Benenti, Casati & Strini (2007), *Principles of Quantum Computation & Information, Vol. I (Basic concepts)*, World Scientific
4. Berman R., *Thermal Conduction in Solids,* Oxford Science Publications
5. Guy K. White, *Experimental Techniques in Low Temperature Physics*, Oxford Science Publications
6. Dobson K., D. Grace& D. Lovett, *Physics*, Collins

BS 11: Applied Physics Laboratory I   0:0:2
[1]

Module 1: Choice of three experiments from, Lens aberration; Comparison of reflectivity from plane glass and AR coated glass at different angles of incidence and different wavelengths of visible, infrared, ultraviolet light; Use of diffraction grating as a wavelength selector; Use of polarized light to detect strain; Resolving Power of circular aperture (for different diameters) *(3 Sessions)*

Module 2: Choice of three experiments from, Experiment on photoconductivity; Measurement of sound pressure level; Determination of velocity of ultrasonic waves using ultrasonic interferometer; Measurement of compressibility of liquid using ultrasonic interferometer; Determination of wavelength using acoustic grating; *(3 Sessions)*

Module 3: Choice of four experiments from, Determination of Planck's constant using photocell; Characteristics of photocell; Estimation of errors in temperature / resistance measurement using Wheatstone bridge; Measurement of white noise in the resistance as a function of temperature and calibration against known thermometer and thus use a resistor as secondary noise thermometer; Temperature dependence of characteristics of semiconductor laser; Laser beam profile – to find beam divergence; *(4 Sessions)*

BS 12: Applied Physics III   2:0:0
[2]

Module1: Electromagnetic Theory and Dielectrics covering, Coulomb's law for distribution of charges, Polarization Gauss's law, Electric current and equation of continuity, Magnetic induction and Lorentz force, Steady current and Biot- Savert law, Ampere's law, Magnetization and magnetic intensity, Faradays law of induction, Generalization of

Ampere's law, Maxwell's equations; Introduction to dielectrics, Concept of Polarization; Dipole and dipole moment, Electric field due to dipole (without derivation); Depolarization field, depolarization factors, Local electric field at an atom, Lorentz field, Lorentz relation; Dielectric constant and polarizability – Clausius-Mossotti equation (with derivation); Types of polarization – electronic, ionic, dipolar, space charge; Temperature and frequency dependence of dielectric constant; *(8 Lectures)*

Module 2: Magnetism and Superconductivity covering, Magnetic field and Magnetization; Magnetic susceptibility, Paramagnetism - Paramagnetism due to partially filled shells, transition elements (3d), rare earths (4f) and actinides, Magnetization and total angular momentum (definition and relationship); Concept of magnetic moment, gyromagnetic ratio, Lande's g-factor, Bohr Magneton, Curie's Law – derivation for 'spin only' system (L = 0), expression for non-zero orbital angular momentum system (J = L + S); Ferromagnetism, antiferromagnetism, and ferrimagnetism; Exchange interaction between magnetic ions; Molecular field, Expression for Curie-Weiss law, concept of θ_P ;Ferromagnetism and Ferrimagnetism – Curie temperature, hysteresis, Hard ferromagnets, permanent magnets – SmCo5, Nd2Fe14B, Sintered Alnico, Sintered Ferrite – 3 etc. – Comparison and applications; Soft ferromagnets –Permalloys, Ferrites etc. – Comparison and applications; Neel temperature, Curie-Weiss law; Magnetic resonance, NMR and MRI, MASER; Superconductivity- Zero resistance, Critical temperature T_c ,Perfect diamagnetism, Meissner effect, Critical field Hc, Type I and Type II superconductors, Cooper pairs and formation of superconducting gap at Fermi level, Electron-Phonon interaction and BCS theory, Isotope effect, Applications – Superconducting magnets, Transmission lines, Josephson effect (DC & AC, qualitative), SQUID; *(7 Lectures)*

Module 3: Physics of Nanomaterials with prerequisites of wave mechanics and introductory quantum mechanics covering, Introduction – Nanoscale; Properties of nanomaterials- Optical (SPR, luminescence, tuning band gap of semiconductor nanoparticles), Electrical (SET), Magnetic, Structural, Mechanical; Brief description of different methods of synthesis of nanomaterials (physical - laser ablation, ball milling; chemical - vapor deposition, sol gel); Reduction of dimensionality, Quantum wells (two dimensional), Quantum wires (one dimensional), Quantum dots (zero dimensional); Density of states and energy spectrum for Zero dimensional solid, One dimensional quantum wire, Two dimensional potential well, Particle in a three dimensional box; Some special nanomaterials like, Aerogels – properties and applications, Carbon nanotubes - properties and applications, Core shell nanoparticles - properties and applications; Applications of nanomaterials: Electronics, Energy, Automobiles, Space, Medical, Textile, Cosmetics; Nanotechnology and Environment; *(7 Lectures)*

Module 4: Quantum Computation and Communication covering, the idea of 'qubit' and examples of single qubit logic gates- Classical bits, Qubit as a two level system; Bloch vector representation of state of qubit; Polarization states of photon and measurements; Pauli gates, Hadamard gate, Phase shift gate, Quantum gates as rotations in Bloch sphere; EPR paradox, concept of entanglement and Bell's inequality- The paradox, joint state of entangled particles; Proof of Bell's inequality; Two-qubit controlled gates; entanglement generation and the Bell basis- Generic two-qubit state, Controlled-NOT gate; Quantum circuit for transforming computational basis to Bell basis; Qualitative discussion on the 'circuit' model of 'quantum computation; An overview of classical cryptography: Vernam cypher; Public key cryptosystem; The 'Rivest-Shamir-Adleman' or 'RSA' protocol; Comments on No-cloning theorem and impossibility of faster-than-light transfer of information; The BB84 protocol in

quantum cryptography- The protocol; its validity on the basis of Heisenberg's uncertainty principle; Quantum Teleportation- Basic idea; measurement using Bell operator, need for classical communication channel; quantum circuit describing teleportation protocol; *(8 Lectures)*

Text/Reference Books:
1. Kittel C., *Introduction to Solid State Physics,* Wiley Eastern
2. Callister W.C. Jr., *Material Science and Engineering: An Introduction, 6th Edn.,* John Wiley & Sons
3. Kulkarni Sulabha K., *Nanotechnology: Principles & Practices,* Capitol Publishing Co.
4. Charles P. Poole, Jr., Frank J. Owens, *Introduction to Nanotechnology,* Wiley Eastern
5. Nielsen M. A., I. L. Chuang, *Quantum Computation & Quantum Information*, Cambridge Univ. Press
6. Harald Ibach, Hans Luth, *Solid State Physics – An Introduction to Theory and Experiment* Narosa Publishing House

BS 13: Applied Physics Laboratory II   *0:0:2 [1]*

Module 1: Choice of ten experiments from, Determination of dielectric constant using ac or dc fields; Experiment on piezoelectricity – detection / determination of expansion on application of electric field; Ferroelectric hysteresis; Holography – Recording and reconstruction of hologram; Spectral analysis of He-Ne discharge tube; Newton's Ring; Measurement of capacitance of different dielectric materials; Hall Effect and determination of Hall coefficient; Determination of energy band gap of semiconductor (diode/thermistor); Characteristics of solar cell at different intensities and determination of maximum workable power; Thermal conductivity of Al and SS (rods) –relative study; Thermal diffusivity of Al and SS (rods); Newton's cooling law for Al rod and Al sheet with same mass; Thermal conductivity of insulator by Lee's disc method; Relative thermal resistance of interface between two Aluminum plates by varying (i) surface roughness (ii) with and without conducting paste; Measurement of Magneto-resistance of semiconductors; *(10 Sessions)*

(iii) Chemistry

The purpose of these courses is to emphasize the relevance of fundamentals and applications of chemical sciences in the field of *engineering*. Thus, the courses have been conceived in such a way that they take into account appropriate combinations of old and new emerging concepts in the chemical sciences area and their current and potential uses in *engineering*. The Courses attempt to address the principles of general chemistry and specific topics relevant to various engineering disciplines, wherein the students can apply this learning in their respective areas of expertise. The modular courses (8 credits, jn all) have been split into two *courses,* the first one giving the concepts in general chemistry followed by laboratory experiments, designed to give hands on experience of various analytical techniques and associated calculations. In the second *course,* the focus is more on the application of the basic concepts with introduction of some advanced concepts in the area of chemical sciences relevant to *engineering*.

BS 14: Chemistry I   *2:0:0 [2]*

Module 1: Water covering, Types of hardness- Units, Determination of hardness by EDTA method, Alkalinity of water and its significance, Numerical problems. Softening methods and Numerical problems based on these methods; Membrane-based processes; Problems with

Boiler feed water and its treatments, Specifications for drinking water (BIS and WHO standards), Chlorination of Water; Sources and quality of drinking water, concept of water drainage systems; Concept of water harvesting, storage and recycling; Nature and uses of sludge obtained on treatment of municipal and industrial effluent water, role of a-forestation for water recycling; Toxicity of water; Sources of water pollutants, water pollution through analytical laboratories in schools, colleges and universities, measures for minimization and recycling of laboratory waste water. *(10 Lectures)*

Module 2: Polymers & Composites covering, Basics of Polymer Chemistry, Molecular weight, Molecular shape, Crystallinity, Glass transition temperature and melting point, Visco-elasticity, Structure-property relationship; Methods of polymerization, Thermoplastics and Thermo-sets, Copolymerization, Elastomers-Structure, Applications, curing techniques; Advanced polymeric materials; Conducting polymers, Liquid crystal properties. Dendrimers and their difference from polymers, degradable polymer materials, solubility of polymeric & dendrimeric molecules, physicochemical properties of polymers; Fabrication of polymers-Compression/Injection/Extrusion moulding. Synthesis, Properties and Uses of PE, PVC, PMMA, Formaldehyde resins; Melamine-formaldehyde-urea resins, adhesives and their adhesive mechanism; Composites- Basics of composites, Composition and Characteristic properties of composites; Types of Composites- Particle, Fibre, Reinforced, Structural, & their applications; Metallic and non-metallic fillers, molecular and oligomerization mechanism, nano-composites. *(10 Lectures)*

Module 3:Surfactants and Lubricants covering, Surface active agents- Methods of preparation of soap, Cleaning mechanism, Types and advantages of detergents; Critical miceller concentration, hydrophilic and hydrophilic interactions. Fricoohestiy of surfactant solutions, HLB values; Lubricants- Concept of tribology; Types of lubricants and Mechanism of lubrication, Physical and Chemical properties of lubricants, Additives of lubricants, Selection of lubricants, freezing points of lubricants. *(6 Lectures)*

Module 4: Biotechnology covering, Significance and application of Biotechnology, Bio-reactors, Biotechnological processes; Fermentation, Production of Alcohol, Production of Vitamins; Industrial enzymes, Bio-fuels, Biosensors, Bio-fertilizers, Bio-surfactants; Applications of Biochips; Intra-molecular multiple force theory (IMMFT) of Bio-surfactants. *(6 Lectures)*

Module 5: Green Chemistry covering, Introduction, Significance and latest research in this field; Various Industrial applications of green chemistry; Green technology- Latest green laboratory technology for saving experimental resources and infrastructural framework; R4M4 (Reduce, Reuse, Recycle, Redesign; Multipurpose, Multidimensional, Multitasking, Multi-tracking;) model with special reference of survismeter, econoburette; Safer Technique for Sustainable Sodium Extract Preparation for Extra Elements Detection; Concept of molecular and atomic economy & its use in green chemistry; Life cycle analysis technique (cradle to grave approach) *(6 Lectures)*

Module 6: Instrumental Techniques covering, Fundamentals of Spectroscopy; Principles and applications of UV-visible, IR & Atomic absorption Spectroscopy; Flame photometry; Principles and applications of chromatographic techniques including Gas, Column, HPLC. NMR & DSC working.*(7 Lectures)*

Text/Reference Books:

1. Shashi Chawla (2004), *A Text Book of Engineering Chemistry,* Dhanpat Rai Publishing Co.

2. S.S.Dara (2006), *Engineering Chemistry,* Chand & Co.

3. Jain and Jain (2006), *Engineering Chemistry,* Dhanpat Rai Publishing Co.

4. *Journal Biochem. Biophys. Methods,* Vol. 67(2-3), 2006, pp.151-61

5. *International Journal of Environmental Analytical Chemistry,* Vol. 91 (3), 2011, pp. 272 – 279

6. *Chemical Education Journal,* Vol. 13, No. 2, 2009, Reg. No. 13-12, 28,

BS 15: Chemistry Laboratory I *0:0:2* *[1]*

Module 1: Choice of ten experiments from, Total Hardness of Water; Determination of carbonate and non carbonate hardness of water sample; Determination of Alkalinity of water sample; Chloride Content in Water; Residual Chlorine in Tap water; Method of removal of hardness of water using ion exchange column; Saponification Value of an Oil; Acid value of an Oil; Viscosity Index and surface tension determination together; Flash Point by Abel's Apparatus; Flash Point by Pensky-Marten's Apparatus; Determination of Viscosity of polymer solution using survismeter; Demonstration of TLC / Paper chromatograph. (*10 Sessions)*

Module 2: Experiments to be demonstrated: Green Tech titration for experimental resource saving in analytical lab using econoburette, semi micro technique based measurement; Determination of water binding capacity of few toxic metal salts, dyes and carcinogenic compounds like pyridine and benzene using survismeter; Determination of friccohesity of oil samples with Survismeter; Comparative water binding capacity of Bovine serum albumin protein, NaCl salt and glucose as carbohydrate molecules with survismeter protein denoturation – precipitation; Friccohesity determination of band locations of glycine, α-alanine and β-alanine in aqueous mixture; Green Tech method of viscosity & surface tension measurements together with survismeter; Determination of viscosity and surface tension together of polymer solution using survismeter; Determination of wetting coefficient and contact angle measurement of soap and detergent using survismeter; Viscosity average molecular weight and shape determination using survismeter; Determination of mutual mixing & emulsion quality of oil and water liquid-liquid-interfaces (LLI) with survismeter; Potentionmetric Titration/Redox potential

BS 16: Chemistry II *3:0:0* *[3]*

Module 1: Electrochemistry covering, Conductance, Cell constant and its determination; Single electrode potentials, Electrolytic and Galvanic cells, EMF series, Nernst equation, Cell emf measurement, Reversible and irreversible cells; Thermodynamic overview of electrochemical processes. *(6 Lectures)*

Module 2: Corrosion covering, Definition and scope of corrosion, Direct chemical corrosion, Electrochemical corrosion and its mechanisms; Types of electrochemical corrosion, (differential aeration, galvanic, concentration cell); Typical Electrochemical corrosion like Pitting, Inter-granular, Soil, Waterline; Factors affecting corrosion, Protection of corrosion, Applications with few practical problems of corrosion; Permeability of oxygen to patch forming materials, scaling of iron materials. *(8 Lectures)*

Module 3: Energy Sciences covering, Fuels [Conventional] – Types of fuels, Calorific value, Determination of Calorific value, Numerical problems based on it; Analysis of coal, Refining of Petroleum, Liquid fuels, Fuels for IC engines, Knocking and anti-knock agents, Octane and Cetane values, Cracking of oils; Calorie value of semisolids fuels; Alternative sources of Energy – Limitations of fossil fuels, Non-conventional sources of energy- Solar, Wind, Geo, Hydro power and biomass; Advantages and disadvantages; Nuclear Energy production from nuclear reactions, Nuclear reactor, Nuclear fuel cycles, Nuclear waste disposal; Safety measures of Nuclear reactors; Battery technology – Fundamentals of primary cells, Rechargeable batteries, Ni-Cd, Ni-metal hydride, Li-ion batteries; Fuel cells- principles, applications, advantages/disadvantages; Stable current supply & life of battery. *(10 Lectures)*

Module 4: Nanomaterials covering, Introduction, Fullerenes, Carbon nanotubes, Nanowires; Electronic and mechanical properties; Synthesis of nanomaterials; Topdown & bottom up approach; Applications of nanomaterials–Catalysis, Electronics & Telecommunication, Medicines, Composites, Energy sciences; Fundamentals of nanomaterials. *(6 Lectures)*

Module 5: Environmental Chemistry covering, Air pollution; Noise pollution, optimum decibel levels; Water pollution; Determination and Significance of COD and BOD; TOC Numerical problems; Solid waste treatment and collection of NKP; Green house effect and Global warming; e-Waste and Radioactive pollution; Role of electromagnetic radiation in global warming. *(10 Lectures)*

Module 6: Metals & Alloys covering, Phase Rule, phase rule applications to one and multiple component systems; Iron-Carbon phase equilibrium diagram; Types of Alloys-ferrous and nonferrous alloys, Carbon steel, Alloy steel, Alloys of Cu, Al, Pb. *(5 Lectures)*

Text/Reference Books:

1. Shashi Chawla (2004), *A Text Book of Engineering Chemistry,* Dhanpat Rai Publishing Co.

2. S.S.Dara (2006), *Engineering Chemistry,* Chand & Co.

3. Jain and Jain (2006), *Engineering Chemistry*, Dhanpat Rai Publishing Co.

4. Reed- Hill, *Physical Metallurgy.*

(iv) Biology

Biology is the scientific exploration of the vast and diverse world of living organisms; an exploration that has expanded enormously within the last four decades revealing a wealth of knowledge about ourselves and about the millions of other organisms with whom we share this planet Earth. The study of biology has an immediate relevance to our daily lives. It is important for everyone to develop an informed sense of how we may individually and collectively continue to fit into the complex ecology of our planet without rendering horrendous destruction. Some of the greatest engineering feats of the future are likely to involve bioengineering projects, particularly concerning the disposal of municipal and industrial wastes and the development of renewable resources. The Engineering students by studying Biology - both at elementary and advanced levels will get exposure to the functions and interactions of biological systems from qualitative and quantitative perspective. This syllabus is a part of the quest to help future generation Engineers apply engineering

knowledge for achieving sustainable future. This syllabus is a part of the quest to help future generation engineers apply engineering knowledge for achieving a sustainable future.

BS I7: Elementary Biology   *1:0:2   [2]*

Module 1A: Concepts in Biology covering, Chemical foundations and basic chemistry of cell- Carbon compounds and cell as a unit of life; Physical and chemical principles involved in maintenance of life processes; Scientific methods- Microscopy (principesl and applications); *(3 Lectures)*

Module1B: Cell structure and functions covering, Ultra-structure and functions of cellular components- Prokaryotic and Eukaryotic cells, cell wall, plasma membrane, endoplasmic reticulum; Biomolecules- Carbohydrates, Lipids, Amino Acids, Proteins, Nucleic acids; Tissue systems- Overview of animal and plant tissue systems; *(3 Lectures)*

Module 2A: Metabolisms covering Bio-membranes, diffusion, absorption, osmo-regulation; Photo-synthesis and respiration; *(3 Lectures)*

Module 2B: Chromosomes and Cell Divisions covering, Morphology of chromosomes; Cell theory- Cell cycle and phases; Mitosis and meiosis; *(4 Lectures)*

Module 3A: Genetics covering, Laws of heredity- Biological indicators, bio-censors; Mutations- Cause, types and effects on species; *(3 Lectures)*

Module 3B: Organic Evolution covering, Origin of life- Haldane and Oparins concepts; Modern concept of natural selection and speciation- Lamarkism, Darwinism/Neo-Darwinism;*(4 Lectures)*

Module 4: Plant and Animal Classification covering, Plant classification: Benthem and Hooker's classification with examples of economically important plants; Animal classification- Linnaean hierarchy of animal kingdom; *(3 Lectures)*

Module 5:Laboratory Sessions covering, Laboratory safety and scientific measurements (metric); Structure and function of simple compound microscope; Study of unicellular organisms - gram staining for bacteria, cell structure of *Paramoecium*, *Anaebena* or *Nostoc;* Demonstration &Practical: Study of photosynthesis (using *Hydrilla*) and respiration (with germinating seeds), Cyclosis in Dicotyledonous leaf; Study of Mitosis using Onion or Garlic root-tip; Study of Karyotypes of normal and abnormal human cells, study of syndromes (Down's syndrome, Turner's syndrome); Demonstration/ Instructor's choice- Natural Selection Survivorship using 'forest' as a model; Metabolism- Study of diffusion and osmosis using plant samples; Plant classification- 10 locally available species (with an option of Field Visit to a Botanical Garden); Animal classification using 10 species; *(15 Sessions)*

BS I8: Advanced Biology I   *1:0:2   [2]*

Module 1A: Introduction to Microbiology covering, Microbial diversity: Prokaryotes, Eukaryotes, Archaebactaria; Impact of micro-organisms: Impact on industry, agriculture and health; *(4 Lectures)*

Module 1B: Industrial Microbiology covering, Primary and secondary screening of microorganisms, fermentation processes, bioreactors; Microbial Ecology- Principals of microbial ecology, Microbial bio-remediation; Medical Microbiology: Microbial diseases (air-borne, food-borne, sexually transmitted diseases), epidemiology and public health; *(4 Lectures)*

Module 2A: Animal Physiology covering, Nutrition and digestion; Excretion and circulation; *(3 Lectures)*

Module 2B: Reproductive Biology covering, Reproduction: Asexual and sexual reproduction; Human reproductive system: An overview; Embryonic development, Assisted Reproductive Technology (ART); *(3 Lectures)*

Module 3A: Immunology covering, Human immune mechanism- Types of immunities; Antigen/Antibody reactions- Applications in human health; Immunological disorders: Auto-immune diseases; *(3 Lectures)*

Module 3B: Biochemistry covering, Amino acids & Proteins- Classification based on function and structure; Protein synthesis- Components and regulatory mechanisms; Enzymes- An overview; *(3 Lectures)*

Module 4: Biological Techniques covering, Separation of organelles- Centrifugation; Separation of macromolecules- Chromatography, electrophoresis; Colourimetry;*(3 Lectures)*

Module 5: Laboratory & Field Work Sessions covering, Streak plating, Spread plate and bulk seed of micro-organisms- determination of viable count; Wine making experiment from fruit source; Dissection of digestive system of an animal (cockroach or earthworm); Amylase estimation from different organisms; Institutional visit to Assisted Reproductive Technology (ART) Facility (any Hospital); Total RBC, WBC count and Platelet count/ Determination of Blood Group; Determination of KM value of Amylase and to study effect of temperature and pH on the same; Thin Layer Chromatography to separate plant pigments; Circular Paper Chromatography to separate sugars; Separation of Proteins by Gel Electrophoresis *(15 Sessions)*

BS I9: Advanced Biology II   *1:0:2*
[2]

Module 1A: Plant Physiology covering, Transpiration; Mineral nutrition *(3 Lectures)*

Module 1B: Ecology covering, Ecosystems- Components, types, flow of matter and energy in an ecosystem; Community ecology- Characteristics, frequency, life forms, and biological spectrum; Ecosystem structure- Biotic and a-biotic factors, food chain, food web, ecological pyramids; *(3 Lectures)*

Module 2A: Population Dynamics covering, Population ecology- Population characteristics, ecotypes; Population genetics- Concept of gene pool and genetic diversity in populations, polymorphism and heterogeneity; *(3 Lectures)*

Module 2B: Environmental Management covering, Principles: Perspectives, concerns and management strategies; Policies and legal aspects- Environment Protection Acts and modification, International Treaties; Environmental Impact Assessment- Case studies (International Airport, thermal power plant); *(3 Lectures)*

Module 3A: Molecular Genetics covering, Structures of DNA and RNA; Concept of Gene, Gene regulation, e.g., Operon concept; *(3 Lectures)*

Module 3B: Biotechnology covering, Basic concepts: Totipotency and Cell manipulation; Plant & Animal tissue culture- Methods and uses in agriculture, medicine and health; Recombinant DNA Technology- Techniques and applications; *(3 Lectures)*

Module 4A: Biostatistics covering, Introduction to Biostatistics:-Terms used, types of data; Measures of Central Tendencies- Mean, Median, Mode, Normal and Skewed distributions; Analysis of Data- Hypothesis testing and ANNOVA (single factor) *(4 Lectures)*

Module 5 : Laboratory & Fieldwork Sessions covering, Comparison of stomatal index in different plants; Study of mineral crystals in plants; Determination of diversity indices in plant communities; To construct ecological pyramids of population sizes in an ecosystem; Determination of Importance Value Index of a species in a plant community; Seminar (with PPTs) on EIA of a Mega-Project (e.g., Airport, Thermal/Nuclear Power Plant/ Oil spill scenario); Preparation and extraction of genomic DNA and determination of yield by UV absorbance; Isolation of Plasmid DNA and its separation by Gel Electrophoresis; Data analysis using Bio-statistical tools; *(15 Sessions)*

(c) ENGINEERING SCIENCES

ES 01: Engineering Graphics *2:2:0*
[3]

The objective of this Course is to provide the basic knowledge about Engineering Drawing. Detailed concepts are given in projections, technical drawing, dimensioning and specifications, so useful for a student in preparing for an *engineering career.*

Module 1: Introduction to Engineering Drawing covering, Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales – Plain, Diagonal and Vernier Scales;

Module 2: Orthographic Projections covering, Principles of Orthographic Projections-Conventions - Projections of Points and lines inclined to both planes; Projections of planes inclined Planes - Auxiliary Planes;

Module 3: Projections of Regular Solids covering, those inclined to both the Planes- Auxiliary Views;

Module 4:Sections and Sectional Views of Right Angular Solids covering, Prism, Cylinder, Pyramid, Cone – Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone;

Module 5: Isometric Projections covering, Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions;

Text/Reference Books:
1. Bhat, N.D.& M. Panchal (2008), *Engineering Drawing,* Charotar Publishing House

2. Shah, M.B. & B.C. Rana (2008), *Engineering Drawing and Computer Graphics,* Pearson *Education*

3. Dhawan, R.K. (2007), *A Text Book of Engineering Drawing,* S. Chand Publications

4. Narayana, K.L. & P Kannaiah (2008), *Text book on Engineering Drawing,* Scitech Publishers

ES 02: Engineering Workshop *0:0:6*
[3]

The objective of this practical Course is to provide the basic concepts about tools used in an Engineering Workshop. Detailed concepts are proposed in all the major trades of current interest. It is expected that at least 6 experiments need to be conducted from each of the Modules, as listed below.

Module 1: Mechanical Engineering covering, the following trades for experiments (with a minimum of two exercises under each trade) - Carpentry, Fitting, Tin-Smithy and

Development of jobs carried out and soldering, Black Smithy, House Wiring, Foundry (Moulding only), Plumbing; *(6 Sessions)*

Module 2: Mechanical Engineering covering, the following   trades for demonstration for exposure - Power tools in Construction, Wood working, Electrical and Mechanical Engineering practices; *(2 Sessions)*

Module 3: Information Technology covering, Hardware Experiments- Task 1**:** Identify the peripherals of a computer, components in a CPU and its functions. Draw the block diagram of the CPU along with the configuration of each peripheral; Task 2**:** Disassemble and assemble the PC back to working condition; Task 3**:** Install MS windows and Linux on the personal computer and configure to dual boot the system; Task 4**:** Troubleshooting**:** Students to be given a PC which does not boot due to improper assembly or defective peripherals and system software problems. To identify the problem and fix it to get the PC back to working condition; Software Experiments- Task 5: Students to get connected to their Local Area Network and access the Internet. In the process to configure the TCP/IP setting, access the websites and email; Task 6: Productivity Tools- Use Office Tools Word, Excel for creating Scheduler, Calculating GPA, basic Power Point utilities and tools which help to create basic Power Point Presentation as well as interactive Presentation using Hyperlinks, Inserting – Images, Clip Art, Audio, Video, Objects, Tables and Charts;*(7 Sessions)*

Text/Reference Books:

1. Kannaiah, P. and K.L. Narayana (2009), *Workshop Manual,* Sceitech Publishers

2. Anfinson, David and Ken Quamme (2008), *IT Essentials PC Hardware and Software Companion Guide*, CISCO Press, Pearson Education

3. Venkat Reddy, K (2008), *Workshop Practice Manual*, B.S. Publications

4. Gupta, Vikas (2010), *Comdex Information Technology Course Tool Kit* - WILEY Dreamtech

5. Chris Grover, Mathew MacDonald, E.A., Vander Veer, (2007), *Microsoft Office 2007: The Missing Manual* , O'reilly Media

ES 03: Materials Science   *2:0:0*
[2]

Module 1: Crystal Structure covering, Atomic structure and inter-atomic bonding; Structure of crystalline solids; Lattices, unit cells; Crystal systems, Bravais lattices; Indexing of directions and planes, notations, Inter-planar spacings and angles, co- ordination number, packing factors;

Module 2: Defects in Crystals covering, Point defects; Dislocations, Types of dislocations, Burgers vector and its representation; Planar defects, stacking faults, twins, grain boundaries;

Module 3: Ceramic Materials covering, Introduction, ceramic structures, silicate structures, processing of ceramics; Properties, glasses; Composite Materials**-** Introduction, classification, concrete, metal-matrix and ceramic –matrix composites; Electrical & Electronic Properties of Materials: Electrical Conductivity, Electronic and Ionic Conductivity, Intrinsic and Extrinsic Semi conductivity, Semiconductor Devices, Dielectric Properties, Piezo-electricity;

Module 4: Mechanical Properties of Materials covering, Concepts of stress and strain, Stress-Strain diagrams; Properties obtained from the Tensile test; Elastic deformation,

Plastic deformation. Impact Properties, Strain rate effects and Impact behaviour. Hardness of materials;

Module 5: Magnetic Materials covering, Introduction, Magnetic fields or quantities, types of magnetism, classification of magnetic materials, soft magnetic materials, H magnetic materials, Ferrites, Ferro, Para Magnetic materials; *Nano Materials* covering, Introduction – Nano material preparation, purification, sintering nano particles of Alumina and Zirconia, Silicon carbide, nano-op, nano-magnetic, nano-electronic, and other important nano materials;

Text/Reference Books:
1. Askeland D.R.,& P. P. Fullay (2007), *The Science and Engineering of Materials –4th* Cengage Learning Publishers
2. William D. Callister, Jr (2008), *Callister's Materials Science and Engineering*, (Adopted by R. Balasubramaniam) Wiley-Eastern
3. A.S. Edelstein and R.C. Cammarata Ed.(1998), Nano Materials: *Synthesis, Properties and Applications,* Inst. Of Physics Publishing, UK
4. Raghavan V (2007), *Materials Science and Engineering - A First Course*, Prentice Hall, India
5. James F. Shackelford (1996), *Introduction to Materials Science for Engineers,* Prentice Hall, India

ES 04: Basic Engineering Mechanics   2:2:0
[3]

The objective of this Course is to provide an introductory treatment of *Engineering Mechanics* to all the students of engineering, with a view to prepare a good foundation for taking up advanced courses in the area in the subsequent semesters.

Module 1: Introduction to Engineering Mechanics covering, Basic concepts, System of Forces, Coplanar Concurrent Forces, Components in Space – Resultant- Moment of Forces and its Application; Couples and Resultant of Force System, Equilibrium of System of Forces, Free body diagrams, Equations of Equilibrium of Coplanar Systems and Spatial Systems;

Module 2: Friction covering, Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, wedge friction, screw jack & differential screw jack;

Module 3: Centroid and Centre of Gravity covering, Centroid of simple figures from first principle, centroid of composite sections; Centre of Gravity and its implications; Area moment of inertia- Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections; Mass moment inertia of circular plate, Cylinder, Cone, Sphere, Hook;

Module 4:Introduction to Dynamics covering, Basic terms, general principles in dynamics; Types of motion, Instantaneous centre of rotation in plane motion and simple problems; D'Alembert's principle and its applications in plane motion and connected bodies; Work energy principle and its application in plane motion of connected bodies; Kinetics of rigid body rotation;

Module 5: Mechanical Vibrations covering, Basic terminology, free and forced vibrations, resonance and its effects; Degree of freedom; Derivation for frequency and amplitude of free vibrations without damping and single degree of freedom system, simple problems, types of pendulum, use of simple, compound and torsion pendulums;

Text/Reference Books:

1. Shanes and Rao (2006), *Engineering Mechanics,* Pearson Education,
2. Hibler and Gupta (2010),*Engineering Mechanics (Statics, Dynamics)* by Pearson Education
3. Reddy Vijaykumar K. and K. Suresh Kumar(2010), *Singer's Engineering Mechanics*
4. Bansal R.K.(2010), *A Text Book of Engineering Mechanics,* Laxmi Publications
5. Khurmi R.S. (2010), *Engineering Mechanics,* S. Chand & Co.
6. Tayal A.K. (2010), *Engineering Mechanics,* Umesh Publications

ES 05: Basic Electrical Engineering   *3:0:0*
[3]

The objective of this Course is to provide the students with an introductory and broad treatment of the field of *Electrical Engineering.*

Module 1: D. C. Circuits covering, Ohm's Law and Kirchhoff's Laws; Analysis of series, parallel and series-parallel circuits excited by independent voltage sources; Power and energy; *Electromagnetism* covering, Faradays Laws, Lenz's Law, Fleming's Rules, Statically and dynamically induced EMF; Concepts of self inductance, mutual inductance and coefficient of coupling; Energy stored in magnetic fields;

Module 2: Single Phase A.C. Circuits **covering,** Generation of sinusoidal voltage- definition of average value, root mean square value, form factor and peak factor of sinusoidal voltage and current and phasor representation of alternating quantities; Analysis with phasor diagrams of R, L, C, RL, RC and RLC circuits; Real power, reactive power, apparent power and power factor, series, parallel and series- parallel circuits; *Three Phase A.C. Circuits* covering, Necessity and Advantages of three phase systems, Generation of three phase power, definition of Phase sequence, balanced supply and balanced load; Relationship between line and phase values of balanced star and delta connections; Power in balanced three phase circuits, measurement of power by two wattmeter method;

Module 3: Transformers covering, Principle of operation and construction of single phase transformers (core and shell types). EMF equation, losses, efficiency and voltage regulation; *Synchronous Generators* covering, Principle of operation; Types and constructional features; EMF equation;

Module 4: DC Machines covering, Working principle of DC machine as a generator and a motor; Types and constructional features; EMF equation of generator, relation between EMF induced and terminal voltage enumerating the brush drop and drop due to armature reaction; DC motor working principle; Back EMF and its significance, torque equation; Types of D.C. motors, characteristics and applications; Necessity of a starter for DC motor;

Module 5:Three Phase Induction Motors covering; Concept of rotating magnetic field; Principle of operation, types and constructional features; Slip and its significance; Applications of squirrel cage and slip ring motors; Necessity of a starter, star-delta starter**.**

Module 6: Sources of Electrical Power covering, Introduction to Wind, Solar, Fuel cell, Tidal, Geo-thermal, Hydroelectric, Thermal-steam, diesel, gas, nuclear power plants; Concept of cogeneration, and distributed generation**;**

Text/Reference Books:

1. Nagrath I.J. and D. P. Kothari (2001), *Basic Electrical Engineering,* Tata McGraw Hill
2. Hayt and Kimberly, *Engineering Circuit Analysis*, Tata McGraw Hill
3. Kulshreshtha D.C. (2009), *Basic Electrical Engineering*, Tata McGraw Hill
4. Rajendra Prasad (2009), *Fundamentals of Electrical Engineering*, Prentice Hall, India
5. Hughes, E. 2005), *Electrical Technology* .Pearson

6. Parker Smith (2003), *Problems in Electrical Engineering* , CBS Publishers
7. Van Valkenburg *Network Analysis*, Prentice Hall, India
8. H. Lee Willis (2004)m *Power Distribution Planning Reference Book*, CRC Press

ES 06: Basic Electrical Engineering Laboratory *0:0:2*
[1]

Module 1: Laboratory Sessions covering, General introduction to Electrical Engineering Laboratory, experimental set-ups, instruments etc; Introduction to domestic wiring, service mains, meter board and distribution board; Wiring of two-way and three-way switching of lamp; Use of Fuse and Miniature Circuit breaker; Electric Shocks and precautions against shocks; Basic methods of Earthing; Verification of Kirchhoff's Voltage Law and Kirchhoff's Current Law; Serial and Parallel resonance- Tuning, Resonant frequency, Bandwidth and Q factor determination for RLC network; Measurement of active and reactive power in balanced 3-phase circuit using two-watt meter method; Polarity and Ratio Test for single Phase Transformer; Predetermination of efficiency and regulation by Open Circuit and Short circuit tests on single - phase transformer; Speed control of Induction Motor using rotor resistance; *(15 Sessions)*

Text/Reference Books:

1. Tarnekar, S.G. *A Textbook of Laboratory Course in Electrical Engineering* S Chand Publications
2. Rao S, *Electrical Safety, Fire Safety Engineering,* Khanna Publications
3. H. Lee Willis 2004), *Power Distribution Planning Reference Book ,* CRC Press
4. David A Bell (2000), *Laboratory Manual For Electric Circuits*, Prentice- Hall, India

ES 07: Basic Electronics Engineering *3:0:0*
[3]

The objective of this Course is to provide the students with an introductory and broad treatment of the field of *Electronics Engineering*.

Module1: Diodes and Applications covering, Semiconductor Diode - Ideal versus Practical, Resistance Levels, Diode Equivalent Circuits, Load Line Analysis; Diode as a Switch, Diode as a Rectifier, Half Wave and Full Wave Rectifiers with and without Filters; Breakdown Mechanisms, Zener Diode – Operation and Applications; Opto-Electronic Devices – LEDs, Photo Diode and Applications; Silicon Controlled Rectifier (SCR) – Operation, Construction, Characteristics, Ratings, Applications;

Module 2: Transistor Characteristics covering, Bipolar Junction Transistor (BJT) – Construction, Operation, Amplifying Action, Common Base, Common Emitter and Common Collector Configurations, Operating Point, Voltage Divider Bias Configuration; Field Effect Transistor (FET) – Construction, Characteristics of Junction FET, Depletion and Enhancement type Metal Oxide Semiconductor (MOS) FETs, Introduction to CMOS circuits;

Module 3: Transistor Amplifiers and Oscillators covering, Classification, Small Signal Amplifiers – Basic Features, Common Emitter Amplifier, Coupling and Bypass Capacitors, Distortion, AC Equivalent Circuit; Feedback Amplifiers – Principle, Advantages of Negative Feedback, Topologies, Current Series and Voltage Series Feedback Amplifiers; Oscillators – Classification, RC Phase Shift, Wien Bridge, High Frequency LC and Non-Sinusoidal type Oscillators;

Module 4: Operational Amplifiers and Applications covering, Introduction to Op-Amp, Differential Amplifier Configurations, CMRR, PSRR, Slew Rate; Block Diagram, Pin Configuration of 741 Op-Amp, Characteristics of Ideal OpAmp, Concept of Virtual Ground;

Op-Amp Applications - Inverting, Non-Inverting, Summing and Difference Amplifiers, Voltage Follower, Comparator, Differentiator, Integrator;

Module 5: Timers and Data Converters covering, IC 555 Timer – Block Diagram, Astable and Monostable Multivibrator Configurations; Data Converters – Basic Principle of Analogue–to-Digital (ADC) and Digital-to-Analogue (DAC) Conversion, Flash type, Counter-ramp type and Successive Approximation type ADCs, Resistor Ladder Type DAC, Specifications of ADC and DAC;

Module 6:BasicDigital Electronics covering, Binary Number Systems and Codes; Basic Logic Gates and Truth Tables, Boolean Algebra, De Morgan's Theorems, Logic Circuits, Flip-Flops – SR, JK, D type, Clocked and Master-Slave Configurations; Counters – Asynchronous, Synchronous, Ripple, Non-Binary, BCD Decade types; Shift Registers – Right-Shift, Left-Shift, Serial-In-Serial-Out and Serial-In-Parallel-Out Shift Registers; Applications;

Text/Reference Books:

1. R. L. Boylestad & Louis Nashlesky (2007), *Electronic Devices &Circuit Theory*, Pearson Education

2. Santiram Kal (2002), *Basic Electronics- Devices, Circuits and IT Fundamentals*, Prentice Hall, India

3. David A. Bell (2008), *Electronic Devices and Circuits*, Oxford University Press

4. Thomas L. Floyd and R. P. Jain (2009), *Digital Fundamentals*, Pearson Education

5. R. S. Sedha (2010), *A Text Book of Electronic Devices and Circuits*, S.Chand & Co.

6. R. T. Paynter (2009), *Introductory Electronic Devices & Circuits – Conventional Flow Version,* Pearson Education

ES 08: Basic Electronics Engineering Laboratory   *0:0:2* [1]

Module 1: Laboratory Sessions covering, Identification, Specifications, Testing of R, L, C Components (Colour Codes), Potentiometers, Switches (SPDT, DPDT and DIP), Bread Boards and Printed Circuit Boards (PCBs); Identification, Specifications, Testing of Active Devices – Diodes, BJTs, JFETs, MOSFETs, Power Transistors, SCRs and LEDs;

Module 2: Study and Operation of *Digital Multi Meter, Function / Signal Generator, Regulated Power Supply (RPS), Cathode Ray Oscilloscopes;* Amplitude, Phase and Frequency of Sinusoidal Signals using Lissajous Patterns on CRO; *(CRO);*

Module 3: Experimental Verification of PN Junction Diode Characteristics in A) Forward Bias B) Reverse Bias, Zener Diode Characteristics and Zener Diode as Voltage Regulator, Input and Output Characteristics of BJT in Common Emitter (CE) Configuration, Drain and Transfer Characteristics of JFET in Common Source (CS) Configuration;

*Module 4:*Study of Half Wave and Full Wave Rectification, Regulation with Filters, Gain and Bandwidth of BJT Common Emitter (CE) Amplifier, Gain and Bandwidth of JFET Common Source (CS) Amplifier, Gain and Bandwidth of BJT Current Series and Voltage Series Feedback Amplifiers, Oscillation Frequency of BJT based RC Phase Shift, Hartley and Colpitts Oscillators; *Module 5:* Op-Amp Applications – Adder, Subtractor, Voltage Follower and Comparator; Op-Amp Applications – Differentiator and Integrator*,* Square Wave and Triangular Wave Generation, Applications of 555 Timer – Astable and Monostable Multivibrators;

Module 6: Truth Tables and Functionality of Logic Gates – NOT, OR, AND, NOR, NAND, XOR and XNOR Integrated Circuits (ICs); Truth Tables and Functionality of Flip-Flops – SR, JK and D Flip-Flop ICs; Serial-In-Serial-Out and Serial-In-Parallel-Out Shift operations using 4-bit/8-bit Shift Register ICs; Functionality of Up-Down / Decade Counter ICs; *(15 Sessions)*

Text/Reference Books:

1. David. A. Bell (2003), *Laboratory Manual for Electronic Devices and Circuits*, Prentice Hall, India
2. Thomas L. Floyd and R. P. Jain (2009), *Digital Fundamentals* by Pearson Education,
3. Paul B. Zbar, A.P. Malvino and M.A. Miller (2009), *Basic Electronics – A Text-Lab. Manual,* TMH
4. R. T. Paynter (2009), *Introductory Electronic Devices & Circuits, Conventional Flow Version,* Pearson

ES 09: Computer Programming   *2:0:0*

[2]

Module 1: Introduction covering, Introduction to computer organization; Evolution of Operating Systems; Machine languages, Assembly Languages and High Level Languages; Key Software and Hardware Trends, Procedural & Object Oriented Programming Methodologies; Program Development in C, Structured Programming - Algorithm, Pseudo-code; The C Standard Library, Data types in C, Arithmetic operators, Control Structures – If-else, While, for, do-while, Switch, break and continue statements; Formatted input-output for printing Integers, floating point numbers, characters and strings; Simple C Programming examples;

Module 2: Designing Structured Programs in C covering, Top Down Design and Stepwise refinement; Program Modules in C, Math Library Functions, Function Definition, Prototypes; Header files, Parameter passing in C, Call by Value and Call by Reference; Standard functions, Recursive functions, Preprocessor commands, Example C programs; Scope, Storage classes; *Arrays* covering, Declaring arrays in C, Passing arrays to functions, Array applications, Two – dimensional arrays, Multidimensional arrays, C program examples;

Module 3: Pointers in C covering, Pointer variable declaration and Initialization. Pointer operators, Pointer expressions and Arithmetic, Relationship between pointers and arrays; *Strings* including Concepts, String Conversion functions, C Strings, String Manipulation Functions and String Handling Library;

Module 4: Derived types covering, Structures – Declaration, definition and initialization of structures, accessing structures, structures in functions, self referential structures, unions; *Data Structures* including Introduction to Data Structures, Stacks, Queues, Trees, representation using arrays, Insertion and deletion operations;

Module 5: Dynamic Memory Allocation covering Linked List Implementation, Insertion, Deletion and Searching operations on linear list; *Searching and Sorting* – Sorting- selection sort, bubble sort, insertion sort, quick sort, merge sort, Searching-linear and binary search methods;

Text/Reference Books:
1. Dietel & Dietel (2000), *C – How to Program,* Pearson Education
2. Ellis Horowitz, Sartaj Sahni, Susan Anderson (1993), *Fundamentals of Data Structures in C,* Prentice Hall of India
3. B.W. Kernighan and Dennis M.Ritchie (1988), *The C Programming Language*, Pearson Education
4. J.R. Hanly and E.B. Koffman (2007), *Problem Solving and Program Design in C,* Pearson Education

5. A.M. Tanenbaum, Y. Langsam & M.J. Augenstein(2005),*Data Structures using C,* Pearson Education

ES10: Computer Programming Laboratory   *0:0:4   [2]*

Laboratory Sessions covering the following exercises:

Module l: To write a C program in each case, to find the sum of individual digits of a positive integer, generate the first n terms of the Fibanocci sequence and generate all the prime numbers between 1 and n, where n is a value supplied by the user; to calculate the Sum $=1-x^2/2! +x^4/4!-x^6/6!+x^8/8!-x^{10}/10!$

Module 2: To write C programs that use both recursive and non-recursive functions, To find the factorial of a given integer and To find the GCD (greatest common divisor) of two given integers;
Also, to write a C program, which takes two integer operands and one operator from the user, performs the operation and then prints the result. (Consider the operators +,-,*, /, % and use Switch Statement) and *to write a C program* that uses functions to perform the Addition of Two Matrices and Multiplication of Two Matrices;

Module 3: To write a C program that uses functions to perform the operations: To insert a sub-string in to a given main string from a given position; To delete n Characters from a given position in a given string; *To write a C program* to determine if the given string is a palindrome or not; *Also to write a C program* that displays the position or index in the string S where the string T begins, or – 1 if S doesn't contain T; *To write a C program* to count the lines, words and characters in a given text.

Module 4: To write a C program to generate Pascal's triangle and also to construct a pyramid of numbers; *Also to write a C program* that uses functions to perform the following operations on singly linked list: Creation, Insertion, Deletion,Traversal;

Module 5: To write C programs that implements stack (its operations) using Arrays, Pointers and
that implements Queue (its operations) using Arrays, Pointers;

Module 6: To write a C program that implements the following sorting methods to sort a given list of integers in ascending order using - Bubble sort, Selection sort;*Also, to write C programs* that use both recursive and non-recursive functions to perform the following searching operations for a Key value in a given list of integers- Linear search, Binary search;

Module 7: To write a C program that implements the following sorting method to sort a given list of integers in ascending order- *Quick sort*;*Also to write a C program* that implements the following sorting method to sort a given list of integers in ascending order- *Merge sort;*

Text/Reference Books:
1. Dietel & Dietel (2000), *C – How to Program*, Pearson Education
2. R. J. Dromey (1991), *How to solve it by Computer,* Prentice-Hall, India.
3. B.W. Kernighan and Dennis M.Ritchie (1988),*The C Programming Language*, Pearson Education
4. J.R. Hanly and E.B. Koffman(2007), *Problem Solving and Program Design in C*, Pearson Education

ES 11: Basic Simulation Laboratory   *0:0:2   [1]*

(Simulation Lab. Experiments may be carried out using MATLAB)

Module 1 : Creating a One-Dimensional Array (Row / Column Vector) Exercise – Creating a vector of even whole numbers between 31 and 75; Creating a Two-Dimensional Array (Matrix of given size) and (A). Performing Arithmetic Operations - Addition, Subtraction, Multiplication and Exponentiation. (B). Obtaining Modified Matrix - Inverse, Transpose, with Appended and Deleted Elements;

Module 2: Performing Matrix Manipulations - Concatenating, Indexing, Sorting, Shifting, Reshaping, Resizing and Flipping about a Vertical Axis / Horizontal Axis; Creating Arrays X & Y of given size (1 x N) and Performing
      (A). Relational Operations   -   >, <, ==, <=, >=, ~=
      (B). Logical Operations   -   ~, &, |, XOR

Module 3: Generating a set of Commands on a given Vector (Example: X = [1 8 3 9 0 1]) to
(A). Add up the values of the elements (Check with **sum**)
(B). Compute the Running Sum (Check with **sum**), where Running Sum for element j = the sum of the elements from 1 to j, inclusive.
(C). Compute the Sine of the given X-values (should be a vector).
 Also, Generating a Random Sequence using **rand() / randn()** functions and plotting them.

Module4: Evaluating a given expression and rounding it to the nearest integer value using Round, Floor, Ceil and Fix functions; Also, generating and Plots of   (A) Trigonometric Functions - *sin(t), cos(t), tan(t), sec(t), cosec(t) and cot(t)* for a given duration *'t'*. (B). Logarithmic and other Functions – log(A), $\log_{10}$(A), Square root of A, Real n^{th} root of A.

Module 5: Creating a vector X with elements, $X_n = (-1)^{n+1}/(2n-1)$ and Adding up 100 elements of the vector, X; And, plotting the functions, x, x^3, e^x and $exp(x^2)$ over the interval *0 < x < 4* (by choosing appropriate mesh values for x to obtain smooth curves), on (A). A Rectangular Plot
(B). A Semi log Plot (C). A log-log Plot

Module 6: Generating a Sinusoidal Signal of a given frequency (say, 100Hz) and Plotting with Graphical Enhancements - Titling, Labelling, Adding Text, Adding Legends, Adding New Plots to Existing Plot, Printing Text in Greek Letters, Plotting as Multiple and Sub-Plots; *Also,* Making Non-Choppy and Smooth Plot of the functions,
        f(x) = sin(1/x) for *0.01 < x < 0.1* and *g(x) = (sin x) / x.*

Module 7: Creating A Structure, An Array of Structures and Writing Commands to Access Elements of the created Structure and Array of Structures; *Also,* Solving First Order Ordinary Differential Equation using Built-in Functions; *And,* Creating an M x N Array of Random Numbers using **rand** and setting any value that is < 0.2 to '0' and any value that is ≥ 0.2 to '1' by moving through the Array, Element by Element;

Module 8: Generating normal and integer random numbers (1-D & 2-D) and plotting them;*Also,* Writing a Script (which keeps running until no number is provided to convert) that asks for Temperature in degrees Fahrenheit and Computes the Equivalent Temperature in degrees Celsius. [Hint: Function **is empty** is useful]

Module 9: Writing brief Scripts starting each Script with a request for input (using **input**) to Evaluate the function h(T) using if-else statement, where

$$h(T) \quad = \quad (T - 10) \qquad \text{for} \qquad 0 < T < 100$$
$$= \quad (0.45\, T + 900) \qquad \text{for} \qquad T > 100.$$

Exercise : Testing the Scripts written using A). T = 5, h = -5 and B). T = 110, h = 949.5

Also, Creating a Graphical User Interface (GUI); And, Curve Fitting using (A) Straight line Fit (B). Least Squares Fit

Module 10: Interpolation based on following Schemes (A). Linear (B). Cubic (C). Spline
Also, Generating the first Ten Fibonacci numbers according to the relation $F_n = F_{n-1} + F_{n-2}$ with $F_0 = F_1 = 1$, and Computing the ratio F_n / F_{n-1} for the first 50 Fibonacci numbers.
[Exercise: Verifying that the computed ratio approaches the value of the golden mean $(1 + sqrt(5)) / 2$]; *Also* Generating Equivalent Square Wave from a Sine Wave of given Amplitude and Frequency; And,. Obtaining the Covariance & Correlation Coefficient Matrices for a given Data Matrix.

Text Books:

1. *Getting Started with MATLAB - A Quick introduction for Scientists & Engineers* by Rudra Pratap, Oxford Univ. Press, 5th edition, 2010.
1. *MATLAB An Introduction with Applications* by Amos Gilat, Wiley Student Edition, 2009.
2. *MATLAB Programming for Engineers* by Stephen J. Chapman, Thomson Learning, 2008.

Reference Books:

1. www.mathworks.com/nn8/moler, e-book, 2009.
2. *Introduction to MATLAB 7 for Engineers* by William Palm III, McGraw-Hill, 2nd edition, 2004.
3. *MATLAB and its Applications in Engineering* by Raj Kumar Bansal, Ashok Kumar Goel, Manoj Sharma - Pearson Education,1st edition, 2009.

ES 12: Basic Thermodynamics   *3:0:0*
[3]

Module 1: Introduction- Basic Concepts: System, Control Volume, Surrounding, Boundaries, Universe, Types of Systems, Macroscopic and Microscopic viewpoints, Concept of Continuum, Thermodynamic Equilibrium, State, Property, Process, Exact & Inexact Differentials, Cycle – Reversibility – Quasi – static Process, Irreversible Process, Causes of Irreversibility – Energy in State and in Transition, Types, Displacement & Other forms of Work and Heat, Point and Path functions, Zeroth Law of Thermodynamics – Concept of quality of Temperature – Principles of Thermometry –Reference Points – Constant Volume gas Thermometer – Scales of Temperature, Ideal Gas Scale.

Module2: PMM I – Joule's Experiments – First law of Thermodynamics – Corollaries – First law applied to a Process –applied to a flow system – Steady Flow Energy Equation. Limitations of the First Law – Thermal Reservoir, Heat Engine, Heat pump, Parameters of performance, Second Law of Thermodynamics, Kelvin-Planck and Clausius Statements and their Equivalence / Corollaries, PMM of Second kind, Carnot's principle, Carnot cycle and its specialties, Thermodynamic scale of Temperature, Clausius Inequality, Entropy, Principle of Entropy Increase – Energy Equation, Availability and Irreversibility – Thermodynamic Potentials, Gibbs and Helmholtz Functions, Maxwell Relations –Elementary Treatment of the Third Law of Thermodynamics.

Module3: Pure Substances, p-V-T- surfaces, T-S and h-s diagrams, Mollier Charts, Phase Transformations – Triple point at critical state, properties during change of phase, Dryness Fraction – Clausius Clapeyron Equation, Property tables. Mollier charts – Various Thermodynamic processes and energy Transfer – Steam Calorimetry. Perfect Gas Laws – Equation of State, specific and Universal Gas constants – various Non-flow processes, properties, end states, Heat and Work Transfer, changes in Internal Energy – Throttling and Free Expansion Processes – Flow processes.

Module4: Deviations from perfect Gas Model – Vander Waals Equation of State – Compressibility charts – variable specific Heats – Gas Tables. Mixtures of perfect Gases – Mole Fraction, Mass Fraction, Gravimetric and Volumetric Analysis – Dalton's Law of partial pressures, Avogadro's Laws of additive volumes – Mole fraction , Volume fraction and partial pressure, Equivalent Gas constant and Molecular Internal Energy, Enthalpy, Specific Heats and Entropy of Mixture of Perfect Gases and Vapour, Atmospheric air - Psychometric Properties – Dry Bulb Temperature, Wet Bulb Temperature, Dew point Temperature, Thermodynamic Wet Bulb Temperature, Specific Humidity, Relative Humidity, Saturated Air, Vapour pressure, Degree of saturation – Adiabatic Saturation, Carrier's Equation – Psychrometric chart.

Module5: Power Cycles- Otto, Diesel, Dual Combustion cycles, Sterling Cycle, Atkinson Cycle, Ericsson Cycle, Joule Cycle – Description and representation on P–V and T-S diagram, Thermal Efficiency, Mean Effective Pressures on Air standard basis – comparison of Cycles. Refrigeration Cycles- Brayton and Rankine cycles – Performance Evaluation – combined cycles, Bell-Coleman cycle, Vapour compression cycle-performance Evaluation.

Text Books:
   1. Engineering Thermodynamics / PK Nag /TMHill, 4th Edition, 2008.
   2. Fundamentals of Engineering Thermodynamics , P. Yadav, Central Publishing, Allahabad, 2009.

Reference Books:
   1. Fundamentals of Thermodynamics - Sonntag, Borgnakke and Van Wylen - John Wiley 2010.
   2. Thermodynamics – An Engineering Approach – Yunus Cengel & Boles /TMH, New Delhi 2008.

ES 13: Solid Mechanics and Fluid Mechanics   *3:0:0   [3]*
(A)   Solid Mechanics:

Module1: Simple Stresses and Strains- Elasticity and plasticity – Types of stresses and strains – Hooke's law – stress – strain diagram for mild steel – Working stress – Factor of safety – Lateral strain, Poisson's ratio and volumetric strain – Elastic moduli and the relationship between them – Bars of varying section – composite bars – Temperature stresses. STRAIN ENERGY – Resilience – Gradual, sudden, impact and shock loadings – simple applications.

Module2: Flexural Stresses-Theory of simple bending – Assumptions – Derivation of bending equation: M/I = f/y = E/R - Neutral axis – Determination of bending stresses – Section modulus of rectangular and circular sections (Solid and Hollow), I,T,Angle and Channel sections – Design of simple beam sections.

*Module3:*Shear Stresses- Derivation of formula – Shear stress distribution across various beam sections like rectangular, circular, triangular, I, T angle sections.

(B)   Fluid Mechanics:

Module4: Fluid Properties and Fluid statics- Density, Specific weight, Specific gravity, viscosity, vapour pressure, compressibility, Pressure at a point, Pascal's law, and pressure variation with temperature, density and attitude. Hydrostatic law, Piezometer, Simple and differential manometers, pressure gauges, total pressure and centre of pressure-plane, vertical and inclined surfaces. Buoyancy and stability of floating bodies.

Module5: Fluid kinematics- Stream line, path line and streak lines and stream tube, classification of flows-steady & unsteady, uniform & non uniform, laminar & turbulent, rotational & irrotational flows, one, two and three dimensional flows-Continuity equation in 3D flow, stream function, velocity potential function.

Module6: Fluid dynamics- Surface and body forces –Euler's and Bernoulli's equation derivation, Navier-stokes equation (explanation only) Momentum equation-applications, vortex-Free and Forced. Forced vortex with free surface.

Text Books:
1. Strength of Materials – R.S.Khurmi, S.Chand and Co, Revised edition, 2007.
2. Mechanics of Materials - Ferdinand P.Beer, E.Russel Jhonston Jr., John.T. DEwolf – TMH 2002.
3. Fluid Mechanics - Hydraulics & Hydraulic Machines, Modi & Seth, Standard Publications, New Delhi.
4. Engineering Fluid Mechanics by K. L. Kumar, S.Chand & Co.

Reference Books:
1. Strength of Materials Schaum's out line series, William Nash – Mc Graw Hill, 1999.
2. Mechanics of Materials – Dr. B. C. Punmia, Laxmi Publications.
3. Strength of Materials by R. Subramanian, Oxford University Press, New Delhi.
4. Fluid Mechanics-Fundamentals & Applications , Yunus A. Cengel & John M Cimbala, McGraw Hill,.

ES 14: Solid Mechanics and Fluid Mechanics Laboratory   *0:0:2   [1]*

A. *Strength of Materals   –   List of Experiments*
1. Tension test
2. Bending tests on simply supported beam and Cantilever beam.
3. Torsion test
5. Hardness tests (Brinnel's and Rockwell)
6.Tests on closely coiled and open coiled springs
7. Compression test on wood or concrete
8. Impact test
9. Shear test

Text/Reference Books:
1. Strength of Materials – R S Khurmi, S. Chand and Co.
2. Laboratory Manual Of Testing Materials - William Kendrick Hatt

B. *Fluid Mechanics   –   List of Experiments*
1. Calibration of Venturimeter & Orifice meter
2. Determination: Coefficient of discharge for small orifice/mouthpiece by constant head method.
3. Calibration of contracted Rectangular Notch and / Triangular Notch
4. Determination of friction factor of a pipe.
5. Determination of Coefficient for minor losses.
6. Verification of Bernoulli's equation.

Text/Reference Books:
1. Fluid Mechanics and Hydraulic Machines A Lab Manual - T S Desmukh.

ES 15: Engineering Mechanics   *2:2:0   [3]*

Module 1: Statics –Basics Concepts, Fundamental principles & concepts: Vector algebra, Newton's laws, gravitation, force (external and internal, transmissibility), couple, moment (about point and about axis), Varignon's theorem, resultant of concurrent and non-concurrent coplanar forces, static equilibrium, free body diagram, reactions. Problem formulation concept; 2-D statics, two and three force members, alternate equilibrium equations, constraints and static determinacy; 3-D statics.

Module 2: Analysis of Structures- Trusses: Assumptions, rigid and non-rigid trusses; Simple truss (plane and space), analysis by method of joints. Analysis of simple truss by method of sections; Compound truss (statically determinate, rigid, and completely constrained).Analysis of frames and machines.

Module 3: Friction- Coulomb dry friction laws, simple surface contact problems, friction angles, types of problems, wedges. Sliding friction and rolling resistance.

Module 4: Moment of Inertia- First moment of mass and center of mass, centroids of lines, areas, volumes, composite bodies. Area moments- and products- of inertia, radius of gyration, transfer of axes, composite areas. Rotation of axes, principal area-moments-of-inertia, Mohr's circle. Second momet of mass, Mass moments- and products- of inertia, radius of gyration, transfer of axes, flat plates (relation between area- and mass- moments- and products- of inertia), composite bodies. Rotation of axes, principal mass-moments-of-inertia.

Module 5: Virtual Work and Energy Method- Virtual displacements, principle of virtual work for particle and ideal system of rigid bodies, degrees of freedom. Active force diagram, systems with friction, mechanical efficiency. Conservative forces and potential energy (elastic and gravitational), energy equation for equilibrium. Applications of energy method for equilibrium. Stability of equilibrium.

Module 6: Review of particle dynamics- Rectilinear motion; Plane curvilinear motion (rectangular, path, and polar coordinates). 3-D curvilinear motion; Relative and constrained motion; Newton's 2nd law (rectangular, path, and polar coordinates). Work-kinetic energy, power, potential energy.Impulse-momentum (linear, angular); Impact (Direct and oblique).

*Module 7:*Plane kinematics of rigid bodies- Rotation; Parametric motion. Relative velocity, instantaneous center of rotation. Relative acceleration, rotating reference frames. Rotating reference frames, 3-part velocity and 5-part acceleration relations, Coriolis acceleration. Applications of rotating reference frames.

Module 8: Plane kinetics of rigid bodies- Kinetics of system of particles and derivation of moment equation. Translation. Fixed axis rotation; General planar motion. Work – kinetic energy, potential energy, power; Impulse-momentum. Impact; Combination problems.

Text/Reference Books:

1. Johnston, R.E., Beer, F., Eisenberg, E. R., & Mazurek, D. *Vector Mechanics for Engineers: Statics and Dynamics*: McGraw-Hill.
2. Meriam, J. L., & Kraige, L. G. *Engineering Mechanics: Statics & Engineering Mechanics: Dynamics*: John Wiley & Sons.
3. Hibbeler, R. C. *Egineering mechanics: statics and dynamics*: Prentice Hall.
4. Irving, H., Shames, *Engineering Mechanics - Statics and Dynamics*, Prentice-Hall of India
5. Pytel, A., Kiusalaas, J., & Sharma, I. *Engineering Mechanics: Statics & Engineering Mechanics: Dynamics,* Cengage Learning.
6. Palanichamy, M.S., Nagan, S., *Engineering Mechanics – Statics & Dynamics*, TMH
7. Rajasekaran, S, Sankarasubramanian, G., *Fundamentals of Engineering Mechanics*, Vikas.Publishing
8. McLean, *Engineering Mechancis,* Schaum Series, McGraw Hill.
9. NPTEL courses: *http://nptel.iitm.ac.in/courses.php*, web and video resources on *Engineering Mechanics*.

ES 16: Solid Mechanics   *3:0:2*
[4]

Module 1: Simple Stresses and Strains- Concept of stress and strain, St. Venant's principle, stress and strain diagram, Hooke's law, Young's modulus, Poisson's ratio, stress at a point, stresses and strains in bars subjected to axial loading, Modulus of elasticity, stress produced in compound bars subjected to axial loading.Temperature stress and strain calculations due to applications of axial loads and variation of temperature in single and compound walls.

Module 2: Compound Stresses and Strains- Two dimensional system, stress at a point on a plane, principal stresses and principal planes, Mohr's circle of stress, ellipse of stress and their applications. Two dimensional stress-strain system, principal strains and principal axis of strain, circle of strain and ellipse of strain. Relationship between elastic constants.

Module 3: Bending oment and Shear Force Diagrams- Bending moment (BM) and shear force (SF) diagrams.BM and SF diagrams for cantilevers simply supported and fixed beams with or without overhangs. Calculation of maximum BM and SF and the point of contra flexure under concentrated loads, uniformly distributed loads over the whole span or part of span, combination of concentrated loads (two or three) and uniformly distributed loads, uniformly varying loads, application of moments.

Module 4: Theory of bending stresses- Assumptions in the simple bending theory, derivation of formula: its application to beams of rectangular, circular and channel sections, Composite beams, bending and shear stresses in composite beams.

Module 5: Slope and deflection- Relationship between moment, slope and deflection, Moment area method, Macaulay's method. Use of these methods to calculate slope and deflection for determinant beams.

Module 6: Torsion- Derivation of torsion equation and its assumptions. Applications of the equation of the hollow and solid circular shafts, torsional rigidity., Combined torsion and bending of circular shafts, principal stress and maximum shear stresses under combined loading of bending and torsion. Analysis of close-coiled-helical springs.

Module 7: Thin Cylinders and Spheres- Derivation of formulae and calculations of hoop stress, longitudinal stress in a cylinder, and sphere subjected to internal pressures.

Module 8: Columns and Struts- Columns under uni-axial load, Buckling of Columns, Slenderness ratio and conditions. Derivations of Euler's formula for elastic buckling load, equivalent length. Rankine Gordon's empirical formula.

Text/Reference Books:
1. Pytel A H and Singer F L, *"Strength of Materials",* Harper Collins, New Delhi.
2. Beer P F and Johston (Jr) E R, *"Mechanics of Materials",* SI Version, McGraw Hill, NY.
3. Popov E P, *"Engineering Mechanics of Solids",* SI Version, Prentice Hall, New Delhi.
4. Timoshenko S P and Young D H, *"Elements of Strength of Materials",* East West Press,New Delhi.
5. Shames, I. H., Pitarresi, J. M.,*"Introduction to Solid Mechanics*," Prentice-Hall, NJ.
6. NPTEL courses*, http://nptel.iitm.ac.in/courses.php*, web and video courses on Strength of Materials by Prof. Sharma, S. C., and Prof. Harsha, S. P.

ES 17: Thermodynamics   2:2:0
[3]

Module 1: Basic Concepts- Basic concepts - concept of continuum, macroscopic approach, Thermodynamic systems - closed, open and isolated. Property, state, path and process, quasi-static process, work, modes of work. Zeroth law of thermodynamics, concept of temperature and heat. Concept of ideal and real gases.

Module 2: First Law of Thermodynamics- Concepts of Internal Energy, Specific Heat Capacities, Enthalpy. Energy Balance for Closed and Open Systems, Energy Balance for Steady-Flow Systems. Steady-Flow Engineering Devices. Energy Balance for Unsteady-Flow

Module 3: Second Law of Thermodynamics- Thermal energy reservoirs, heat engines energy conversion, Kelvin's and Clausius statements of second law, the Carnot cycle, the Carnot Theorem, the thermodynamic temperature scale, the Carnot heat engine, efficiency, the Carnot refrigerato and heat pump, COP. Clausius inequality, concept of entropy, principle of increase of entropy – availability, the increase of entropy principle, perpetual-motion machines, reversible and irreversible processes, Entropy change of pure substances, isentropic processes, property diagrams involving entropy, entropy change of liquids and solids, the entropy change of ideal gases, reversible steady-flow work, minimizing the compressor work, isentropic efficiencies of steady-flow devices, and entropy balance.
Energy - a measure of work potential, including work potential of energy, reversible work and irreversibility, second-law efficiency, exergy change of a system, energy transfer by heat, work, and mass, the decrease of exergy principle and exergy destruction, energy balance: closed systems and control volumes energy balance.

Module 4: Properties Of Pure Substance- Properties of pure substances. Thermodynamic properties of pure substances in solid, liquid and vapour phases. Phase rule, P-V, P-T, T-V, T-S, H-S diagrams, PVT surfaces. Thermodynamic properties of steam. Calculations of work done and heat transfer in non- flow and flow processes.

Module 5: Power Cycles- Vapour and combined power cycles, including the Carnot vapor cycle, Rankine cycle: the ideal cycle for vapor power, the ideal reheat and regenerative and the second-law analysis of vapour power cycles. Gas power cycles, including basic considerations in the analysis of power cycles, the Carnot cycle and its value in engineering, , an overview of reciprocating engines, air standard assumptions ,gasoline engine Otto cycle,

diesel engine cycle, gas-turbine Brayton cycle, and the second-law analysis of gas power cycles.

Module 6: Ideal and Real Gases and Thermodynamic Relations- Gas mixtures – properties ideal and real gases. Equation of state, Avogadro's Law, Vander Waal's equation of state, Compressibility factor, compressibility chart. Dalton's law of partial pressure. Exact differentials, T-D relations, Maxwell's relations. Clausius Clapeyron equations, Joule – Thomson coefficient.*Module VII:* Psychrometry Psychrometry and psychrometric charts, property calculations of air vapour mixtures. Psychrometric process – Sensible heat exchange processes. Latent heat exchange processes. Adiabatic mixing, evaporative cooling. Use of standard thermodynamic tables, Mollier diagram, Psychometric chart and Refrigerant property tables. Refrigeration cycles, including refrigerators and heat pumps, the ideal reversed Carnot vapour-compression refrigeration cycle, actual vapor-compression refrigeration cycles, heat pump systems, gas refrigeration cycles, and absorption refrigeration systems.

Text/ Reference Books:
1. Nag.P.K., "Engineering Thermodynamics", Tata McGraw-Hill, New Delhi.
2. Cengel, 'Thermodynamics – An Engineering Approach' Tata McGraw Hill, New Delhi.
3. Sonntag, R. E., Borgnakke, C., & Wylen, G. J. V. *Fundamentals of thermodynamics*: Wiley.
4. Moran, M. J., Shapiro, H. N., Boettner, D. D., & Bailey, M. *Fundamentals of Engineering Thermodynamics*: John Wiley & Sons.
5. Jones, J. B., & Dugan, R. E. *Engineering thermodynamics*: Prentice Hall.
6. Potter, M. C., & Somerton, C. W. *Schaum's Outline of Thermodynamics for Engineers,* McGraw-Hill.

ES 18: Engineering Materials   2:0:0
[2]

Module 1: Basic Crystallography- Crystal structure – BCC, FCC and HCP structure – unt cell – crystallographic planes and directions, miller indices. Crystal imperfections, point, line, planar and volume defects – Grain size, ASTM grain size number. Frank Reed source of dislocation Elastic & plastic modes of deformation, slip & twinning, strain hardening, seasons cracking, Bauschinger's effect, yield point phenomenon, cold/hot working, recovery, re-crystallization, and grain growth, strengthening of metals.

Module 2: Constitution of Alloys and Phase Diagrams- Constitution of alloys – Solid solutions - substitutional and interstitial. Phase diagrams, Isomorphous, eutectic, peritectic, eutectoid and peritectoid reactions. Iron – Iron carbide equilibrium diagram. Classification of steel and cast Iron microstructure, properties and application.

Module 3: Heat Treatment- Definition – Full annealing, stress relief, recrystallisation and spheroidizing – normalising, hardening and tempering of steel. Isothermal transformation diagrams –cooling curves superimposed on I.T. diagram CCR Hardenability, Jominy end quench test –Austempering, martempering.Case hardening, carburising, nitriding, cyaniding, carbonitriding – Flame and Induction hardening.

Module 4: Ferrous and Non Ferrous Metals- Effect of alloying additions on steel (Mn, Si, Cr, Mo, V Ti & W) - stainless and tool steels – HSLA. Gray, White malleable, spheroidal - Graphite - alloy cast-iron. Copper and Copper alloys – Brass, Bronze and Cupronickel. Aluminium and Al-Cu – precipitation strengthening treatment – Bearing alloys.

Module 5: Non-Metallic Materials- Polymers – types of polymer, commodity and engineering polymers – Properties and applications of PE, PP, PS, PVC, PMMA, PET, PC, PA, ABS, PI, PAI, PPO, PPS, PEEK, PTFE Polymers. Urea and Phenol formaldehydes. Engineering Ceramics – Properties and applications of Al2O3, SiC, SiC, Si3, N4, PSZ etc. Fibre and particulate reinforced composites and resin plastics. Powder metallurgy, Manufacturing Process, Compacting, Sintering, Vacuum processing. Properties of Powder processed materials, high energy compaction. Metal matrix composites, preparation propertes and uses.

Module 6: Mechanical Properties and Testing- Mechanism of plastic deformation, slip and twinning. Types of fracture – Testing of materials under tension, compression and shear loads – dness tests (Brinell, Vickers and Rockwell) Impact test, Izod and charpy, fatigue and creep test.

Module 7: Introduction to Science and Technology of Nano materials- Nano structured materials, Low-dimensional structures: Quantum wells, Quantum wires, and Quantum dots, Nano clusters & Nano crystals. Electronic and optical properties of nano crystallites, Metallic and semiconducting super lattices. Synthesis of nanostructured materials, Fabrication and characterization of nano electronic devices and MEMS. Basics of synthesis and characterization of nano-multi-component systems for sensors(magnetic, electronic and optical) and electrodes. Synthesis and fabrication of carbon nano structures for fuel cell and energy storage applications.

Text/ Reference Books:

1. Kenneth G.Budinski and Michael K.Budinski, *Engineering Materials* Prentice-Hall of India
2. William D Callister, Material *Science and Engineering*, John Wiley and Sons.
3. Raghavan.V. *Materials Science and Engineering*, Prentice Hall of India.
4. Lakhtin, Y., & Weinstein, N. *Engineering Physical Metallurgy*: University Press of the Pacific.
5. Avner, S. H. *Introduction to physical metallurgy*: McGraw-Hill.
6. Jacobs, J. A., & Kilduff, T. F. *Engineering materials technology: structures, processing, properties, and selection:* Pearson/Prentice Hall.
7. Bolton, W., Engineering *materials technology*: Butterworth-Heinemann.
8. Flinn, R. A., & Trojan, P. K., Engineering *Materials and Their Applications*: Wiley
9. Koch, C. C. *Nanostructured materials: processing, properties, and applications*: William Andrew Pub.
10. NPTEL courses, *http://www.nptel.iitm.ac.in/courses.php?disciplineId=112:* related web and video resources under *Mechanical Engineering* &*Metallurgy and Material Science* categorie

OE 01: Database Management Systems   *3:0:2*
[4]

Module 1: Introduction - Database Systems versus File Systems, View of Data, Data Models, database languages, Database Users and Administrators. Transaction Management, Decision Support Systems, Components of a Database management System. Distributed Processing and Client- Server Architecture. Entity-Relationship Model – Basic Concepts, Constraints, Keys, Design Issues, E-R Diagrams.

Module 2: Relational Model- Structures of relational databases, Integrity Constraints, Logical database Design, Tables, Views, Data Dictionary. Relational Algebra, Relational Calculus. SQL – Basic Structures, Query Handling, Embedded SQL, Open Database Connectivity (ODBC), Java Database Connectivity (JDBC), Triggers, Security and Authorization. Query By Example (QBE), User Interfaces and Tools, Forms and Graphical User Interfaces. Report Generators. Overview of Relational Query Optimization.

Module 3: Relational Database Design- Functional Dependencies, Multi-valued Dependencies, Normal Forms, Decomposition into Normalized Relations, Physical Database Design – File Structures. Object-Relational Databases – Nested Relations, Complex Data types, Object-Relational Features in SQL:1999.

Module 4: Internet Databases- World Wide Web, Client Side Scripting and Applets, Web Servers and Sessions, Services, Server Side Scripting. XML – Structure of XML Data, XML Document Schema, XQuery, Storage of XML Data, XML Applications.

Module 5: Advanced Topics- Fundamental Concepts of Transaction Management, XConcurrency Control, Recovery Systems, Data Analysis and OLAP. Introduction to Data Mining, Data Farming, Data Warehousing, Spatial and Geographic Databases, Temporal databases a,d Multimedia Databases.

Text Books:
1. Database Systems Concepts – Korth et. Al.
2. An Introduction to Database Design – Date
3. Object-Oriented Database Design – Harrington

Reference Books:
1. Fundamentals of Database Systems – Elmasri and Navathe
2. Database Management and Design – Hansen and Hansen .

OE 02: Software Engineering   *3:0:0   [3]*

Module 1: Introduction- Notion of Software as a Product – characteristics of a good Software Product. Engineering aspects of Software production – necessity of automation. Job responsibilities of Programmers and Software Engineers as Software developers.

Module 2: Process Models and Program Design Techniques- Software Development Process Models – Code & Fix model, Waterfall model, Incremental model, Rapid Prototyping model,

Spiral (Evolutionary) model. Good Program Design Techniques – Structured Programming, Coupling and Cohesion, Abstraction and Information Hiding, Automated Programming, Defensive Programming, Redundant Programming, Aesthetics. Software Modelling Tools – Data flow Diagrams, UML and XML. Jackson System Development.

Module 3: Verification and Validation: Testing of Software Products – Black-Box Testing and White-Box Testing, Static Analysis, Symbolic Execution and Control Flow Graphs – Cyclomatic Complexity. Introduction to testing of Real-time Software Systems.

Module 4: Software Project Management: Management Functions and Processes, Project Planning and Control, Organization and Intra-team Communication, Risk Management. Software Cost Estimation – underlying factors of critical concern. Metrics for estimating costs of software products – Function Points. Techniques for software cost estimation – Expert judgement, Delphi cost estimation, Work break-down structure and Process break-down structure, COCOMO and COCOMO-II.

Module 5: Advanced Topics: Formal Methods in Software Engineering – Z notation, Hoare's notation. Formalization of Functional Specifications – SPEC. Support environment for Development of Software Products. Representative Tools for Editors, Linkers, Interpreters, Code Generators, Debuggers. Tools for Decision Support and Synthesis, Configuration control and Engineering Databases, Project Management. Petrinets. Introduction to Design Patterns, Aspect-oriented Programming.

Text Books:
1. Fundamentals of Software Engineering – Carlo Ghezzi et. al.
2. Software Engineering – Design, Reliability Management – Pressman.

Reference Books:
1. Software Engineering – Ian Sommerville.
2. Software Engineering - Shoeman.
3. Software Engineering with Abstraction – Berzins and Luqi

OE 03: Design and Analysis of Algorithms $\qquad$ *3:0:0*
[3]

Module 1: Introduction- Fundamental characteristics of an algorithm. Basic algorithm analysis –Asymptotic analysis of complexity bounds – best, average and worst-case behaviour, standard notations for expressing algorithmic complexity. Empirical measurements of performance, time and space trade-offs in algorithms. Using recurrence relations to analyze recursive algorithms – illustrations using recursive algorithms.

Module 2: Fundamental Algorithmic Strategies: Brute-Force, Greedy, Branch-and-Bound, Backtracking and Dynamic Programming methodologies as techniques for design of algorithms – Illustrations of these techniques for Problem-Solving. Heuristics – characteristics and their domains of applicability. Design of algorithms for String/ Texmatching problems, Huffman Code and Data compression problems, Subset-sum and Knapsack problems.

Module 3: Graph and Tree Algorithms: Depth- and Breadth- First traversals. Shortest path algorithms, Transitive closure, Minimum Spanning Tree, Topological sort, Network Flow problems.

Module 4: Tractable and Intractable Problems: Computability. The Halting problem. Computability classes – P, NP, NP-complete and NP-hard. Cook's theorem. Standard NP-complete problems Reduction techniques.

Module 5: Advanced Topics: Approximation algorithms, Randomized algorithms, Class of problems beyond NP – PSPACE.

Text Books:
1. Algorithm Design – Jon Kleinberg and Eva Tardos
2. Introduction to Algorithms – T.H. Corman et. al.

Reference Books:
1. Fundamentals of Algorithms – E. Horowitz et al.
2. Combinatorial Optimization: Algorithms and Complexity – C.H. Papadimitriou et al.

OE 04: Disaster Management   *3:0:0   [3]*

Module 1: Introduction *(3 lectures)-* Concepts and definitions: disaster, hazard, vulnerability, risk, capacity, impact, prevention, mitigation).

Module 2: Disasters *(12 lectures)-* Disasters classification; natural disasters (floods, draught, cyclones, volcanoes, earthquakes, tsunami, landslides, coastal erosion, soil erosion, forest fires etc.); manmade disasters (industrial pollution, artificial flooding in urban areas, nuclear radiation, chemical spills etc); hazard and vulnerability profile of India, mountain and coastal areas, ecological fragility.

Module 3: Disaster Impacts *(5 lectures)-* Disaster impacts (environmental, physical, social, ecological, economical, political, etc.); health, psycho-social issues; demographic aspects (gender, age, special needs); hazard locations; global and national disaster trends; climate-change and urban disasters.

Module 4: Disaster Risk Reduction (DRR) *(15 lectures)-* Disaster management cycle – its phases; prevention, mitigation, preparedness, relief and recovery; structural and non-structural measures; risk analysis, vulnerability and capacity assessment; early warning systems, Post-disaster environmental response (water, sanitation, food safety, waste management, disease control); Roles and responsibilities of government, community, local institutions, NGOs and other stakeholders; Policies and legislation for disaster risk reduction, DRR programmes in India and the activities of National Disaster Management Authority.

Module 5: Disasters, Environment and Development *(5 lectures)-* Factors affecting vulnerability such as impact of developmental projects and environmental modifications (including of dams, land-use changes, urbanization etc.), sustainable and environmental-friendly recovery; reconstruction and development methods.

Text/Reference Books:
   1.   http://ndma.gov.in/ (Home page of National Disaster Management Authority).

2. http://www.ndmindia.nic.in/ (National Disaster management in India, Ministry of Home Affairs).
3. Pradeep Sahni, 2004, Disaster Risk Reduction in South Asia, Prentice Hall.
4. Singh B.K., 2008, Handbook of Disaster Management: techniques & Guidelines, Rajat Publication.
5. Ghosh G.K., 2006, Disaster Management ,APH Publishing Corporation.

OE 05: Project Management   3:0:0   [3]

Module 1:   Introduction to Project management**:** Characteristics of projects, Definition and objectives of Project Management, Stages of Project Management, Project Planning Process, Establishing Project organization.

Module 2:   Work definition: Defining work content, Time Estimation Method, Project Cost Estimation and budgeting, Project Risk Management, Project scheduling and Planning Tools: Work Breakdown structure, LRC, Gantt charts, CPM/PERT Networks.

Module 3: Developing Project Plan (Baseline), Project cash flow analysis, Project scheduling with resource constraints: Resource Levelling and Resource Allocation. Time Cost Trade off: Crashing Heuristic.

Module 4:   Project Implementation: Project Monitoring and Control with PERT/Cost, Computers applications in Project Management, Contract Management, Project Procurement Management.

Module 5: Post-Project Analysis.

Text/Reference Books:
1. Shtub, Bard and Globerson, Project Management: Engineering, Technology, and Implementation, Prentice Hall, India
2. Lock, Gower, Project Management Handbook.
3. Cleland and King, VNR Project Management Handbook.
4. Wiest and Levy, Management guide to PERT/CPM, Prentice Hall. Ibdia
5. Horald Kerzner, Project Management: A Systemic Approach to Planning, Scheduling and Controlling, CBS Publishers, 2002.
6. S. Choudhury, Project Scheduling and Monitoring in Practice.
7. P. K. Joy, Total Project Management: The Indian Context, Macmillan India Ltd.

Additional Readings:
1. John M Nicholas, Project Management for Business and Technology: Principles and Practice, Prentice Hall, India, 2002.
2. N. J. Smith (Ed), Project Management, Blackwell Publishing, 2002.
3. Robert K. Wysocki, Robert Back Jr. and David B. Crane, Effective Project Management, John Wiley, 2002.
4. Jack R Meredith and Samuel J Mantel, Project Management: A Managerial Approach, John Wiley, 2000.

OE 06: Engineering Risk – Benefit Analysis   3:0:0   [3]

Module 1: Introduction- Knowledge and Ignorance, Information Uncertainty in Engineering Systems, Introduction and overview of class; definition of Engineering risk; overview of Engineering risk analysis. Risk Methods: Risk Terminology, Risk Assessment, Risk Management and Control, Risk Acceptance, Risk Communication, Identifying and structuring the Engineering risk problem; developing a deterministic or parametric model

Module 2: System Definition and Structure: System Definition Models, Hierarchical Definitions of Systems, System Complexity. Reliability Assessment: Analytical Reliability Assessment, Empirical Reliability Analysis Using Life Data, Reliability Analysis of Systems

Module 3: Consequence Assessment-Types, Cause-Consequence Diagrams, Microeconomic Modelling, Value of Human Life, Flood Damages, Consequence Propagation. Engineering Economics: Time Value of Money, Interest Models, Equivalence

Module 4: Decision Analysis: Risk Aversion, Risk Homeostasis, Influence Diagrams and Decision Trees, Discounting Procedures, Decision Criteria, Tradeoff Analysis, Repair and Maintenance Issues, Maintainability Analysis, Repair Analysis, Warranty Analysis, Insurance Models

Module 5: Data Needs for Risk Studies: Elicitation Methods of Expert Opinions, Guidance

Text Books:
1. Risk Analysis in Engineering and Economics, B. M. Ayyub, Chapman-Hall/CRC Press, 2003.

Reference Books:
1. Probability, Statistics, and Reliability for Engineers and Scientists, Ayyub & McCuen, 2003.
2. Probabilistic Risk Assessment and Management for Engineers and Scientists, by H. Kumamoto and E. J. Henley, Second Edition, IEEE Press, NY, 1996.
3. Bedford, T. and Cooke, R. Probabilistic Risk Analysis: Foundations and Methods. New York: Cambridge University Press, 2001.
4. Normal Accidents, Living with High-Risk Technologies, C. Perrow, Princeton University Press, 1999.
5. Accident Precursor Analysis and Management - Reducing Technological Risk Through Diligence, National Academy of Engineering, the National Academies Press, Washington, DC, 2004.

OE 07: Infrastructure Systems Planning   *3:0:0   [3]*

Module 1:   Infrastructure Systems Planning- An Overview Definitions, Infrastructure management activities, Evolutions of Systems since 1960s (Mainframes-to-Midrange-to-PCs-to-Client-server computing-to-New age systems) and their management, growth of internet, current business demands and IT systems issues, complexity of today's computing environment, Total cost of complexity issues, Value of Systems management for business.

Module 2: Preparing for Infrastructure Systems Planning & Management- Factors to consider in designing IT organizations and IT infrastructure, Determining customer's Requirements, Identifying System Components to manage, Exist Processes, Data, applications, Tools and their integration, Patterns for IT systems management, Introduction to the design process for information systems, Models, Information Technology Infrastructure Library (ITIL).

Module 3: Service Delivery Processes- Service-Level Management, Financial Management & Costing, IT Services Continuity Management, Capacity Management, Availability Management. Service Support Processes,Configuration Management, Service desk. Incident Management,   Problem Management, Change Management, Release Management.

Module 4: Storage and Security Management Introduction Security, Identity management, Single sign-on, Access Management, Basics of network security, LDAP fundamentals, Intrusion detection, Firewall; security information management Introduction to Storage, Backup & Restore, Archive & Retrieve, Space Management, SAN & NAS, Disaster

Recovery, Hierarchical space management, Database & Application protection, Bare machine recovery, Data retention.

Module 5: System thinking method for model-building of infrastructural planning Model observation, Construction of model structure, Simulation analysis, Multi-agent system.

Text/Reference Books:
1. Foundations of IT Service Management: based on ITIL, by Jan Van Bon, Van Haren Publishing, 2005.
2. High Availability: Design, Techniques & Processes, by Floyd Piedad, Michael Hawkins, Prentice Hall, 2000.
3. IT Organization: Building a World class Infrastructure, by Harris Kem, Stuart Gaiup, Guy Nemiro, Prentice Hall, 2000.
4. IT Systems Management: Designing, Implementing, and Managing World-Class Infrastructures Rich Schiesser, Prentice Hall; 2001.

OE 08: Planning for Sustainable Development   *3:0:0   [3]*

Module 1: Sustainable Development-explains and critically evaluates the concept of sustainable development, Environmental degradation and poverty Sustainable development: its main principles, the evolution of ideas about sustainability, strategies for promoting sustainable development, resistances to the concept, and some alternative approaches. Examine some important current issues and areas of debate in relation to sustainable development.

Module 2: Innovation for sustainable development- Environmental management and innovation strategies.

Module 3: Societal transformations. Institutional theory.

Module 4: Governance for sustainable development. Policy responses to environmental degradation.

Module 5: Capacity development for innovation. Research methods.

Text/Reference Books:
1. Harris, J.M. (2204) Basic Principles for Sustainable Development, Global Development and Environment Institute, working paper 00-04. Available at:
http://ase.tufts.edu/gdae/publications/Working_Papers/Sustainable%20Development.PDF
2. Robinson, J. (2004) Squaring the circle? Some thoughts on the idea of sustainable development Ecological Economics 48(4): 369-384.
3. Hjorth, P. and A. Bagheri (2006) Navigating towards Sustainable Development: A System Dynamics Approach, Futures 38: 74-92.
4. Mog, J.M. (2004) 'Struggling with Sustainability – A Comparative Framework for Evaluating Sustainable Development Programs', World Development 32(12): 2139–2160. IISD Commentary on the OECD's Draft Principles for International Investor Participation in Infrastructure (PDF – 68 kb)
5. Arundel, A., R. Kemp, and S. Parto (2004) Indicators for Environmental Innovation: What and How to Measure, forthcoming in International Handbook on Environment and Technology Management (ETM), edited by D. Annandale, J. Phillimore and D. Marinova, Cheltenham,
Edward Elgar.
6. Douthwaite, B. (2002) Enabling Innovation. A practical guide to understanding and fostering innovation, London, Zed Books.

Additional References:
http://www.sustainability.com/developing-value/definitions.asp

The Challenge of Sustainability, Global Environment Facility. Washington, D.C: World Bank, 2002.

OE 09: Managing Innovation and Entrepreneurship   *3:0:0   [3]*

Module 1: Introduction to Entrepreneurship: Evolution of entrepreneurship from economic theory Managerial and entrepreneurial competencies. Entrepreneurial growth and development.

Module 2: Creativity and Innovation: Creativity and Innovation: Concepts Shifting Composition of the Economy Purposeful Innovation & the 7 Sources of Innovative Opportunity The Innovation Process. Innovative Strategies : Strategies that aim at introducing an innovation. Innovation & entrepreneurship: Can they work together? Planning - incompatible with Innovation & entrepreneurship.

Module 3: Entrepreneurial Motivation: Need for continuous learning & relearning Acquiring Technological Innovation Entrepreneurial motivation (nAch story) Achievement Motivation in Real life.. Case Study.

Module 4: International Entrepreneurship: Concepts and Nature of International Entrepreneurship. The changing International environment. Ethics and International Entrepreneurship. Strategic Issues in International Entrepreneurship.

Module 5: Problem Identification and Problem Solving: Problem Identification. Problem solving. Innovation and Diversification.

Text/Reference Books:
1. Martin, M.J., 1994, "Managing Innovation and Entrepreneurship in Technology based Firm", John Wiley.
2. Ettlie, J.E., 2000, "Managing Technology Innovation", John Wiley & Sons.
3. Drucker, P. F. (2000), "The Discipline of Innovation," Harvard Business Review, May, (originally published 1985, May-June, 63(3), 67-72.1
4. Christensen, C. M. and Raynor, M. E. (2003), The Innovator's Solution: Creating and Sustaining Successful Growth, Boston, MA: Harvard Business School Press.
5. Drucker, P. F. (1985), Innovation and Entrepreneurship, New York: Harper.
6. Harvard Business Review on Innovation (Collection of articles), Harvard Business School Press (2001).
6. Harvard Business Review on Entrepreneurship (Collection of articles), Harvard Business School Press (1999)
8. Rogers, E.M. (2003), Diffusion of Innovations, 5th ed., New York: Simon and Schuster.

OE 10: Global Strategy and Technology   *3:0:0*
[3]

Module 1: Introduction to Global Strategy- What the motivations to expand abroad are and how firms can manage conflicting demands in terms of global integration, local responsiveness and worldwide learning. How Global are We? How global most MNCs are? The End of Corporate Capitalism Beyond Off shoring Distance Still Matters Going International.

Module 2: Location and Global Strategy: Home-Country Effects**:** Shifting global leadership in the watch industry Success of Swatch as a company in this industry Potential threat on the horizon that could once again cause the decline of the Swiss watch industry. Distance and Global Strategy: Host Country Choices: The Globalization of CEMEX The benefits that

CEMEX has derived from expanding across borders Challenges that CEMEX is likely to confront in the future How far can Cemex's competitive advantage travel. Industry Characteristics and Global Strategy: Host - country choices: Characteristics of the global large appliances industry Design of an effective competitive strategy Haier's current global strategy Good rationale for Haier to make global expansion its top strategic priority.

Module 3: International Corporate Governance: International Corporate Governance with Chinese Characteristics Corporate governance matters in China's capital market Corporate governance model in China differ from international standards Special problems associated with Petro China's corporate governance model Conditions required for further reforms in Petro China's corporate governance system. Cross-cultural Negotiation: Learn from the MOUSE negotiation Issues/factors affect positively or negatively & the negotiation outcome Issues crucial in aligning different parties interests. Negotiators attitudes and culture in reaching the agreement The role of information acquisition in reaching an agreement in this negotiation. Foreign Market Entry Strategies: Issues around geographic market diversification and different strategies of internationalization Different entry modes into a foreign market Stages of internationalization International operations Tensions of a family-owned enterprise going international.

Module 4: Technology: Productivity and Diffusion: Productivity Impact and Managing Diffusion Science, Technology and Productivity. Technology, Markets and Competition Incumbents and Entrants Commercialization Intellectual Property and Complementary Assets.

Module 5: Investing in R&D Capabilities: Incentives to Innovate Investing in basic/applied research; Real options and other approaches. Applying the Concepts and Frameworks: R&D Investment Decisions: Applying the NPV, Real Options and Scenario-Planning Frameworks.

Text/Reference Books:
1. Sumantra Ghoshal, "Global Strategy: an organizing framework." Strategic Management Journal (1987), pp. 425-440.
2. Ghemawat & Hout (2008) Tomorrow's Global Giants? Not the Usual Suspects, HBR Michael E. Porter, "The Competitive Advantage of Nations" HBR, 1990.
3. Pankaj Ghemawat, "Distance Still Matters: The Hard Reality of Global Expansion" Harvard Business Review Sept. (2001), pp. 137-147.
4. George S. Yip, "Global Strategy in a World of Nations?" Sloan Management Review (Fall 1989), pp. 29-41.
5. Larker and Tayan, "Models of Corporate Governance: Who's the Fairest of them all?" Stanford Business School Case, 2008, CG11.
6. Aguilera, R. V. (2005) "Corporate Governance" In J. Beckert and M. Zafirovski, International Encyclopedia of Economic Sociology. London: Rutledge.
7. Adler, Nancy "Negotiating Globally," in International Dimensions of Organizational Behavior, Cincinnati, OH: South-Western College Publishing, 1997 (3rd edition.), pp. 189-232.
8. Brett, Jeanne M. 2001. "Making decisions and managing conflict in multi-cultural teams," in Negotiating Globally. How to Negotiate Deals, Resolve Disputes, and Make Decisions across Cultural Boundaries. San Francisco: Joseey-Bass, pp. 136-166.
9. Kumar, V. and Subramaniam, V. "A Contingency Framework for the Mode of Entry Decision, "Journal of World Business, 32(1) (Spring 1997), pp. 53-72.
10. Horn, J. T., Lovallo. D. P., and Viguerie, S. P. 2005. "Beating the Odds in Market Entry," The McKinsey Quarterly, 4: 35-45.

OE 11: Knowledge Management   *3:0:0   [3]*

Module 1: Introduction: Definition, evolution, need, drivers, scope, approaches in Organizations, strategies in organizations, components and functions, understanding knowledge; Learning organization: five components of learning organization, knowledge sources, and documentation.

Module 2: Essentials of Knowledge Management; knowledge creation process, knowledge management techniques, systems and tools.

Module 3: Organizational knowledge management; architecture and implementation strategies, building the knowledge corporation and implementing knowledge management in organization.

Module 4: Knowledge management system life cycle, managing knowledge workers, knowledge audit, and knowledge management practices in organizations, few case studies.

Module 5: Futuristic KM: Knowledge Engineering, Theory of Computation, Data Structure.

Text Books:
1. Knowledge Management – a resource book – A Thohothathri Raman, Excel, 2004.
2. Knowledge Management- Elias M. Awad Hasan M. Ghazri, Pearson Education

Reference Books:
1. The KM Toolkit – Orchestrating IT, Strategy & Knowledge Platforms, Amrit Tiwana, Pearson, PHI, II Edn.
2. The Fifth Discipline Field Book – Strategies & Tools For Building A learning Organization – PeterSenge et al. Nicholas Brealey 1994
3. Knowledge Management – Sudhir Warier, Vikas publications
4. Leading with Knowledge, Madanmohan Rao, Tata Mc-Graw Hill.

OE 12: Rural Technology and Community Development   3:0:0
[3]

Module 1: Data Analysis and Measures of Central Tendency- Meaning, nature, scope and limitations of statistics, collection of statistical data, classification, tabulation and diagrammatic representation of data, Measures of central tendency : Statistical averages Mean, Median, Mode.

Module 2: Data, Information and Knowledge; concept of information, need of information (professional, educational, research), qualities of information, value of information, difference between data and information, properties of the needed information. Information and Management; planning, organizing, co-ordinating and controlling,

Module 3: Concepts of marketing; difference between marketing selling and retailing; marketing mix, market-segmentation, marketing planning. Strategy and Approaches; modern concept of marketing.

Module 4: Community development; concept, definition, meaning, need, history, principles, objectives and scope. Community Building: Coming of Age, Regenerating Community, Community Model.

Module 5: Consensus Organizing Model, What's Behind Building Healthy Communities? Participatory Democracy, The Role of various NGOs in Community Development. The Role of Business and Government in Community Development Initiatives How to Form a Non-profit Corporation Fund Raising and Grant Writing.

Text/Reference Books:

1. Biddle, William Wishart. 1968. Encouraging Community Development: A Training Guide for Local Workers. New York: Holt, Rinehart and Winston.
2. Clark, Kenneth B. and Jeannette Hopkins, eds. 1969. A Relevant War Against Poverty: A Study of Community Action Programs and Observable Social Change. New York: Harper and Row.
3. Clinard, Marshall Barron. 1970. Slums and Community Development: Experiments in Self-Help. New York: Free Press.
4. Creevey, Lucy E., ed. 1986. Women Farmers in Africa: Rural Development in Mali and the Sahel. Syracuse, NY: Syracuse University Press.
5. Dobyns, Henry F., Paul L. Doughty, and Harold D. Lasswell, eds. 1971. Peasants, Power, and Applied Social Change: Vicos as a Model. Beverly Hills, CA: Sage.
6. Edwards, Allen David and Dorothy G. Jones. 1976. Community and Community Development. The Hague, Netherlands: Mouton.
7. Green, Tova and Peter Woodrow. 1994. Insight and Action: How to Discover and Support a Life of Integrity and Commitment to Change. Philadelphia, PA: New Society Publishers.
8. Heskin, Allen David. 1991. The Struggle for Community. Boulder, CO: West view Press.
9. Kramer, Ralph M. and Harry Specht. 1975. Readings in Community Organization Practice. 2d ed. Englewood Cliffs, NJ: Prentice-Hall.
10. Lean, Mary. 1995. Bread, Bricks, and Belief: Communities in Charge of Their Future. West Hartford, CT: Kumarian Press.
11. Sustainable Rural Technology, by M.S. Virdi, Daya Publishing House, ISBN: 8170355656
12. Rural Technology, (Paperback, Egnlish), by Punia Rd Roy, Publisher: Satya Prakashan (2009)
13. Rural Education And Technology, by S B Verma S K Jiloka Kannaki Das, Publisher: Deep & Deep Publications Pvt. Ltd. (2006)

OE 13: Artificial Intelligence and Robotics   *3:0:0   [3]*

Module 1: Scope of AI -Games, theorem proving, natural language processing, vision and speech processing, robotics, expert systems, AI techniques- search knowledge, abstraction.

Module 2:. Problem solving - State space search; Production systems, search space control: depth-first, breadth-first search, heuristic search - Hill climbing, best-first search, branch and bound. Problem Reduction, Constraint Satisfaction End, Means-End Analysis

Module 3:. Knowledge Representation- Predicate Logic: Unification, modus pones, resolution, dependency directed backtracking. Rule based Systems : Forward reasoning: conflict resolution, backward reasoning: use of no
backtrack. Structured Knowledge Representation: Semantic Nets: slots, exceptions and default frames, conceptual dependency, scripts.

Module 4: Handling uncertainty and learning- Non-Monotonic Reasoning, Probablistic reasoning, use of certainty factors, fuzzy logic. Concept of learning, learning automation, genetic algorithm, learning by inductions, neural nets.

Module 5: Robotics : Robot Classification, Robot Specification, notation; Direct and Inverse Kinematics: Co-ordinates Frames, Rotations, Homogeneous Coordinates, Arm Equation of four Axis SCARA Robot, TCV, Inverse Kinematics of Four Axis SCARA Robot.

Text Books:
1. E. Rich and K. Knight,"Artificial intelligence", TMH, 2nd ed., 1992.
2. N.J. Nilsson, "Principles of AI", Narosa Publ. House, 2000.
3. Robin R Murphy, Introduction to AI Robotics PHI Publication, 2000

Reference Books:
1. D.W. Patterson, "Introduction to AI and Expert Systems", PHI, 1992.
2. R.J. Schalkoff, "Artificial Intelligence - an Engineering Approach", McGraw Hill Int. Ed., Singapore, 1992.
3. George Lugar, .Al-Structures and Strategies for and Strategies for Complex Problem solving., 4/e, 2002, Pearson Educations.

OE 14: Cloud Computing   *3:0:0   [3]*

Module 1: Introduction- Shift from distributed computing to cloud computing; principles and characteristics of cloud computing- IaaS, PaaS, SaaS; service oriented computing and cloud environment

Module 2: Cloud Computing Technology-Client systems, Networks, server systems and security from services perspectives; Accessing the cloud with platforms and applications; cloud storage

Module 3: Working with Cloud -Infrastructure as a Service – conceptual model and working Platform as a Service – conceptual model and functionalities. Software as a Service – conceptual model and working. Trends in Service provisioning with clouds

Module 4: Using Cloud Services-Cloud collaborative applications and services – case studies with calendars, schedulers and event management; cloud applications in project management.

Module 5: Case studies- Microsoft Azure, Google App Engine and Open source clouds-Open-Nebula and Eucalyptus

Text Books:
1. Anthony T.Velte, Toby J.Velte and Robert E, Cloud Computing – A Practical Approach, TMH 2010
2. Michael Miller, Cloud Computing – Web based Applications, Pearson Publishing, 2011

Reference Books:
1. Resources from Internet /WWW.

OE 15: Digital Communication   *3:0:0   [3]*

Module 1: Pulse Modulation-Sampling process –PAM- other forms of pulse modulation – Bandwidth –Noise trade off –Quantization –PCM- Noise considerations in PCM Systems-TDM- Digital multiplexers-Virtues, Limitation and modification of PCM-Delta modulation – Linear prediction –differential pulse code modulation – Adaptive Delta Modulation

Module 2: Baseband Pulse Transmission- Matched Filter- Error Rate due to noise –Inter-symbol Interference- Nyquist's criterion for Distortion-less Base band Binary Transmission-Correlative level coding –Baseb and M-ary PAM transmission –Adaptive Equalization –Eye patterns

Module 3: Passband Data Transmission-Introduction − Pass band Transmission model-Generation, Detection, Signal space diagram, bit error probability and Power spectra of BPSK, QPSK, FSK and MSK schemes −Differential phase shift keying − Comparison of Digital modulation systems using a single carrier − Carrier and symbol synchronization.

Module 4: Errorr Control Coding- Discrete memory-less channels − Linear block codes - Cyclic codes - Convolutional codes −Maximum likelihood decoding of convolutional codes-Viterbi Algorithm, Trellis coded Modulation, Turbo codes.

Module 5: Spread Spectrum Modulation- Pseudo- noise sequences −a notion of spread spectrum − Direct sequence spread spectrum with coherent binary phase shift keying − Signal space Dimensionality and processing gain − Probability of error − Frequency −hop spread spectrum −Maximum length and Gold codes.

Text Books:
1. Simon Haykins, "Communication Systems" John Wiley, 4th Edition, 2001
2. Taub & Schilling , "Principles of Digital Communication " Tata McGraw-Hill" 28th reprint, 2003

Reference Books:
1.Sam K.Shanmugam "Analog & Digital Communication" John Wiley

OE 16: Digital Signal Processing   3:0:0
[3]

Module 1: Introduction to signals and systems Discrete time signals and systems, Z-transforms, structures for digital filters, design procedures for FIR and IIR filters. Frequency transformations: linear phase design; DFT. Methods for computing FFT. Noise analysis of digital filters, power spectrum estimation. Signals and signal Processing: characterization & classification of signals, typical Signal Processing operations, example of typical Signals, typical Signal Processing applications.

Module 2: Time Domain Representation of Signals & Systems- Discrete Time Signals, Operations on Sequences, the sampling process, Discrete-Time systems, Time-Domain characterization of LTI Discrete-Time systems, state-space representation of LTI Discrete-Time systems, random signals.

Module 3: Transform-Domain Representation of Signals-The Discrete-Time Fourier Transform, Discrete Fourier Transform, DFT properties, computation of the DFT of real sequences, Linear Convolution using the DFT. Z-transforms, Inverse ztransform, properties of z-transform, transform domain representations of random signals. Transform-Domain Representation of LTI Systems: the frequency response, the transfer function, types of transfer function, minimum-phase and maximum-Phase transfer functions, complementary transfer functions, Discrete-Time processing of random signals.

Module 4: Digital Processing of Continuous-Time Signals - sampling of Continuous Signals, Analog Filter Design, Anti-aliasing Filter Design, Sample-and Hold circuits, A/D & D/A converter, Reconstruction Filter Design.

Module 5: Digital Filter Structure and Design- Block Diagram representation, Signal Flow Graph Representation, Equivalent Structures, bone FIR Digital Filter Structures, IIR Filter

Structures, State-space structure, all pass filters, tunable IIR Digital filters. cascaded Lattice realization of IIR and FIR filters, Parallel all pass realization of IIR transfer function, Digital Sine-Cosine generator. Digital Filter Design: Impulse invariance method of IIR filter design, Bilinear Transform method of IIR Filter Design, Design of Digital IIR notch filters, FIR filter Design based on truncated fonner sens, FIR filter design based on Frequency Sampling approach.

Text Books:
1. Proakis J.G., and Manolakis, Introduction to DSP, PHI, 2007
2. Sanjit K. Mitra, "Applications DSP a Computer based approach", TMH, 2006

Reference Books:
1. Allan Y. Oppenhein & Ronald W. Schater , "Applications DSP",.
2. C.Sydney Burrus (Eds), DSP and Digital Filter Design

OE 17: Engineering System Analysis and Design   *3:0:0   [3]*

Module 1:   INTRODUCTION- Systems, Elements of a system, Types of systems, Subsystems, Super systems, Need for system analysis and design, CASE tools for analysis and its limitations.

Module 2:   System Analysis-Methods of system analysis, system development life cycle, structured approach, development tools, data base and networking techniques.

Module 3: System design- Design technologies, Design principles, Design tools and methodologies, feasibility survey, conversion and testing tools, design management and maintenance tools .

Module 4:   Object oriented analysis and design- Introduction, Object modeling, Dynamic modeling, functional modelling, UML diagrams and tools.

Module 5: Case studies- Developing prototypes for systems like, online exam management, Computer gaming and online website management.

Text Books:
1. Perry Edwards, "System analysis and design", McGraw Hill international edition, 1993.
2. Len Fertuck, "System analysis and design with CASE tools", Wm C. Brown Publishers, 1992.

Reference Books:
1. Er. V.K. Jain, "System analysis and design ", Dreamtech Press.
2. Kenneth E.Kendall and Julie E.Kendall, "System analysis and design", Prentice Hall, India, 2007.

OE 18: Engineering System Design Optimization   *3:0:0   [3]*

Module 1: Introduction- Optimization problem formulation, optimization algorithms, applications and examples, different optimization methods available.

Module 2: Single Variable optimization-Optimization criteria, bracketing methods – Exhaustive search method, bound phase method; Region Elimination methods – Fibonacci search method, Golden search method; Gradient based methods – Newton Raphson method, Bisection method; Root finding using optimization technique.

Module 3: Multi objective optimization- Optimization criteria, Different search methods, Unidirectional search, Direct search method – Evolutionary optimization method, Powell's conjugate direction method; Gradient based methods – Newton's method and Variable metric method.

Module 4: Specialized Methods- Integer programming, Geometric programming, simulated annealing, Global optimization using - steep descent method, simulated annealing.

Module 5: Genetic algorithms and evolutionary approaches-Differences and similarities between genetic algorithms and traditional techniques, operators of GA's, Computer program for simulated annealing, Newton Raphson method, Evolutionary optimization method.

Text Books:
1. Kalyanmoy Deb, "Optimization for Engineering design", Prentice Hall, India, 2005.
2. Kalyanmoy Deb, "Multi objective optimization using Evolutionary algorithms", John Wiley, 2001.

Reference Books:
1. Taha, Operations Research, TMH 2010

OE 19: Engineering System Modeling and Simulation *3:0:0* *[3]*

Module 1: Introduction-Systems, System types, System Modeling, Types of system modelling, Classification and comparison of simulation models, attributes of modelling, Comparison of physical and computer experiments, Application areas and Examples

Module 2: Mathematical and Statistical Models- Probability concepts, Queuing Models, Methods for generating random variables and Validation of random numbers.

Module 3: Language-System modelling, programming languages, comparison of languages, Identifying and selection of programming language, feasibility study of programming language for the given application.

Module 4: Experiments-Simulation of different systems, Analysis, validation and verification of input and output simulated data, study of alternate techniques.

Module 5: Case study-Developing simulation model for information centers, inventory systems and analysis of maintenance systems.

Text Books:
1. Geoffrey Gordon, "System Simulation", Second edition, Prentice Hall, India, 2002.
2. Jerry Banks and John S.Carson, Barry L.Nelson, David M.Nicol, "Discrete Event System Simulation", Third edition, Prentice Hall, India, 2002.

Reference Books:
1. Robert E. Shannon, "System Simulation The art and science", , Prentice Hall, New Jersey, 1995.
2. D.S. Hira, "System Simulation", S.Chand and company Ltd, New Delhi, 2001.

OE 20: Game theory with Engineering Applications *3:0:0* *[3]*

Module 1: Introduction-What is Game Theory? Definition of Games. Actions, Strategies, Preferences, Payoffs. Examples. Strategic form games and examples: Prisoner's Dilemma, Bach or Stravinsky, Matching Pennies. Notion of Nash Equilibrium. Examples of Nash Equilibrium. Best Response Functions. Dominated Actions. Symmetric Games and Symmetric Equilibria. Case Studies of Nash Equilibrium in popular games

Module 2: Mixed Strategy Nash Equilibrium- Randomization of Actions, Mixed strategy Nash equilibrium, Dominated actions, Pure strategy equilibria in the presence of randomization, Illustrations: (1) expert diagnosis (2) reporting a crime. Finding all mixed strategy Nash equilibria of some representative games.

Module 3: Extensive games with Perfect Information- Extensive games, Strategies and outcomes, Nash equilibrium, Subgame perfect equilibrium, finding subgame perfect equilibria using backward induction. Allowing for simultaneous moves in extensive games with perfect information. Example of committee decision making. Two Player Zerosum Games: Maxminimization and Nash Equilibrium. Strictly competitive games. Nash equilibrium in strictly competitive games. Minimax theorem. Solution via linear programming. Examples.

Module 4: Bayesian and Repeated Games- Motivational Examples. Definition of a Bayesian Game and Bayesian Nash Equilibrium and examples. Auctions: Independent private values, Nash equilibrium of first price auction and second price auction, common valuations, revenue equivalence of auctions. Idea of repeated games. Finitely repeated prisoner's dilemma, infinitely repeated prisoner's dilemma, strategies in a repeated prisoner's dilemma, Nash equilibria and equilibria payoffs in infinitely repeated prisoner's dilemma, sub-game perfect equilibria and equilibria payoffs in infintely repeated prisoner's dilemma.

Module 5: Coalitional Games- Coaltional games. The Core. Illustrations: (1) Ownership and distribution of wealth (2) exchanging homogeneous items (3) exchanging heterogeneous items (4) voting (5) matching. Shapley value and examples.

Text Books:
1. Martin Osborne. An Introduction to Game Theory. Oxford University Press, 2003.
2. Philip D. Straffin, Jr. Game Theory and Strategy. The Mathematical Association of America, January 1993.

Reference Books:
1. Ken Binmore, Fun and Games : A Text On Game Theory, D. C. Heath & Company, 1992.
2. Y. Narahari. Essentials of Game Theory and Mechanism Design. IISc Press, 2011

OE 21: Supply Chain Management-Planning   *3:0:0   [3]*

Module 1: Introduction to Supply Chain-   Supply chain systems, stages and decision phases and process view of supply chain; supply chain flows; examples of supply chains; competitive supply chain strategies; drivers for supply chain performance.

Module 2: Designing the Supply Chain Network- Distribution Networking – role, design; Supply Chain Network – SCN- Role, factors; framework for design decisions.

Module 3: Facility Location and Network Design- Models for facility location and capacity location; Impact of uncertainty on SCN – discounted cash flow analysis; evaluating network design decisions using decision trees; analytical problems.

Module 4: Planning and Managing Inventories in a Supply Chain- Inventory concepts, trade promotions; managing multi-echelon cycle inventory, safety inventory determination; impact of supply uncertainty aggregation and replenishment.

Module 5: Sourcing, Transportation and Pricing Products-Role of sourcing, supplier- scoring and assessment, selection and contracts, design collaboration; role of transportation, models of transportation and designing transportation network; revenue management.

Text Books:
1. Sunil Chopra and Peter M, Supply Chain Management, Pearson publishing, 2001
2. Blanchard, D. , Supply chain management: Best practices. New Jersey: John Wiley & Sons. 2007

Reference Books:
1. Hugos, M., Essentials of supply chain management. (2nd ed.). New Jersey: John Wiley & Sons, 2006
   2. Kim, B., Supply chain management in the mastering business in As

MC 01: Technical   English   *3:0:0   [3]*

Module 1:   Language Focus- Technical vocabulary, Synonyms and Antonyms, Numerical adjectives, Conjunction and Preposition clauses, Noun and adjective clauses, Abbreviations, Acronyms and homonyms, Phrasal verbs and idioms.

*Module 2:*Language Focus- Relative clauses, Imperative and infinitive structures, Question pattern, Auxiliary verbs (Yes or No questions), Contrasted time structures, Adverbial clauses of time, place and manner, Intensifiers, Basic pattern of sentences.

*Module 3:*Reading- Intensive reading, Predicting content, Interpretation, Inference from text, Inferential information, Implication,   Critical Interpretation, Reading brief notices, advertisements, editorial of news papers.

Module 4: Listening- Listening to lectures, seminars, workshops, News in BBC, CNN TV channels, Writing a brief summary or answering questions on the material listened.

Module 5: Speaking- Pronunciation, stress and intonation, Oral presentation on a topic, Group discussion, Accepting others' views / ideas, Arguing against others' views or ideas, Interrupting others' talk,   Addressing higher officials, colleagues, subordinates, a public gathering, a video conferencing.

Text Books:
1. ------, English for Engineers and Technologists, Volumes 1 and 2, Department of Humanities and Social Sciences, Anna University, Chennai, Orient Longmans Publication, 2008
2. Balasubramanyam, M and Anbalagan, G.,   Perform in English, Anuradha Publications, Kumbakonam, 2010.
3. Meenakshi Raman and Sangeetha Sharma, Technical Communication: Principles and   Practice, Oxford University Press, *New Delhi, 2004.*

Reference Books:
1. Kiranmai Dutt, P. et al. , A Course on Communication Skills, Edition Foundation Books, New Delhi, 2007.
2. Ashraf Rizvi, M., Effective Technical Communication, Tata McGraw Hill Publication, New Delhi, 2008

MC 02: Value Education, Human Rights and Legislative Procedures   *3:0:0 [3]*

Module 1: Values and Self Development-Social values and individual attitudes, Work ethics, Indian vision of humanism, Moral and non moral valuation, Standards and principles, Value judgments. Importance of cultivation of values, Sense of duty, Devotion, Self   reliance, Confidence, Concentration, Truthfulness, Cleanliness, Honesty, Humanity, Power of faith, National unity, Patriotism, Love for nature, Discipline.

Module 2: Personality and Behavior Development- Soul and scientific attitude, God and scientific attitude, Positive thinking, Integrity and discipline, Punctuality, Love and kindness, Avoiding fault finding, Free from anger, Dignity of labor, Universal brotherhood and

religious tolerance, True friendship, Happiness vs. suffering love for truth, Aware of self destructive habits, Association and cooperation, Doing best, Saving nature.

*Module 3:*Character and Competence- Science vs. God, Holy books vs. blind faith, Self management and good health, Science of reincarnation, Equality, Nonviolence, Humility, Role of women, All religions and same message, Mind your mind, Self control, Honesty, Studying effectively.

*Module 4:*Human Rights- Jurisprudence of human rights nature and definition, Universal protection of human rights, Regional protection of human rights, National level protection of human rights, Human rights and vulnerable groups.

Module 5: Legislative Procedures- Indian constitution, Philosophy, fundamental rights and duties, Legislature, Executive and Judiciary, Constitution and function of parliament, Composition of council of states and house of people, Speaker, Passing of bills, Vigilance, Lokpal and functionaries.

Text Books:
1. Chakraborty, S.K., Values and Ethics for Organizations Theory and Practice, Oxford University Press, New Delhi, 2001.
2. Kapoor, S.K., Human rights under International Law and Indian Law, Prentice Hall of India, New Delhi, 2002.
3. Basu, D.D., Indian Constitution, Oxford University Press, New Delhi, 2002.

Reference Books:
1. Frankena, W.K., Ethics, Prentice Hall of India, New Delhi, 1990.
2. Meron Theodor, Human Rights and International Law Legal Policy Issues, Vol. 1 and 2, Oxford University Press, New Delhi, 2000.

MC 03: Environmental Studies   *3:0:0   [3]*

Module 1: Introduction and Natural Resources: Multidisciplinary nature and public awareness, Renewable and nonrenewal resources and associated problems, Forest resources, Water resources, Mineral resources, Food resources, Energy resources, Land resources, Conservation of natural resources and human role.

Module 2: Ecosystems: Concept, Structure and function, Producers composers and decomposers, Energy flow, Ecological succession, Food chains webs and ecological pyramids, Characteristics structures and functions of ecosystems such as Forest, Grassland, Desert, Aquatic ecosystems.

Module 3: Biodiversity and Conservation: Definition, Genetic, Species, and Ecosystem diversity, Bio-geographical classification of India, Value of biodiversity at global, national, local levels, India as a mega diversity nation, Hot sports of biodiversity, Threats to biodiversity, Endangered and endemic species of India, In-situ and ex-situ conservation of biodiversity.

*Module 4:*Environmental Pollution- Definition, Causes, effects and control of air pollution, water pollution, soil pollution, marine pollution, noise pollution, thermal pollution, nuclear hazards, human role in prevention of pollution, Solid waste management, Disaster management, floods, earthquake, cyclone and landslides.

Module 5: Social issues and Environment- Unsustainable to sustainable development, Urban problems related to energy, Water conservation and watershed management, Resettlement and re-habitation, Ethics, Climate change, Global warming, Acid rain, Ozone layer depletion, Nuclear accidents, holocaust, Waste land reclamation, Consumerism and waste products, Environment protection act, Wildlife protection act, Forest conservation act, Environmental issues in legislation, population explosion and family welfare program, Environment and human health, HIV, Women and child welfare, Role of information technology in environment and human health.

Text Books:
1. Agarwal, K.C., *Environmental Biology*, Nidi Publication Ltd**.**, Bikaner, 2001.
2. Bharucha Erach, *Biodiversity of India*, Mapin Publishing Pvt. Ltd., Ahmadabad, 2002.

Reference Books:
1. Clark, R.S., *Marine Pollution*, Clanderson Press, Oxford, 2002.
2. Cunningham, W.P., et al. , *Environmental Encyclopedia*, Jaico Publishing House, Mumbai, 2003.

MC 04: Energy Studies   *3:0:0   [3]*

Module 1: Energy Sources - Fossil fuels, Nuclear fuels, hydel, solar, wind and bio fuels in India, Energy conservation, Nuclear energy through fission and fusion processes.

Module 2: Energy Conversion- Energy conversion from source to utility, Solar, Nuclear, Geothermal, Tide and Wind Energies.

Module 3: Global Energy Scenario- Role of energy in economic development and social transformation, Overall energy demand, availability and consumption, Depletion of energy resources and its impact on economy, Non proliferation of nuclear energy. International energy policies of G-8, G-20, OPEC and European union countries.

Module 4: Indian Energy Scenario- Commercial and noncommercial forms of energy, Utilization pattern in the past, present and also future prediction, Sector wise energy consumption.

Module 5: Energy Policy: Energy policy issues at global level, national level and state level, Energy conservation act 2001, Electricity act 2003, Energy pricing and its impact on global variations.

Text Books:
1. Jose Goldenberg, Thomas Johanson, and Reddy, A.K.N., Energy for Sustainable World, WileyEastern, 2005.
2. Charles E. Brown, World Energy Resources, Springer Publication, New York, 2002.
3. Culp, A.W., Principles of Energy Conversion, McGraw Hill New York, 2004.

Reference Books:
1. Bukhootsow, B., Energy Policy and Planning, Prentice Hall of India, New Delhi, 2003.
2. ---- TEDDY Year Book, The Energy Research Institute (TERI), 2011.
3. ---- International Energy Outlook, EIA Annual Publication, 2011.

MC 05: Technical Communication and Soft Skills   *3:0:0*
[3]

*Module 1:*Information Design and Development- Different kinds of technical documents, Information development life cycle, Organization structures, factors affecting information and document design, Strategies for organization, Information design and writing for print and for online media.

Module 2: Technical Writing, Grammar and Editing- Technical writing process, forms of discourse, Writing drafts and revising, Collaborative writing, creating indexes, technical writing style and language. Basics of grammar, study of advanced grammar, editing strategies to achieve appropriate technical style. Introduction to advanced technical communication, Usability, Hunan factors, Managing technical communication projects, time estimation, Single sourcing, Localization.

Module 3: Self Development and Assessment- Self assessment, Awareness, Perception and Attitudes, Values and belief, Personal goal setting, career planning, Self esteem.

*Module 4:*Communication and Technical Writing- Public speaking, Group discussion, Oral; presentation, Interviews, Graphic presentation, Presentation aids, Personality Development. Writing reports, project proposals, brochures, newsletters, technical articles, manuals, official notes, business letters, memos, progress reports, minutes of meetings, event report.

*Module 5:*Ethics- Business ethics, Etiquettes in social and office settings, Email etiquettes, Telephone Etiquettes, Engineering ethics, Managing time, Role and responsibility of engineer, Work culture in jobs, Personal memory, Rapid reading, Taking notes, Complex problem solving, Creativity.

Text Books:
1. David F. Beer and David McMurrey, Guide to writing as an Engineer, John Willey. New York, 2004
2. Diane Hacker, Pocket Style Manual, Bedford Publication, New York, 2003. (ISBN 0312406843)
3. Shiv Khera, You Can Win, Macmillan Books, New York, 2003.
4. Raman Sharma, Technical Communications, Oxford Publication, London, 2004.

Reference Books:
1. Dale Jungk, Applied Writing for Technicians, McGraw Hill, New York, 2004. (ISBN: 07828357-4)
2. Sharma, R. and Mohan, K. Business Correspondence and Report Writing, TMH New Delhi 2002.
3. Xebec, Presentation Book, TMH New Delhi, 2000. (ISBN 0402213)

MC 06: Foreign Language: French   *3:0:0   [3]*

Module 1: Pronunciation guidelines; Single vowels, Accentuated vowels, Vowels and consonants combinations, Consonants; Numbers 1-10 Articles and Genders; Gender in French, Plural articles, Some usual expressions

Module2: Pronouns and Verbs; The verb groups, The pronouns, Present tense, Some color Adjectives and Plural ; Adjectives, Some adjectives, Our first sentences, More Numbers

Module 3: Sentences Structures; Some Prepositions, Normal Sentences, Negative Sentences, Interrogative Sentences, Exercises The Family; Vocabulary ,Conversation, Notes on Pronunciation, Notes on Vocabulary, Grammar, Liaisons Guideline

Module 4: D'où viens-tu (Where do you come from); Vocabulary, Conversation, Notes on Vocabulary, Liaisons Guidelines . Comparer (Comparing); Vocabulary, Conversation, Notes on Vocabulary, Grammar Liaisons Guidelines, Ordinal Numbers

Module 5: Le temps (Time); [Vocabulary](#), [Grammar](#), [Time on the clock](#) Additional French Vocabulary; Vocabulary related to - The Family, *Vocabulary related to - Where do you come from?*

Module 6: French Expressions and Idioms; [Day-to-day Life, At Work](#), [The car](#), [Sports](#), Specia Events Other French Flavours; Nos cousins d'Amérique - Québec et Accadie, Au pays de la bière et des frites, Mettez-vous à l'heure Suisse, Vé, peuchère, le français bien de chez nous

Reference: http://www.jump-gate.com/languages/french/index.html

CHAPTER VI
MODEL SCHEME OF INSTRUCTION & SYLLABI-
Branch: Computer Science & Engineering *(CS)*

(a) Model Scheme of Instruction for UG Engineering Degree in *CS*
NOTE: Additional Core Courses listed in Chapter II may be considered here in place of those given below;

CS-Semester 1

S. No.	Course Code	Course Title	L	T	P	Contact hrs/wk	Credits
1	HS 01	Sociology & Elements of Indian History for Engineers	3	0	0	3	3
2	HS 02	Economics for Engineers	3	0	0	3	3
3	BS 01	Elementary Mathematics for Engineers	2	0	0	2	2
4	BS 09	Applied Physics I	2	0	0	2	2
5	BS 11	Applied Physics Laboratory I	0	0	2	2	1
	BS 14	Chemistry I	2	0	0	2	2
6	ES 01	Engineering Graphics	2	2	0	4	3
7	ES 02	Engineering Workshop	0	0	6	6	3
8	ES 04	Basic Engineering Mechanics	2	2	0	4	3
		TOTAL	**16**	**4**	**8**	**28**	**22**
9	MC 02	Value Education, Human Rights and Legislative Procedures	3	0	0	3	3

CS-Semester II

S. No.	Course Code	Course Title	L	T	P	Contact hrs/wk	Credits
1	HS 03	Law for Engineers	3	0	0	3	3
2	HS 04	Business Communication & Presentation Skills	2	2	4	8	5
3	BS 03	Differential Equations	3	0	0	3	3
4	BS 10	Applied Physics II	2	0	0	2	2
5	BS 15	Chemistry Laboratory I	0	0	2	2	1
6	ES 05	Basic Electrical Engineering	3	0	0	3	3
7	ES 06	Basic Electrical Engineering Laboratory	0	0	2	2	1
8	ES 09	Computer Programming	2	0	0	2	2
9	ES 10	Computer Programming Laboratory	0	0	4	4	2
		TOTAL	**15**	**2**	**12**	**29**	**22**
10	MC 03	Environmental Studies	3	0	0	3	3

CS-Semester III

S. No.	Course Code	Course Title	L	T	P	Contact hrs/wk	Credits
1	BS 02	Multivariate Analysis, Linear Algebra and Special Functions	3	0	0	3	3
2	BS 07	Discrete Mathematics	2	0	0	2	2
3	ES 03	Materials Science	2	0	0	2	2
4	ES 07	Basic Electronics Engineering	3	0	0	3	3
5	ES 08	Basic Electronics Engineering Laboratory	0	0	2	2	1
6	CS 01	Data Structures & Algorithms	2	2	0	4	3
7	CS 02	Computer Organization & Design	3	2	0	5	4
8	CS 04	Digital Systems	3	0	2	5	4
		TOTAL	**18**	**4**	**4**	**26**	**22**
10	MC 04	Energy Studies	3	0	0	3	3

CS-Semester IV

S. No.	Course Code	Course Title	L	T	P	Contact hrs/wk	Credits
1	BS 04	Complex Algebra	2	0	0	2	2
2	BS 16	Chemistry II	3	0	0	3	3
3	BS 17	Elementary Biology	1	0	2	3	2
4	ES 11	Basic Simulation Laboratory	0	0	2	2	1
5	CS 05	Operating Systems (Unix Programming)	3	2	0	5	4
6	CS 05	Formal Languages & Automation Theory	3	0	0	3	3
7	CS 07	Design & Analysis of Algorithms	3	0	0	3	3
8	CS 08	Computerr Networks	3	2	0	5	4
		TOTAL	**18**	**4**	**4**	**26**	**22**

CS-Semester V

S. No.	Course Code	Course Title	L	T	P	Contact hrs/wk	Credits
1	BS 05	Optimization & Calculus of Variations	2	0	0	2	2
2	BS 18	Advanced Biology I	1	0	2	3	2
3	CS 10	Software Engineering	2	2	0	4	3
4	CS 11	Compiler Design	2	2	0	4	3
5	CS 13	Object Oriented Analysis & Design	2	2	0	4	3
6	CS 15	Graph Theory	3	0	0	3	3
7	CS 16	Artificial Intelligence	2	2	0	4	3
9	CS*	Elective Course to be chosen	2	2	0	4	3
		TOTAL	16	10	2	28	22

CS-Semester VI

S. No.	Course Code	Course Title	L	T	P	Contact hrs/wk	Credits
1	BS 08	Fuzzy Mathematics	2	0	0	2	2
2	CS 17	Computer Graphics & Visualization	3	2	0	5	4
3	CS 18	Simulation & Modelling	3	0	2	5	4
4	CS 19	Internet Web Programming	2	0	2	4	3
5	CS 20	Embedded Computing Systems	2	0	2	4	3
6	CS*	Elective Course to be chosen	2	2	0	4	3
7	CS*	Elective Course to be chosen	2	2	0	4	3
		TOTAL	16	6	6	28	22

CS-Semester VII

S. No.	Course Code	Course Title	L	T	P	Contact hrs/wk	Credits
1	CS 25	Mobile Computing	2	2	0	4	3
2	CS 26	Pattern Recognition	2	2	0	4	3
3	CS*	Elective Course to be chosen	2	2	0	4	3
4	CS*	Elective Course to be chosen	2	2	0	4	3
5	OE	Elective Course to be chosen	3	0	0	3	3
6	OE	Elective Course to be chosen	3	0	0	3	3
7	CS P1	Project Work I			8	8	4
		TOTAL	14	8	8	30	22

CS-Semester VIII

S. No.	Course Code	Course Title	L	T	P	Contact hrs/wk	Credits
1	CS*	Elective Course to be chosen	3	0	0	3	3
2	OE	Elective Course to be chosen	3	0	0	3	3
3	CS P2	Project Work II & Dissertation			32	32	16
		TOTAL	**6**	**0**	**32**	**38**	**22**

CS: Scheme of Instruction-Summary

S. No.	Course Work - Subject Area	*Credits/Semester*				*Credits/Semester*				*Credits-Total*
		I	II	III	IV	V	VI	VII	VIII	
1	Humanities and Social Sciences *(HS)*	6	8	-	-	-	-	-	-	14
2	Basic Sciences*(BS)*	7	6	5	7	4	2	-	-	31
3	Engineering Sciences *(ES)*	9	8	6	1	=	-	-	-	24
4	Professional Subjects-Core *(CS)*	-	-	11	14	15	14	6	-	60
5	Professional Subjects–Electives *(CS*)*	-	-	-	-	3	6	6	3	18
6	Open Subjects- Electives *(OE)*	-	-	-	-	-	-	6	3	9
7	Project Work, Seminar and/or Internship	-	-	-	-	-	-	4	16	20
	TOTAL	**22**	**22**	**22**	**22**	**22**	**22**	**22**	**22**	**176**
8	Mandatory Courses*(MC)(Non-Credit)*	3	3	3	-	-	-	-	-	9

Model Syllabi for U.G Engineering Degree in *CS*

CS 01: Data Structures & Algorithms   *2:2:0*   *[3]*

Module 1: Introduction: to Notions of data type, abstract data type, and data structures. Relation to the notion of classes and objects in object oriented programming. Importance of algorithms and data structures in programming. Notion of Complexity covering time complexity and space complexity. Worst case complexity, Average case complexity. Big Oh Notation.Examples of simple algorithms and illustration of their complexity. Introduction to recurrence relations.

Module 2: Iteration and Recursion- Problem solving using iteration and recursion with examples such as binary search, Fibonacci numbers, and Hanoi towers.Tradeoffs between iteration and recursion.

Module 3: List ADT. Implementation of lists using arrays and pointers. Stack ADT. Queue ADT. Implementation of stacks and queues. Dictionaries, Hash tables: open tables and closed tables. Analysis of hashing. Skip lists and analysis.

Module 4: Binary Trees- Definition and traversals: preorder, postorder, inorder. Common types and properties of binary trees. Counting of binary trees. Huffman coding using binary trees. Binary search trees : worst case analysis and average case analysis. AVL trees. Splay trees. Priority Queues -Binary heaps: insert and deletemin operations and analysis. Binomial queues.

Module 5: Pattern search and matching algorithms: Knuth-Morris-Pratt and Boyer-Moore algorithms.

Module 6: Directed Graphs- Data structures for graph representation. Shortest path algorithms: Dijkstra (greedy algorithm) and Bellman-Ford (dynamic programming). Depth-first search and Breadth-first search. Directed acyclic graphs. Undirected Graphs- Depth-first search and breadth-first search.Minimal spanning trees and algorithms (Floyd and Kruskal) and implementation. Application to the travelling salesman problem.

Module 7: Sorting- Bubblesort, selection sort, insertion sort, Shell sort; Quicksort; Heapsort; Mergesort; Radix sort; Analysis of the sorting methods. Selecting the top k elements. Lower bound on sorting.

Text Books:

1. Data Structures and Algorithms by Alfred V. Aho, Jeffrey D. Ullman and John E. Hopcroft , Addison-Wesley Series (1983)
2. Data Structures and Algorithm Analysis in Java (3rd Edition) by Mark Allen Weiss, Addison Wesley, (2011).

Reference Books:

1. T.H. Cormen, C.E. Leiserson, and R.L. Rivest. *Introduction to Algorithms.* The MIT Press and McGraw-Hill Book Company, Cambridge, Massacusetts, 1990 (Available in Indian Edition).
2. Steven S. Skiena. *The Algorithm Design Manual*. Springer, Second Edition, 2008.

CS 02: Computer Organization and Design *3:2:0* *[4]*

Module 1: Basic organization of computers, Block level description of the functional units as related to the execution of a program; Fetch, decode and execute cycle.

Module 2: Machine instructions, Instruction set architectures, Assembly language programming, addressing modes, instruction cycles, registers and storage, addressing modes; discussions about RISC versus CISC architectures; Inside a CPU:

Module 3: Information representation, Floating point representation (IEEE 754), computer arithmetic and their implementation; Fixed-Point Arithmetic: Addition, Subtraction, Multiplication and Division, Arithmetic Logic Units control and data path, data path components, design of ALU and data path, controller design; Hardwired and Microprogrammed Control

Module 4: Memory Technology, static and dynamic memory, Random Access and Serial Access Memories, Cache memory and Memory Hierarchy, Address Mapping, Cache updation schemes, Virtual memory and memory management unit.

Module 5: I/O subsystems: Input-Output devices such as Disk, CD-ROM, Printer etc.; Interfacing with IO devices, keyboard and display interfaces;   Basic concepts Bus Control, Read Write operations, Programmed IO, Concept of handshaking, Polled and Interrupt-driven I/O, DMA data transfer;

Module 6: Pipeline Processing, Instruction and Arithmetic Pipeline, Pipeline hazards and their resolution, Parallel Processing

Text Book:
1. Computer Organization by V. Carl Hamacher, Safwat G. Zaky and Zvonko G. Vranesic , McGraw-Hill series (2002)

Reference Books:
*1.*Computer Organization and Design, by David Patterson and John Hennessey, " Elsevier. 2008.
2.Computer System Architecture by Mano, M.M.,, Prentice Hall of India, New Delhi, 1992
*3.*Computer Systems Design and Architecture (2nd Edition) by Vincent P. Heuring and Harry F. Jordan (Dec 6, 2003)
*4.*Computer Architecture and Organization, by Hayes, J.P.1998,McGraw-Hill

CS 03: Discrete Mathematics *2:0:0* *[2]*

Module 1: Sets, countable/uncountable sets, integers, induction.

Module 2: Functions, relations, equivalence classes, partitions, elementary graph theory.

Module 3: Propositional logic, Boolean algebra.

Module 4: Abstract Algebra – Basics of groups, rings, finite fields, vector spaces.

Module 5: Combinatorics – Counting principles, recurrence equations, generating functions.

Module 6: Probability Theory – Sample space, events, expectations, variance, distribution, random variables, binomial, poisson and geometric random variables

Textbooks:

1. "Discrete Mathematics and Its Applications", by Kenneth H. Rosen, Tata McGraw Hill, 6th edition, ISBN: 0072880082© 2007
2. " Elements of Discrete Mathematics", by C. L. Liu, Tata McGraw Hill Education Private Limited, 3rd edition, 2008

CS 04: Digital Systems   *3:0:2   [4]*

Module 1: IC Digital Logic Families - Characteristics of digital IC's, Transistor – Transistor Logic family, Standard TTL characteristics, Other TTL series, Open collector TTL, Wired OR/AND connection, Tristate TTL, Emitter-Coupled Logic family, ECL NOR/OR gate and its characteristics, Metal-oxide semi-conductor (MOS) family, NMOS and CMOS gates and their characteristics, CMOS transmission gate circuits   .

Module 2: Simplification of Boolean Functions - Using   Karnaugh map and   Quine-Mccluskey methods, SOP,   POS simplification,   NAND and NOR implementations, other two-level implementation (AND-OR-INVERT).

Module 3: Combinational Logic Design- Design procedure, Adder : Half adder, Full adder, Serial adder, Parallel adder & Carry look-ahead adder, Subtractors : Half subtractor & Full subtractor, BCD to Excess-3 code convertor, BCD to 7-segment decoder, Parity generator and checker /   .

Module 4: Combinational Logic Design using MSI Circuits - Application of typical IC's like 4-bit parallel adder (ex : 7483), Encoders (ex :74148), Multiplexers (ex: 74151, 74153, 74157) and their use in realising boolean functions, Multiplexer trees, Demultiplexer / Decoders (e.g.: 74138, 74154) and their use in realising a boolean function and demultiplexer trees, 4- it magnitude comparator (ex:7485).

Module 5: Synchronous Sequential Logic- Analysis of clocked sequential logic, State reduction and assignment, Flip-flop excitation   tables, Design procedure, Design of sequential ciruits ex : 3-bit up/down counter (mod < 8), 3-bit up/down gray code counter, Serial adder.

Module 6: Counters- Dependancy notation, Symbols for Decoder, Multiplexer, Flipflops, Registers, Counters, RAM. Flipflops, Asynchronous counters (mod 8 and less than 8), IC asynchronous counters (7493, 7490) and cascading, synchronous counters, binary and binary up-down counters, IC synchronous counters (74192, 74190) and cascading.

Module 7: Registers- Registers and their different modes of operation SISO, SIPO, PISO, PIPO, Shift registers (7495 / 74195), bidirectional universal shift register (74194), Applications of shift registers, Time delay, Ring counter, Johnson counter, Sequence generator; Programmable Logic Devices-PLD, PLA, PAL, FPGA structures & applications.

Text Books:
1. M Morris Mano, Digital Design, 3rd Edition, 2006, PHI
2. R. P Jain, Modern Digital Electronics, Second Edition, TMH
3. Bignell &Donovan Digital Electronics, 4th Edition, 2007, Thomson Learning.

Reference Books:
1. Tocci : Digital Systems PHI , 6e, 2001

2. Uyemura : Digital Systems Design, 2003, Thomson Learning

3. Anand Kumar : Digital Integrated Electronics ,2ed 2009

CS 05: Operating Systems (Unix Programming)   *3:2:0*

[4]

Module 1: Introduction-OS Concepts – Evolution of OS, OS Structures- Kernel, Shell, General Structure of MSDOS, Windows 2000, Linux. Introduction- UNIX and ANSI Standards: The ANSI C Standard, The ANSI/ISO C++ Standards, Difference between ANSI C and C++, The POSIX Standards.

Module 2: Process Management-Process & Threads – Process States - Process Control Block – Process Scheduling – Operations on Processes, Threads, CPU Scheduler – Preemptive and Non- Preemptive; Dispatcher, Scheduling Criteria, Scheduling Algorithms – Process Management in UNIX.

Module 3: UNIX Processes: The Environment of a UNIX Process: Introduction, main function, Process Termination, Command-Line Arguments, Environment List, Memory Layout of a C Program, Shared Libraries, Memory Allocation, Environment Variables, setjmp and longjmp Functions, getrlimit, setrlimit Functions, UNIX Kernel Support for Processes. Process Control

Module 4: Process Synchronization & Inter process Communication-Concurrent Processes, Co-operating Processes, Precedence Graph, Hierarchy of Processes, Critical Section Problem – Two process solution, Synchronization Hardware, Semaphores – Deadlock- detection, handling, prevention, avoidance, recovery, Starvation, Critical Regions, Monitors, Inter process communication.

Module 5: Memory Management-Objectives and functions, Simple Resident Monitor Program (No design), Overlays – Swapping; Schemes – Paging – Simple, Multi-level Paging; Internal and External Fragmentation; Virtual Memory Concept, Demand Paging - Page Interrupt Fault, Page Replacement Algorithms; Segmentation – Simple, Multi-level, Segmentation with Paging, Memory Management in UNIX.

Module 6: Inter process Communication – 1: Overview of IPC Methods, Pipes, popen, pclose Functions, Coprocesses, FIFOs, System V IPC, Message Queues, Semaphores. Interprocess Communication – 2: Shared Memory, Client-Server Properties, Stream Pipes, Passing File Descriptors, An Open Server-Version 1, Client-Server Connection Functions.

Module 7: Information Management-Files and Directories – Directory Structure –Directory Implementation – Linear List - Hash Table. Device Management: Dedicated, Shared and Virtual Devices - Serial Access Devices, Direct Access Devices, Direct Access Storage Devices – Channels and Control Units – Disk Scheduling methods.

Text Books:
1. Operating Systems Concepts – Silberschatz, Galvin, Wiley Publications (2008)
2. Modern Operating Systems - Andrew S. Tenenbaum, Pearson Education Asia / PHI (2005)
3. UNIX System Programming Using C++,by Terrence Chan: Prentice Hall India, 1999.
4. Advanced Programming in UNIX Environment, by W. Richard Stevens: 2nd Ed, Pearson Education, 2005.

Reference Books:
1. Operating Systems – William Stallings, Pearson Education Asia (2002)

2.Operating Systems - Nutt, Pearson Education Asia (2003)

CS 06: Formal Languages & Automation Theory   *3:0:0*

[3]

Module 1: Basics of Strings and Alphabets

Module2: Finite Automata – DFA, transition graphs, regular languages, non-deterministic FA, equivalence of DFA and NDFA

Module3: Regular grammars, regular expressions, equivalence between regular   languages, properties of regular languages, pumping lemma.

Module4: Context Free Languages – Leftmost and rightmost derivation, parsing and ambiguity, ambiguity in grammar and languages, normal forms

Module5: Pushdown Automata – NDPDA, DPDA, context free languages and PDA, comparison of deterministic and non-deterministic versions, closure properties, pumping lemma for CFL

Module6: Turing Machines, variations, halting problem, PCP

Module7: Chomsky Hierarchy

Textbooks:

1.An Introduction to Formal Languages and Automata, by Peter Linz, Third Edition, Narosa Publishers (1998)

CS 07: Design and Analysis of Algorithms   *3:0:0*

[3]

Module1: Principles – Computational problem, worst case and average size complexity, big oh notation. Basic Design Techniques – Incremental design - case studies, decremental design - case studies, pruning - binary search, order statistics

Module2: Divide and Conquer – Merge sort, Strassen matrix multiplication, finding max-min, recurrence equations. Dynamic Programming and Greedy Methods – Chain products, optimization problems, Huffman tree construction

Module3: Backtrack, Branch and Bound, Transformations; Graph algorithms – Matching and flow problems.

Module4: Computational Geometry – Convex hull, closest pair, voronoi diagrams; Number Theory Problems – CRT, GCD algorithms, modular arithmetic, discrete log algorithms

Module5: Lower Bound Theory; Approximate Algorithms – Set cover, vertex cover, bin packing problems.

Module 6: Randomized Algorithms – Las Vegas and Monte Carlo methods, Chernoff bounds - case studies.

Textbooks:
1.Introduction to Design and Analysis of Algorithms, Anny Levitin, Person Education Press. 2007.
2. Gilles Brassard & Paul Bratley, Fundamental Algorithms, Prentice-Hall. 1998

Reference Books:
1. Cormen, Leizerson & Rivest, Introduction to algorithms, Prentice-Hall. (2002 **.**
2. Aho, HopCroft, Ullman, The Design and Analysis of Computer Algorithms, Addison-Wesley. 2001.
3. Horowitz & Sahni, Fundamentals of Computer Algorithms, Galgotia Publication. 1999

CS 08: Computer Networks   *3:2:0*

[4]

Module1: Introduction -Hardware and software, Data communication, Networking, Protocols and Protocol architecture, standards. Data transmission concepts.Analog and digital transmission. Transmission impairments. Layered Architecture of Computer Networks, OSI and TCP/IP architectures

Module2: Physical Layer- Guided transmission media and wireless transmission, Data encoding - Digital and analog data and signals, spread spectrum. Data communication interface - asynchronous and synchronous transmission, line configuration and interfacing. Data link control - Flow control. Error detection and error control. HDLC and other data link protocols. Multiplexing – Frequency-division, synchronous time-division, and statistical time-division multiplexing

Module3: Link Layer :Medium Access Control: CDMA, ALOHA, and Ethernet; Link Layer Addressing and Forwarding; Spanning Trees; The Channel Allocation Problem, Multiple Access Protocols, Ethernet, Wireless LANs, Broadband Wireless, Bluetooth, Data Link Layer Switching, Switched networks. Circuit-switched networks. Switching concepts. Routing in circuit-switched networks. Control signaling. Packet switching principles. Routing and congestion control, x.25 protocol standard. LAN Technology - LAN architecture. Bus/tree, ring, star, and wireless LANs. LAN Systems - Ethernet and Fast Ethernet (CSMA/CD) Token ring and FDDI, ATM LANs, Fiber channel, wireless LANs. Bridges - Bridge operation and routing with bridges.

Module4: Network Layer:Network layer design issues. Routing algorithms , Flooding, Shortest path routing, Link Sate routing, Hierarchical routing, Broadcast and multicast routings, Routing in the Internet, Path Vector routing, OSPF routing. The network layer in the Internet: IP protocol,ARP and RARP, BOOTP, ICMP, DHCP, Network Address Translation(NAT) Internetworking

Module5: Transport Layer:TCP introduction, Reliable/Un- Reliable Transport ,TCP , UDP, Congestion Control,Intra-Domain Routing: Distance-Vector, Intra-Domain Routing: Link-State, Wireless Networks: 802.11 MAC, Efficiency considerations

Module6: Application Layer: DNS-The Domain Name System,Electronic Mail, HTTP, FTP, Simple network management protocol (SNMP),The World Wide Web

Module7: Web and Multimedia: The World Wide Web – client and server side of www,

HTML and webpages, JAVA language, Locating on the web. Multimedia- Audio & Video, Data compression, Video on demand, Multicast backbone.

Module 8: Security: Introduction, Cryptography and Cryptanalysis, Public Key Cryptography Algorithms, RSA Algorithm, DES, Authentication and Authorization.

Text Books:
1.*Computer Networks*, by Andrew S Tanenbaum, PHI. (2010)
2.*Data and Computer Communications* , by Walliam Stallings, PHI. (2002)

Reference Books:
1.*Data Communications, Computer networking on OSI* , by Fred Halsall, Addison Wesley Publishing Co.1998
2. *Computer Networking -A Top-Down Approach Featuring the Internet ,* James F. Kurose and Keith W. Ross , Addison Wesley Publishing Co. 2004
3.*Computer Networks: Protocols standards and interfaces* , by Uyless Black, Prentice Hall.2002
4.Data communication & Networks , by Behrou A. Forouzan, Tata McGraw Hill. 2002

CS 09: Data Base Management Systems *3:2:0* *[4]*

Module1: Basic Concepts - Purpose of database systems-Components of DBMS – DBMS Architecture and Data Independence- Data modeling - Entity Relationship Model, Relational – Network- Hierarchical and object oriented models-Data Modeling using the Entity Relationship Model.

Module2: Structure of relational databases – relational databases – relational algebra- tuple relational calculus. Data definition with SQL, insert, delete and update statements in SQL – views – data manipulation with SQL

Module3: Introduction to Transaction Processing- Transaction and System Concepts- Desirable properties of Transactions- Schedules and Recoverability- Serializability of Schedules-Query processing and Optimization-Concurrency Control- -assertions – triggers. Oracle case study: The basic structure of the oracle system – database structure and its manipulation in oracle- storage organization in oracle - Programming in PL/SQL- Cursor in PL/SQL

Module4: Database Design– Design guidelines– Relational database design – Integrity Constraints – Domain Constraints- Referential integrity – Functional Dependency- Normalization using Functional Dependencies, Normal forms based on primary keys- general definitions of Second and Third Normal Forms. Boyce Codd Normal Form– Multivalued Dependencies and Forth Normal Form – Join Dependencies and Fifth Normal Form – Pitfalls in Relational Database Design.

Module5: Distributed databases: Distributed Database Concepts- Data Fragmentation, Replication and Allocation Techniques- Different Types- Query Processing – semijoin - Concurrency Control and Recovery.

Text Books:
1. Fundamentals of Database System Elmasri and Navathe (4rd Edition), Pearson Education Asia (2008)
2. Database System Concepts - Henry F Korth, Abraham Silbershatz, Mc Graw Hill 2nd edition. (2005)

Reference Books:
1.An Introduction to Database Systems - C.J.Date (7th Edition) Pearson Education Asia (2006)

2.An Introduction to Database Systems – Bibin C. Desai ,Galgotia Publications , (2000

CS 10: Software Engineering   *2:2:0*

[3]

Module1: Evolution and impact of Software engineering, software life cycle models: Waterfall, prototyping, Evolutionary, and Spiral models. Feasibility study, Functional and Non-functional requirements, Requirements gathering, Requirements analysis and specification.

Module2: Basic issues in software design, modularity, cohesion, coupling and layering, function-oriented software design: DFD and Structure chart, object modeling using UML, Object-oriented software development, user interface design. Coding standards and Code review techniques.

Module3: Fundamentals of testing, White-box, and black-box testing, Test coverage analysis and test case design techniques, mutation testing, Static and dynamic analysis, Software reliability metrics, reliability growth modeling.

Module4: Software project management, Project planning and control, cost estimation, project scheduling using PERT and GANTT charts, cost-time relations: Rayleigh-Norden results, quality management, ISO and SEI CMMI, PSP and Six Sigma. Computer aided software engineering, software maintenance, software reuse, Component-based software development.

Text Books:
1. Fundamentals of Software Engineering by Rajib Mall, – PHI-3rd Edition, 2009.

Reference Books:
1.Software Engineering, by Ian Sommerville, Pearson Education Inc., New Delhi, (2009)**.**
2. Software Engineering: A Practitioner's Approach", by Roger S. Pressman, McGraw-Hill. (2005).

CS 11: Compiler Design   *2:2:0*
[3]

Module1: Overview of compilation- The structure of a compiler and applications of compiler technology; Lexical analysis - The role of a lexical analyzer, specification of tokens, recognition of tokens, hand-written lexical analyzers, LEX, examples of LEX programs.

Module2: Introduction to syntax analysis -Role of a parser, use of context-free grammars (CFG) in the specification of the syntax of programming languages, techniques for writing grammars for programming languages (removal left recursion, etc.), non- context-free constructs in programming languages, parse trees and   ambiguity, examples of programming language grammars.

Module3: Top-down parsing- FIRST & FOLLOW sets, LL(1) conditions, predictive parsing, recursive descent parsing, error recovery. LR-parsing - Handle pruning, shift-reduce parsing, viable prefixes, valid items, LR(0) automaton, LR-parsing algorithm, SLR(1), LR(1), and LALR(1) parsing. YACC, error recovery with YACC and examples of YACC specifications.

Module 4:   Syntax-directed definitions (attribute grammars)-Synthesized and inherited attributes, examples of SDDs, evaluation orders for attributes of an SDD, dependency graphs. S-ttributed and L-attributed SDDs and their implementation using LR-parsers and recursive-descent parsers respectively.

Module5: Semantic analysis- Symbol tables and their data structures. Representation of "scope". Semantic analysis of expressions, assignment, and control-flow   statements, declarations of variables and functions, function calls, etc., using S- and L-attributed SDDs (treatment of arrays and structures included). Semantic error recovery.

Module6: Intermediate code generation - Different intermediate representations –quadruples, triples, trees, flow graphs, SSA forms, and their uses. Translation of expressions (including array references with subscripts) and assignment statements. Translation of control-flow statements – it-   then-else, while-do, and switch. Short-circuit code and control-flow translation of Boolean expressions. Back patching. Examples to illustrate intermediate code generation for all constructs.

Module 7: Run-time environments:- Stack allocation of space and activation records. Access to non-local data on the stack in the case of procedures with and without nesting of procedures.

Module 8: Introduction to machine code generation and optimization- Simple machine code generation, examples of machine-independent code optimizations.

Text Books:
1. Compilers: Principles, Techniques, and Tools , by A.V. Aho, Monica Lam, Ravi Sethi, and J.D. Ullman, (2nd ed.), Addison-Wesley, 2007 (main text book, referred to as ALSU in lab assignments).
2. K.D. Cooper, and Linda Torczon, Engineering a Compiler, Morgan Kaufmann, 2004.

Reference Books:
1. K.C. Louden, Compiler Construction: Principles and Practice, Cengage Learning, 1997.
2. D. Brown, J. Levine, and T. Mason, LEX and YACC, O'Reilly Media, 1992.

Laboratory Assignments:

   1. Familiarization with LEX by writing simple specifications for tokens such as, identifiers, numbers, comments in C/C++, etc. All LEX specifications must be compiled and executed with appropriate inputs. Atleast ten such exercises must be completed in two lab classes.   (2 lab classes)

   2. LEX specification for tokens of the small language in ALSU's book (appendix A) (1 lab class)

   3. Complete the specifications in (2) above to make a complete lexical analyzer. (1 lab class)

   4. Familiarization with YACC by writing simple specifications for desk   calculator, variable declarations in C (only numbers and array). All YACC   specifications must be compiled and executed with appropriate inputs. Note that this exercise also requires LEX specifications o the tokens involved.   (2 lab classes)

   5. YACC specifications for the syntax of the small language in ALSU's book (appendix A) (1 lab class)

6. Adding error recovery to (5) above to make a complete parser.   (1 lab class)

7. S-attributed specification of the semantics of the small language in ALSU's   book (appendix A) to be incorporated into YACC specifications produced in   (6) above.   (3 lab classes)

8. Adding semantic error recovery to the semantic analyzer in (7) above to make   a complete semantic analyzer.   (1 lab class)

9. Intermediate code generation for the constructs of the small language in   ALSU's book (appendix A) to be incorporated into the semantic analyzer of   (8) above. Students doing this last assignment may be awarded bonus marks.   (3 lab classes)

CS 12: Cryptography & Information Security   *3:2:0*

[4]

Module1: Symmetric Ciphers **-**   Overview : Services, Mechanisms and Attacks, The OSI Security Architecture, A Model of Network Security. Classicial Encryption Techniques : Symmetric Cipher Model, Substitution Techniques, Transposition Techniques, Rotor Machines, Steganography. Block Cipher and the Data Encryption Standard : Simplified DES, Block Cipher Principles, The DES, The Strength of DES, Differential and Linear Cryptanalysis. Symmetric Ciphers : Triple DES, Blowfish. Confidentiality using Conventional Encryption : Placement of Encryption Function, Traffic Confidentiality, Key Distribution, Random Number Generation.

Module2: Public Key Encryption, Digital Signatures **-** Number Theory, Prime Numbers Format's and Euler's Theorems, Testing for Primality. Public Key Cryptography and RSA : Principles of Public Key Cryptosystems, The RSA Algorithms, Key Management, Diffie Hellman Key Exchange.

Module3: Authentication Protocols **-** Message Authentication : Authentication Requirements, Authentication Functions, Message Authentication Codes, MD5 Message Digest Algorithms, Digital Signatures and Authentication Protocols : Digital Signatures, Authentication Protocols, Digital Signature Standards.

Module4: Network Security **-** Authentication Applications : Kerberos, X.509 Directory Authentication Service. Electronic Mail Security : Pretty Good Privacy. IP Security : Overview, IP Security Architecture, Authentication Header, Encapsulation Security Payload. Web Security : Web Security Requirements, Secure Sockets Layer and Transport Layer Security, Secure Electronic Transaction.

Module5: System Security**-** Intruders, Malicious Software, Viruses and Related Threats, Counter Measures, Firewalls and its Design Principles.

Text Books:
1. William Stallings, Cryptography and Network Security, 4th Edition, Pearson Education/PHI. 2006

ReferenceBooks:
1. Charlie Kaufman, Radia Perlman, Mike Speciner, Network Security: Private Communication in Public World, 2nd Edition,2011, Pearson Education.

2. Atul Kahate, Cryptography and Network Security, TMH. (2003)

CS 13: Object Oriented Analysis and Design   *2:2:0*

[3]

Module1: Introduction to object oriented systems, Classes, Objects, Abstraction, Inheritance, Polymorphism, Encapsulation, Message Sending, Association, Aggregation, Iterative development and the Unified Process (UP), UP phases: Inception, Elaboration, Construction and Transition, Object-oriented metrics

Module2: Introduction to UML, Use Cases and functional requirements, Identifying and writing Use Cases, Decomposition of use cases, Modeling System Workflows using Activity Diagrams, Modeling a System's Logical Structure using Classes and Class Diagrams, Modeling Interactions using Sequence Diagrams and Communication Diagrams, Timing Diagrams, Interaction Overview Diagrams, Component Diagram, Package diagram, State Machine Diagrams, Deployment Diagrams.

Module3: Introduction to Patterns, GoF Patterns, Creational Patterns, Structural Patterns, Behavioral Patterns, Software Architectural patterns, The Observer Pattern, The Template Method Pattern , Factory Patterns: Factory Method and Abstract Factory , The Singleton Pattern , The Iterator Pattern , The Composite Pattern , The Facade Pattern , The State and Strategy patterns , Command Pattern , The Adapter Pattern , The Proxy Pattern , The Decorator Pattern, The Visitor Pattern , AntiPatterns, Patterns for Assigning Responsibilities: GRASP Patterns

Module4: Domain modeling, assigning responsibility using sequence diagrams, mapping design to code, CASE tools, Unit, Cluster, and System-level testing of Object-oriented programs, Aspect- oriented and Service-oriented software.

Text Books:
1.Applying UML and Patterns: An Introduction to object-oriented Analysis and Design and iterative development, by Craig Larman, Pearson Education. (1998)

Reference Books:
1. Design Patterns - Elements of Reusable Object-Oriented Software, Gamma, et. al., Addison-Wesley. (1994)

CS 14: Distributed Computing Systems   *3:0:0*

[3]

Module1: Characterization of Distributed Systems: Introduction, Examples of distributed Systems, Issues in Distributes Operating Systems, Resource sharing and the Web Challenges. System Models: Architectural models, Fundamental Models Theoretical Foundation for Distributed System: Limitation of Distributed system, absence of global clock, shared memory, Logical clocks, Lamport's & vectors logical clocks, Causal ordering of messages, global state, termination detection. Distributed Mutual Exclusion: Classification of distributed mutual exclusion, requirement of mutual exclusion theorem, Token based and non token based algorithms, performance metric for distributed mutual exclusion algorithms.

Module2: Distributed Deadlock Detection: system model, resource Vs communication deadlocks, deadlock prevention, avoidance, detection & resolution, centralized dead lock detection, distributed dead lock detection, path pushing algorithms, edge chasing algorithms. Agreement Protocols: Introduction, System models, classification of Agreement Problem-Interactive consistency Problem, Applications of Agreement algorithms.

Module3: Distributed Objects and Remote Invocation: Communication between distributed objects, Remote procedure call, Events and notifications, Java RMI case study. Transactions and Concurrency Control: Transactions, Nested transactions, Locks, Optimistic Concurrency control, Timestamp ordering, Comparison of methods for concurrency control

Module4: Distributed Transactions: Introduction, Flat and nested distributed transactions, Atomic commit protocols, concurrency control in distributed transactions, Distributed deadlocks, Transaction recovery. Distributed shared memory – Design and Implementation issues, consistency models, CORBA Case Study: CORBA RMI, CORBA services.

Module5: File service components, design issues, interfaces, implementation techniques, Sun Network File System – architecture and implementation, other distributed file systems – AFS, CODA. Name services – SNS name service model.

Text Books:
1. "Advanced Concepts in Operating Systems", by Mukesh Singhal & Niranjan G Shivaratri,Tata McGraw Hill (2001).
2. "Distributed System: Concepts and Design", by Coulouris, Dollimore, Kindberg , Pearson Education (2006)

Reference Books:
1.Tanenbaum S , "Distributed Operating Systems", Pearson Education (2005).
2. P K Sinha, ""Distributed System: Concepts and Design", PHI (2004).

CS 15: Graph Theory   *3:0:0*

[3]

Module1: Basics – Graphs, degree sequences, distance in graphs, complete, regular and bipartite graphs, basic properties.

Module2: Structure and Symmetry – Cut vertices, bridges and blocks, automorphism groups, reconstruction problem.

Module3: Trees and connectivity – Properties of trees, Arboricity, vertex and edge connectivity, Mengers theorem.

Module4: Eulerian and Hamiltonian graphs – Characterization of Eulerian graphs - Sufficient conditions for Hamiltonian graphs.

Module5: Colouring and planar graphs – vertex and edge colouring, perfect graphs, planar graphs, Euler's theorem, Kuratowski's theorem, Colouring of planar graphs, Crossing number and thickness.

Module6: Matching, factors, decomposition and domination

Module7: Extremal Graph theory – Turan's theorem, Ramsay's theorem, Szemeredi's

regularity lemma, applications

Text Books:
1.Graph Theory, by J. A. Bondy and U. S. R. Murthy, Springer Verlag (2008.)
2.Introduction to Graph Theory,by D. B. West, PHI, 2004.

Reference Books:
1 Graph Theory, by R. Diestel : Springer Verlag (Free Download available).(2003)

CS 16: Artificial Intelligence   *2:2:0*

[3]

Module1:   Introduction- What is intelligence? Foundations of artificial intelligence (AI). History of AI;   Problem Solving- Formulating problems, problem types, states and operators, state space, search strategies.

Module2: Informed Search Strategies- Best first search, A* algorithm, heuristic functions, Iterative deepening A*(IDA), small memory A*(SMA); Game playing - Perfect decision game, imperfect decision game, evaluation function, alpha-beta pruning

Module3: Reasoning-Representation, Inference, Propositional Logic, predicate logic (first order logic), logical reasoning, forward chaining, backward chaining; AI languages and tools **-** Lisp, Prolog, CLIPS

Module4: Planning- Basic representation of plans, partial order planning, planning in the blocks world, heirarchical planning, conditional planning, representation of resource constraints, measures, temporal constraints

Module5: Uncertainty **-** Basic probability, Bayes rule, Belief networks, Default reasoning, Fuzzy sets and fuzzy logic; Decision making**-** Utility theory, utility functions, Decision-theoretic expert systems.

Module 6: Inductive learning **-** decision trees, rule based learning, current-best-hypothesis search, least-commitment search , neural networks, reinforcement learning, genetic algorithms; Other learning methods - neural networks, reinforcement learning, genetic algorithms.

Module7: Communication **-** Commiunication among agents, natural language processing, formal grammar, parsing, grammar

Text Books:
1.Stuart Russell and Peter Norvig. *Artificial Intelligence – A Modern Approach,* Pearson Education Press, 2001.
2.Kevin Knight, Elaine Rich, B. Nair, *Artificial Intelligence, McGraw Hill, 2008.*

Reference Books:
1.George F. Luger, *Artificial Intelligence,* Pearson Education, 2001.
2.Nils J. Nilsson, *Artificial Intelligence: A New Synthesis,* Morgan Kauffman, 2002.

CS 17: Computer Graphics and Visualization *3:2:0*

[4]

Module1: Introduction - History of computer graphics, applications, graphics pipeline, physical and synthetic images, synthetic camera, modeling, animation, rendering, relation to computer vision and image processing, review of basic mathematical objects (points, vectors, matrix methods)

Module2: Introduction to OpenGL - OpenGL architecture, primitives and attributes, simple modeling and rendering of two- and three-dimensional geometric objects, indexed and RGB color models, frame buffer, double buffering, GLUT, interaction, events and callbacks, picking.

Module3: Geometric transformations- Homogeneous coordinates, affine transformations (translation, rotation, scaling, shear), concatenation, matrix stacks and use of modelview matrix in OpenGL for these operations.

Module4: Viewing - Classical three dimensional viewing, computer viewing, specifying views, parallel and perspective projective transformations; Visibility- z-Buffer, BSP trees, Open-GL culling, hidden-surface algorithms.

Module 5: Shading - Light sources, illumination model, Gouraud and Phong shading for polygons.
Rasterization- Line segment and polygon clipping, 3D clipping, scan conversion, polygonal fill, Bresenham's algorithm

Module 6: Discrete Techniques- Texture mapping, compositing, textures in OpenGL; Ray

Tracing- Recursive ray tracer, ray-sphere intersection

Module 7: Representation and Visualization- Bezier curves and surfaces, B-splines, visualization, interpolation, marching squares algorithm

Text Books:
1.Edward Angel, Interactive Computer Graphics. A Top-Down Approach Using OpenGL (fifth Edition), Pearson Education, 2008
2.Donald Hearn and Pauline Baker, Computer Graphics with OpenGL (third edition), Prentice Hall, 2003
3.F. S. Hill Jr. and S. M. Kelley, Computer Graphics using OpenGL (third edition), Prentice Hall, 2006
4.Peter Shirley and Steve Marschner, Computer Graphics (first edition), A. K. Peters, 2010

Web Resources:

http://www.graphicsforum.in

This website contains several resources relevant to this course; May be beneficial to both students / instructors.

CS 18: Simulation and Modelling *3:0:2*

[4]

Module1: Introduction- When simulation is appropriate and when not, advantages and disadvantages of simulation, application areas in communication, computer and software design, systems and systems environment, components of a system, discrete and continuous systems, model of a system, types of models, discrete-event simulation, steps in a simulation study. Simulation Examples- Simulation of queueing systems, on-demand and inventory systems, simulation for reliability analysis etc

Module 2: General Principles- Concepts in discrete event simulation: event scheduling/time advance algorithms, world views. List Processing: properties and operations, data structures and dynamic allocation, techniques;

Module 3: Simulation Software- Integrated environments. Examples and review of some existing software popular and useful in the industry, e.g., Arena, AutoMod, Extend, Flexsim, Micro Saint, ProModel, Quest, SIMUL8, WITNESS etc. Simulation using languages and environments like C++/Java/GPSS/SSF etc. Experimentation and Statistical-Analysis Tools: common features and relevant current products.

Module 4: Statistical Models in Simulation- Terms and concepts. Statistical Models. Review of discrete and continuous distributions. Review of Poisson (stationary and non-stationary) processes. Empirical Distributions; Elementary Queueing Theory- Basic Structure of Queueing Models. Input Source (Calling Population). Queue, Queue Discipline, Service Mechanisms. Notations and relationships between *L, W, Lq,* and *Wq.* Little's Formula. Role of Exponential Distribution and Properties. Birth and Death Processes. M/M/s queues. Finite queue variation in M/M/s/K models with different s values. Finite Calling Population cases. Queueing Models involving Non-Exponential Distributions: M/G/1, M/D/s, M/Ek/s (involving Erlang distribution), Models without a Poisson Input, Models involving hyper-exponential distributions, Priority Discipline Queueing Models: Preemptive and Non-Preemptive with results, properties and server number variations, Queueing Networks: Equivalence Property. Infinite Queues in Series and Product Form Solutions. Jackson Networks,

Module 5: Application of Queueing Models- Review of Characteristics (calling populatiom system capacity, arrival processes, behavior and disciplines, service times and mechanisms etc) and notations, Application of Long-Run Measures of Performance: Time average in system, average time spent per customer, Little's Formula and server utilization, costs. Steady State behaviour of Infinite (M/G/1, M/M/c/infinity, M/M/c/N/infinity) and finite (M/M/c/K/K) Calling Population Models, Use of Network of Queues.

Module 6: Random Number Generation- Properties. Generation of Pseudo-Random Numbers, Techniques for Generation of Pseudo-Random Numbers: Linear Congruential, Combined Linear Congruential, Random Number Streams. Tests for Random Numbers: Frequency Tests and Tests for Autocorrelation. Random Variate Generation- Inverse Transform Techniques for Exponential, Uniform, Weibull, Triangular and for Empirical Continuous Distributions. Acceptance-Rejection Techniques for Poisson (Stationary and Non-Stationary) Distribution and Gamma Distribution. Special Properties like the Direct Transformation for the Normal and Lognormal Distributions, Convolution Method and others.

Module 7: Input Modeling- Data collection, Identifying the Distribution with Data: Histograms, Selection of the Appropriate Family of Distributions, Quantile-Quantile Plots.

Parameter Estimation: Sample Mean and Sample Variance and various biased and unbiased Estimators. Goodness of Fit Tests applied to Simulation inputs: Chi-Square and Chi-Square with Equal Probabilities, Kolmogorov-Smirnov Tests, p-Values and Best Fits.Verification and Validation of Simulation Models- Verification and Validation of Simulation Models. Calibration and Validation: Face Validity, Validation of Assumptions, Input-Out Transformation Validation.

Module 8: Output Analysis of a Single Model- Output analysis and types of simulation. Stochastic Nature of the Output Data. Measures of Performance and Estimation: Point Estimation and Confidence-Interval Estimation. Output Analysis for Terminating Simulations and Estimation of Probabilities. Output Analysis of Steady State Simulations: Initialization Bias, Error Estimation, Replications, Sample Size and Batch Means for Interval Estimation.

Module 9: Comparison and Evaluation of Alternative System Designs- Comparison of Two System Designs.; Sampling with Equal and Unequal Variances. Common Random Numbers. Confidence Intervals with Specified Precision. Comparison of Several System Designs: Bonferroni Approaches to Multiple Comparisons and to Screening and to Selection of the Best. MetamodelingL Sample Linear Regression, Testing for Significance, Multiple Linear Regression. Random Number Assignment for Regression. Optimization via Simulation: Robust Heuristics.

Module10: Simulation of Computer Systems- Simulation Tools: Process Orientation and Event Orientation. Model Input: Modulated Poisson Process and Virtual-Memory Referencing. High-Level Simulation. CPU and Memory Simulations. Simulation of Computer Networks- Traffic Modeling, Media Access Control: Token-Passing Protocols and Ethernet, Data Link Layer, TCP, Model Construction.

Laboratory Component: Programming and/or software usage assignment/exercises to accompany each unit and can be of total 8 hours duration.

Text Books:
1.Jerry Banks, John S. Carson II, Barry L. Nelson and David M. Nicol, *Discrete-Event System and Simulation,* Prentice Hall of India, New Delhi, 2005
2.Averill M. Law, *Simulation modeling and analysi (SIE),* Tata McGraw Hill India, 2007
3.David Cloud, Larry Rainey, A*pplied Modeling and Simulation,* Tata McGraw Hill, India.

Reference Books:
1.Gabriel A. Wainer, *Discrete-event modeling and simulation: a practitioner's approach,* CRC Press, 2009.
2. Bernard P. Zeigler, Herbert Praehofer, Tag Gon Kim, *Theory of modeling and simulation: integrating discrete event and continuous complex dynamic systems,* Academic Press, 2000.
3. Averill M. Law, W. David Kelton, *Simulation modeling and analysis,* McGraw Hill, 2000.
4. Walter J. Karplus, George A. Bekey, Boris Yakob Kogan, *Modeling and simulation: theory and practice*, Springer, 2003.
5.Stanislaw Raczynski, *Modeling and simulation: the computer science of illusion,* Wiley, 2006.
6.Mohammad Salameh Obaidat, Georgios I. Papadimitriou, *Applied system simulation: methodologies and application,* Springer, 2003.
7.van Dijk, Nico M.; Boucherie, Richard J. (Eds.) 2011. *Queueing Networks: A Fundemental Approach*. 798 p. 148 illus. Springer.
8.Bhat, U. Narayan, *An Introduction to Queueing Theory: Modeling and Analysis in Applications,* Springer 2008 (Birkhäuser Boston).
9.James J. Nutaro, *Building software for simulation: theory and algorithms, with applications in C++*. Wiley, 2010.

CS 19: Internet Web Programming   *2:0:2   [3]*

Module1:   Working with User Interfaces – JAVA AWT Package, Window fundamentals, Basic User Interface Components (Labels, buttons, Check boxes, Radio buttons, choice Menu or Choice Lists, Text fields, Text areas, scrolling list, scroll bars, panels and frames), Layouts (Flow, Grid, Border, Card). Event-driven programming-Event driven programs, Event handling process, Java's event types. JAVA Swings- Comparison between Swing and AWT, Java swing packages, Swing basic containers, Swing components, event handling using Java swing, using dialogs, Joptionpane class, input dialog boxes, Timers and Sliders, Tables, Borders for components.

Module2:   JAVA database connectivity- JDBC/ODBC bridge, JAVA.SQL package, Connecting to remote data base, Data manipulation and Data navigation JAVA Servlets – Introduction- Servlet API, Lifecycle of Java Servlet, Creating Servlets, Running servlets, Cookie class. Networking with java- Java.net package, Implementation of client-server application using TCP/IP and UDP.

Module3:   Introduction to HTML- HTML tags, Frames and forms, Java Script- Introduction to scripting, control statements, Functions, Arrays, Objects. DHTML – Object model and Collections, Event model, Filters and Transitions, Data binding with tabular data control. XML – XML vocabularies, Document Object Model, SAX, Simple Object Access Protocol (SOAP), Extensible Style sheet Language(XSL)

Module4:   Server side scripting Languages- JSP- Introduction to JSP, JSP Architecture, Scripting components, Standard actions, JSP with JDBC – case study of a simple online application. PHP – Introduction (variables, control statements etc), String processing and regular expression, Form processing and business logic, Connecting to a database, Cookies, Dynamic content in PHP-case study of an online application

Module5:   I/O – AWT – Event handling – Introduction to Threads - Basics of Networking – TCP and UDP sockets – Connecting to the Web

Text Books:
1. Deitel & Deitel, JAVA : How to Program, Pearson education , 7e (2008)
2. Deitel & Deitel, Internet and World Wide Web How to Program, Pearson education, 3e ,(2005)

Reference Books:
1. Ivan BayRoss, Web Enabled Commercial Application using Java 2, bpb publication (1998)
2. David Flanagan , Java Script The Definitive Guide, O'relly, 5e (2006)

CS 20: Embedded Computing Systems   *2:0:2*

[3]

Module1:   Hardware Concepts -Application and characteristics of embedded systems, Overview of Processors and hardware units in an embedded system, General purpose processors, Microcontrollers:8051, Application- Specific Circuits (ASICs), ASIP, FPGA, ARM-based System on a Chip (SoC), Network on Chip (NoC), Levels of hardware modelling, Verilog, Sensors, A/D-D/A converters, Actuators, Interfacing using RS-232,

UART, USB, I2C, CAN bus, Flexray, SRAM and DRAM, Flash memory.

Module2: Real-Time Operating Systems- Real-Time Task Scheduling: Some important concepts, Types of real-time tasks and their characteristics, Task scheduling, Clock-Driven scheduling, Hybrid schedulers, Event-Driven scheduling, Earliest Deadline First (EDF) scheduling, Rate monotonic algorithm (RMA). Commercial Real-time operating systems: Time services, Features of a Real-time operating system, Unix-based Real-time operating systems, POSIX-RT, A survey of contemporary Real- time operating systems, Microkernel-based systems, Benchmarking real-time systems.

Module3: Embedded Application Development - UML 2.0, State charts, General language characteristics, MISRA C, Hardware/Software Co- design, Hardware/software partitioning, Testing embedded systems, Design for testability and Self-test.

Text Books:
1. Embedded Systems Design – A Unified Hardware /Software Introduction, by Frank Vahid and Tony Givargis, John Wiley.(2001)
2. An Embedded Software Primer, by David E.Simon, Pearson Education Asia. (1999)

Reference Books:
1. Wayne Wolf, Computers as Components; Principles of Embedded Computing System Design – Harcourt India, Morgan Kaufman Publishers.(2000)

CS 21: Software Testing   *3:2:0*

[4]

Module1: Basics of Software Testing- The Testing process, Testing and Debugging; Test Metrics; Software and Hardware Testing; Testing and Verification; Defect Management; Execution History; Test case generation Strategies, Static and dynamic analysis., Model-Based Testing; Control-flow Graph, state-model, and data-flow-based testing.

Module2: Test Generation and Regression Testing-Introduction; The Test-Selection Problem; Equivalence Partitioning; Boundary Value Analysis; Category-Partition Method. Cause-Effect Graphing, Test Generation from Predicates. Combinatorial Designs; A Combinatorial Test-Design Process; Fault Model. Basics of Regression Testing (RTS), Selecting Regression Tests; Test Selection Using Execution Trace; Test Selection Using program slicing; Test Minimization; Test Prioritization; Tools for Regression Testing.

Module3: Test Adequacy- Test Adequacy: Basics; Adequacy Criteria Based on Control Flow. Data-Flow Concepts; Adequacy Criteria Based on Data-Flow; Control Flow versus Data- Flow; The Subsumes Relation; Structural and Functional Testing; Scalability of Coverage Measurement.

Text Books:
1. Srinivasan Desikan, Gopalaswamy Ramesh: Software testing Principles and Practices, TMH. (2005)

Reference Books:
1. Aditya P Mathur: Foundations of Software Testing, Pearson Education. (2008).
2. Ron Patton: Software Testing, 2nd Edition, Pearson. (2005),
3. Mauro Pezze and Michal Young. Software Testing and Analysis, Wiley. (2006)

CS 22: Data Mining   *3:2:0*

[4]

Module1: Introduction: Basic concepts of data mining, including motivation and definition; different types of data repositories; data mining functionalities; concept of interesting patterns; data mining tasks; current trends, major issues and ethics in data mining

Module2: Data: Types of data and data quality; Data Preprocessing: data cleaning, data integration and transformation, data reduction, discretization and concept hierarchy generation; Exploring Data: summary statistics, visualization, multidimensional data analysis

Module3: Association and Correlation Analysis: Basic concepts: frequent patterns, association rules - support and confidence; Frequent itemset generation - Apriori algorithm, FP-Growth algorithm; Rule generation, Applications of Association rules; Correlation analysis.

Module4: Clustering Algorithms and Cluster Analysis: Concept of clustering, measures of similarity, Clustering algorithms: Partitioning methods - k-means and k-medoids, CLARANS, Hierarchical methods - agglomerative and divisive clustering, BIRCH, Density-based methods - Subspace clustering, DBSCAN; Graph-based clustering - MST clustering; Cluster evaluation; Outlier detection and analysis.

Module5: Classification: Binary Classification - Basic concepts, Bayes theorem and Naive Bayes classifier, Association based classification, Rule based classifiers, Nearest neighbour classifiers, Decision Trees, Random Forest; Perceptrons; Multi-category classification; Model overfitting, Evaluation of classifier performance - cross validation, ROC curves.

Module6: Applications: Text mining, Web data analysis, Recommender systems. Prerequisites: Familiarity with basic Linear Algebra and Probability will be assumed.

Text Books:
1. Pang-Ning Tan, Michael Steinbach and Vipin Kumar, Introduction to Data Mining. Pearson (2005), India. ISBN 978-8131714720
2. Jiawei Han and Micheline Kamber, Data Mining: Concepts and Techniques, Morgan Kaufmann, 3rd edition (July 2011). 744 pages. ISBN 978-0123814791
3. Ian H. Witten and Eibe Frank, Data Mining: Practical Machine Learning Tools and Techniques, Morgan Kaufmann, 3rd edition (January 2011). 664 pages. ISBN 978-0123748560.

Reference Books:
1. T. Hastie, R. Tibshirani and J. H. Friedman, The Elements of Statistical Learning, Data Mining, Inference, and Prediction. Springer, 2nd Edition, 2009. 768 pages. ISBN 978-0387848570
2. C. M. Bishop, Pattern Recognition and Machine Learning. Springer, 1st edition, 2006. 738 pages. ISBN 978-0387310732

Data Mining Laboratory Exercises:

This laboratory course is a part of the course on "Data Mining". This course will give students an opportunity to learn the specifics of some open source data mining software and carry out experiments on real-world data sets. The students may be asked to do independent project work as a part of this laboratory course. In particular, the students are expected to

1. Learn to install open source data mining software such as Weka, XL Miner etc.

2. Do experiments with respect to

a. Data preprocessing, attribute oriented analysis and visualization

b. Mining association rules

c. Classifier design: Naive Bayes Classifier, Rule based classifiers, Decision Trees and Perceptions (both for binary and multiclass Classification), Random Forests

d. Evaluation of classifiers

e. Clustering algorithms: k-means and k-medoids, hierarchical, CLARANS, BIRCH and DBSCAN

f. Cluster evaluation

3. Extend the data mining algorithms implemented in open source data mining software

4. Propose, implement and test new data mining algorithms

5. Apply the new algorithms to some sample data sets such as KDD CUP data sets and compare them with some existing algorithms

CS 23: Advanced Computer Architecture   *3:0:0*

[3]

Module 1:   Introduction - What is computer architecture? Software-hardware interface. Performance and Power. Performance   metrics. Performance   measurement. Benchmark programs.

Module2:   Instructions- Instruction Set. Operations. Operands and addressing modes. Role of   compilers and system software. Understanding implementation of function calls and returns, array   references, pointers.

Module3:   Computer Arithmetic- Signed integers. Floating point. Rounding and accuracy. Addition and Subtraction. Multiplication. Division; Processor - Data path elements. Data path control.

Module4: Pipelining - Speedup. Pipeline hazards. Stalling. Forwarding. Branch prediction. Exceptions. Speculation. Multiple issue. Dynamic scheduling;   Cache memory- Locality of reference. Cache organization and access. Multilevel caches. Performance. Cache coherence.

Module5:   Virtual memory- Hardware support for address translation, page fault handling. Translation look aside buffer. Hardware-software interface.

Module6:   Input/Output- Hard disk. Flash memory. I/O interfacing. Memory mapped I/O. Interrupt driven I/O.   Direct memory access. Redundant arrays of inexpensive disks; Introduction to advanced topics- Multi-cores. Multi-processors. Clusters.

Text Books:

1.David A. Patterson and John L. Hennessy, Computer Organization and Design: The Hardware and Software Interface, Morgan Kaufmann Publishers, Fourth Edition.(2009)

Reference Books:

1.John L. Hennessy and David A. Patterson, Computer Architecture: A Quantitative Approach, Morgan Kaufmann Publishers (2007)

CS 24: Approximation of Algorithms   *3:0:0*

[3]

Module1:   Background;   2-approx for unweighted vertex cover via max'l matching;

Module2:   2-approx for steiner tree via MST;   Christofides 1.5-approx for metric TSP;

Module3:   PTAS for knapsack by coarsening; ln(n)-approx for set cover by greedy;

Module4:   Linear programming;   Duality, 2-approx for weighted vertex cover via duality;

Module 5:   Basic probability, randomized rounding; max-cut, max-sat by randomized rounding;

Module6:   Chernoffbound, load-balancing (from chapter); Semi-definite programming, max-cut by semi-definite programming multi-commodity flow by lagrangian relaxation?

Module 7:   Hardness of approximation

Text Books:

1.Approximation Algorithms, by Vijay Vazirani, Springer-Verlag, ISBN: 3-540-65367-8, published 2001.

Reference Books:

1.Dorit Hochbaum (Editor), Approximation Algorithms for NP-Hard Problems, Brooks/Cole Pub Co; ISBN: 0534949681; 1st edition (July 26, 1996)
2.Alexander Schrijver, Theory of Linear and Integer Programming, ISBN: 0471982326, Wiley, John & Sons, Incorporated, June 1998.

CS 25: Mobile Computing   *2:2:0*

[3]

Module1:   Technical Background -   Transmission Fundamentals ,   Communication Networks ,   Protocols and the TCP/IP Suite

Module2:   Wireless Communication Technology :   Cellular Wireless Networks , Antennas and Wave Propagation ,   Modulation Techniques ,   Multiple Access in Wireless System

Module3:   Mobile Adaptive Computing , Mobility Management , Data Dissemination and Management

Module4:   Context-Aware Computing

Module5: Introduction to Mobile Middleware , Middleware for Application Development: Adaptation and Agents , Service Discovery Middleware: Finding Needed Services

Module6: Introduction to Ad Hoc and Sensor Networks , Challenges , Protocols

Module7: Wireless Security , Approaches to Security , Security in Wireless Personal Area Networks , Security in Wireless Local Area Networks ,Security in Wireless Metropolitan Area Networks (802.16) , Security in Wide Area Networks

Text Books:
1.*Wireless Communications and Networking*, Willam Stallings, Pearson Education. (2002)
2.“Fundamentals of Mobile & Pervasive Computing ” by Frank Adelstein, Sandeep Ks Gupta ,ISBN : 9780070603646, TMH (2005)

Reference Books:
1.Jochen Schiller, *"Mobile Communications,"* Addison-Wesley (2009)
2.R. Dayem, *"Mobile Data & Wireless Lan Technologies,"* Prentice-Hall (2005)

CS 26: Pattern Recognition   *2:2:0*

[3]

Module1: Introduction- Paradigms for pattern recognition, Statistical and Syntactic pattern recognition, Soft and Hard computing schemes for pattern recognition. Statistical Pattern Recognition- Patterns and classes, Supervised, Semi-supervised, and Unsupervised classification,

Module 2: Representation- Vector space representation of patterns and classes, patterns and classes as strings, Tree-based representations, Frequent itemsets for representing classes and clusters, Patterns and classes as logical formulas.

Module 3: Proximity Measures- Dissimilarity measures, metrics, similarity measures, Edit distance, Hausdorff metric between point sets, Kernel functions, Contextual and conceptual similarity between points.

Module 4: Dimensionality Reduction- Feature selection: Branch and bound, Sequential feature selection, Feature extraction: Fisher's linear discriminant, Principal components as features; Nearest Neighbor Classifiers- Nearest neighbor classifier, Soft nearest neighbor classifiers, Efficient algorithms for nearest neighbor classification, K-nearest neighbor classifier, minimal distance classifier, condensed nearest neighbor classifier and its modifications.

Module5: Bayes Classifier- **B**ayes classifier, naïve Bayes classifier, Belief net ; Decision Trees- Axis-parallel and oblique decision trees, Learning decision trees, Information gain and Impurity measures.

Module 6: Linear Discriminant Functions- Characterization of the decision boundary, Weight vector and bias, Learning the discriminant function, Perceptrons; Support Vector Machines- Maximizing the margin, Training support vector machines, Kernel functions.

Module 7:   Clustering- Clustering process, Clustering algorithms, Clustering large datasets*;*

Module 8:   Combination of Classifiers- AdaBoost for classification, Combination of homogeneous classifiers, Schemes for combining classifiers.

Text Books:
1.V. Susheela Devi and M. Narasimha Murty, *Pattern Recognition: An Introduction,* Universities Press, Hyderabad, 2011.

Reference Books:
1.R. O. Duda, P. E. Hart and D. G. Stork, *Pattern Classification,* John Wiley and Sons, 2000.
2.M. Narasimha Murty and V. Susheela Devi, *Pattern Recognition,* NPTEL Web Course, 2011 (http://nptel.iitm.ac.in/courses.php?disciplineId=106).

CS 27: Information Retrieval   3:2:0

[4]

Module 1:   Introduction- Basics of Information Retrieval and Introduction to Search Engines; Boolean Retrieval-: Boolean queries, Building simple indexes, Processing Boolean queries

Module 2:   Term Vocabulary and Posting Lists- Choosing document units, Selection of terms, Stop word elimination, Stemming and lemmatization, Skip lists, Positional postings and Phrase queries;   Dictionaries and Tolerant Retrieval: Data structures for dictionaries, Wildcard queries, Permuterm and K-gram indexes, Spelling correction, Phonetic correction.

Module 3:   Index Construction- Single pass scheme, Distributed indexing, Map Reduce, Dynamic indexing; Index Compression - Statistical properties of terms, Zipf's law, Heap's law, Dictionary compression, Postings file compression, Variable byte codes, Gamma codes.

Module 4:   Vector Space Model- Parametric and zone indexes, Learning weights, Term frequency and weighting, Tf-Idf weighting, Vector space model for scoring, variant tf-idf functions.

Module 5:   Computing Scores in a Complete Search System- Efficient scoring and ranking, Inexact retrieval, Champion lists, Impact ordering, Cluster pruning, Tiered indexes, Query term proximity, Vector space scoring and query operations;

Module 6:   Evaluation in Information Retrieval: Standard test collections, unranked retrieval sets, Ranked retrieval results, Assessing relevance, User utility, Precision and Recall**,** **R**elevance feedback, Rocchio algorithm, Probabilistic relevance feedback, Evaluation of relevance feedback.

Module 7:   Probabilistic Information Retrieval- Review of basic probability theory, Probability ranking principle, Binary independence model, Probability estimates, probabilistic approaches to relevance feedback.   Text Classification- Rocchio classifier, K-Nearest neighbor classifier, Linear and nonlinear classifiers, Bias-variance tradeoff, Naïve Bayes and Support Vector machine based classifiers.

Module 8: Text Clustering- Clustering in information retrieval, Evaluation of clustering, K-Means and Hierarchical clustering. Introduction to Linear Algebra, Latent Semantic Indexing.

Text Books:

1.C. D. Manning, P. Raghavan, and H. Schutze, *An Introduction to Information Retrieval,* Cambridge University Press, 2009.

Reference Books:

1.R. Baeza-Yates and B. Ribeiro-Neto, *Modern Information Retrieval, Pearson Education*, 1999.

CS 28: Software Architecture   *3:2:0*

[4]

Module1: Introduction to Software architecture − Architectural styles − pipes and filters − data abstraction and object oriented organization − Event based, Implicit invocation, Layered systems − Repositories − Interpreters − Process control − Heterogeneous Architectures.

Module2: Shared Information Systems − Integration in software Development Environment − Integration in the design of Buildings − Architectural structures for shared information systems

Module3: Guidance for user interface architecture Quantified design space − Formal models and specifications-The value of architectural formalism − Formalizing the architecture of a specific system − Formalizing the architectural style −Formalizing an architectural design space

Module4: Linguistic issues - Requirements for architecture − Description languages − first class connectors − Adding implicit invocation to factorial processing languages.

Module5: Tools for architectural design − Unicon − Exploiting style in architectural design environments − Architectural interconnection ; ADL − Languages for describing architectures.

Text Books:
1. Software Architecture − perspectives on an emerging discipline - Mary Shaw, David Garlan, PHI (1996)
2. Mary Shaw and David Garlan, "Software Architecture − Perspectives on an emerging Discipline", PHI, 2003

Reference Books:
1. Hong Zhu, " Software Design Methodology − From principles to Architectural styles", Elsevier, 2006.
2. David Budgen, "Software Design", Pearson Education, 2004

CS 29: VLSI Design & Algorithms   *2:2:0*

[3]

Module1: Introduction to MOSFETs, MOSFET Equivalent Circuits; MOSFET logic circuits: NMOS inverter, CMOS inverter, CMOS Processing.

Module 2:   Layout design rules. CAD tools for VLSI Design. MOSFET   Logic gates; CMOS combinational, sequential logic circuits,

Module 3:   Flip flop and latch timings, Clocking; Circuit characterization and performance estimation: R, C estimation,

Module 4:   Switching characteristics, Delay models; Power dissipation, Packaging, Scaling of MOS FET dimensions.

Module 5:   CMOS testing: Fault models. CMOS subsystem design;   Data path operations: Addition, Multiplication, Counters, Shifters, Memory elements.

Text Books:
1.Jan M. Rabaey, A. Chandrakasan, and B. Nikolic, Digital Integrated Circuits: A design Perspective, Pearson Education, 2002

Reference Books:
1.S.M.Kang & Y. Leblebici, CMOS Digital Integrated Circuits, McGraw Hill, 2002
2.Ken Martin, Digital Integrated Circuit Design, Oxford Press, 2000.

CS 30: Soft Computing   *3:0:0*

[3]

Module1:   Introduction - What is soft computing ? Differences between soft computing and hard computing, Soft Computing constittuents, Methods in soft computing, Applications of Soft Computing.

Module2:   Introduction to Genetic Algorithms-   Introduction to Genetic Algorithms (GA), Representation, Operators in GA, Fitness function, population, building block hypothesis and schema theorem.; Genetic algorithms operators- methods of selection, crossover and mutation, simple GA(SGA), other types of GA, generation gap, steady state GA, Applications of GA

Module 3:   Neural Networks- Concept, biological neural syste,. Evolution of neural network, McCulloch-Pitts neuron model, activation functions, feedforward networks, feedback networks, learning rules – Hebbian, Delta, Percepron learning and Windrow-Hoff, winner-take-all.

Module 4:   Supervised learning- Perceptron learning, single l layer/multilayer perceptron, linear separability, hidden layers, back popagation algorithm, Radial Basis Function network; Unsupervised learning -   Kohonen, SOM,   Counter-propagation, ART, Reinforcement learning, adaptive resonance architecture, applications of neural networks to pattern recognition systems such as character recognition, face recognition, application of neural networks in image processing.

Module 5:   Fuzzy systems **-** Basic definition and terminology, set-theoretic operations, Fuzzy Sets, Operations on Fuzzy Sets, Fuzzy Relations, Membership Functions, Fuzzy Rules & Fuzzy Reasoning, Fuzzy Inference Systems, Fuzzy Expert Systems, Fuzzy Decision Making;   Neuro-fuzzy modeling- Adaptive Neuro-Fuzzy Inference Systems, Coactive

Neuro-Fuzzy Modeling, Classification and Regression Trees, Data Clustering Algorithms, Rulebase Structure Identification and Neuro-Fuzzy Control , Applications of neuro-fuzzy modeling.

Module 6: Swarm Intelligence- What is swarm intelligence? Various animal behaviour which have been used as examples, ant colony optimization, swarm intelligence in bees, flocks of birds, shoals of fish, ant-based routing, particle swarm optimization

Text Books:
1. S.N. Shivanandam, *Principle of soft computing*, Wiley. ISBN13: 9788126527410 (2011)
2. Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani, "Neuro-Fuzzy and Soft Computing", Prentice-Hall of India, 2003.
3. George J. Klir and Bo Yuan, "Fuzzy Sets and Fuzzy Logic-Theory and Applications", Prentice Hall, 1995.
4. James A. Freeman and David M. Skapura, "Neural Networks Algorithms, Applications, and Programming Techniques", Pearson Edn., 2003.

Reference Books:
1. Mitchell Melanie, "An Introduction to Genetic Algorithm", Prentice Hall, 1998.
2. David E. Goldberg, Genetic Algorithms in Search, Optimization & Machine Learning, Addison Wesley, 1997.

CS 31: Game Theory   *3:0:0   [3]*

Module1: Introduction- What is Game Theory? Definition of Games. Actions, Strategies, Preferences, Payoffs. Examples**;** Strategic Form Games - Strategic form games and examples: Prisoner's Dilemma, Bach or Stravinsky, Matching Pennies, Tragedy of Commons, Braess Paradox.

Module 2: Dominant Strategy Equilibrium- Strongly dominant strategies, weakly dominant strategies, dominant strategy equilibrium; Examples of Prisoner's Dilemma and Vickrey Auction.

Module 3: Pure Strategy Nash Equilibrium- Best response strategies; Notion of pure strategy Nash equilibrium. Examples of Nash Equilibrium. Examples of Nash Equilibrium in popular games. Symmetric Games and Symmetric Equilibria; Mixed Strategy Nash Equilibrium- Randomization of Actions, Mixed strategy Nash equilibrium, Necessary and sufficient conditions for a Nash equilibrium. Examples of mixed strategy Nash equilibrium. Computing mixed strategy Nash equilibria. Related algorithmic issues.

Module4: Two Player Zerosum Games (Matrix Games)- Max-minimization and Min-maximization. Saddle points. Nash equilibrium in matrix games. Mini-max theorem. Solution via linear programming. Examples; Extensive games with Perfect Information- Extensive games, Strategies and outcomes, Nash equilibrium, Subgame perfect equilibrium, finding subgame perfect equilibria using backward induction. Allowing for simultaneous moves. Examples.

Module 5: Bayesian Games- Motivational Examples. Definition of a Bayesian Game and Bayesian Nash Equilibrium and examples.

Module 6: Mechanism Design= Social choice functions. Direct and indirect mechanisms. Notion of incentive compatibility. Revelation theorem. Properties of social choice functions.

Gibbard Satterthwaite theorem. Quasi-linear utilities. Vickrey auction. Clarke mechanisms. Groves mechanisms. Examples of VCG (Vickrey-Clarke-Groves) mechanisms. Different types of auctions. Revenue equivalence theorem.

Module7: Cooperative Game Theory- Correlated strategies and correlated equilibrium. The two person Nash bargaining problem and its solution with examples. Games in characteristic form and examples. . The Core of a characteristic form game. Shapley value and its implications. Examples.

Text Books:
1.Martin Osborne. *An Introduction to Game Theory*. Oxford University Press, 2003.
2.Y. Narahari. *Essentials of Game Theory and Mechanism Design*. IISc Press, 2011

Reference Books:
1.Phiip D. Straffin, Jr. *Game Theory and Strategy*. The Mathematical Association of America, January 1993.
2.Ken Binmore, *Fun and Games : A Text On Game Theory*, D. C. Heath & Company, 1992.

CS 32: Combinational Optimization   3:0:0

[3]

Module1: Unconstrained Optimization: Optimizing Single-Variable Functions, conditions for Local Minimum and Maximum, Optimizing Multi-Variable Functions.

Module2: Constrained Optimization: Optimizing Multivariable Functions with Equality Constraint: Direct Search Method, Lagrange Multipliers Method, Constrained Multivariable Optimization with inequality constrained: Kuhn-Tucker Necessary conditions, Kuhn – Tucker Sufficient Conditions.

Module3: Optimization: Quasi-Newton Methods and line search, least squares optimization, Gauss-Newton, Levenberg- Marquartd, Extensions of LP to Mixed Integer Linear Programming (MILP), Non-Liner Programming, The Newton Algorithm, Non-Linear Least Squares, Sequential Quadratics Programming (SQP), Constrained Optimization, SQP Implementation, Multi-Objective Optimization, Branch and Bound Approaches, Genetic Algorithms and Genetic Programming, Singular Based Optimization, On-Line Real-Time Optimization, Optimization in Econometrics Approaches – Blue.

Module4: Optimization and Functions of a Complex Variable and Numerical Analysis: The Finite Difference Method for Poisson's Equation in two Dimensions and for the Transient Heat Equation, Eulers Method, The Modified Euler Method and the Runga-Kutta Method for Ordinary Differential Equations, Gaussian Quardative Tranzoidal Rule and Simpson's 1/3 and 3/8 Rules, the Newton Raphson in one and two Dimensions, Jacobi's Iteration

Module5: Optimization in Operation Research: Dynamic Programming, Transportation – Linear Optimization Simplex and Hitchcock Algorithms, Algorithms, Minimax and Maximum Algorithm, Discrete Simulation, Integer Programming – Cutting Plane Methods,

Module6: Separable Programming, Stochastic Programming, Goal Programming, Integer Linear Programming, Pure and Mixed Strategy in theory of Games, Transshipment Problems, Heuristic Methods.

Text Books:
1.Optimization: Theory and Applications.by Rao S.S., John Wheily & Sons Publication, 4th edition, 2009
2.Operations Research: Applications and Algorithms by Wayne L. Winston, PWS-Kent Pub. Co., 1991

CS 33: Computer Vision   *3:0:0*

[3]

Module1: Introduction- Machine vision systems, optics and lenses, image sensors, human vision and Neuro-visual model; Marr's paradigm; Imaging geometry - world co-ordinate system and camera co-ordinate system, co-ordinate transformations, projection geometry, camera calibration, radiometry.

Module2: Early processing and image filtering: Noise removal, region segmentation, concept of primal sketch, scale space, edge detection and localization, edge linking, Hough transform, corner and junction detection. Reflectance map and photometric stereo: Image brightness and radiometry, image formation and surface reflectance under different conditions, reflectance map and bidirectional reflectance distribution function, photometric stereo recovering albedo and surface orientation, shape from shading.

Module3: Range measurement and recovering s cene geometry: Binocular technique stereo pair, epipolar line and plane, Stereo matching, photogrammetry, monocular technique - texture processing and shape from texture, depth from focusing and symmetry, different range finder (active) - laser range finder, light-stripe method.

Module4: Motion estimation: Motion field, optical flow - smoothness, boundary conditions, discontinuities of optical flow, block based method, pre-recursive method, Bayesian method, Motion segmentation method, motion from points and lines, token tracking, stereo and motion tracking, use of Kalman filter, focus of expansion, structure from motion, motion compensated filtering and restoration, video compression, active and passive surveillance.

Module5: Representation and analysis of polyhedral scene: understanding line drawings, gradient and dual space, generalized cylinder, volumetric representation, edge and junction labelling; Labelling and recognition of scene objects; Construction of model-base and visual learning, model based recognition system - Acronym, model based recognition from sparse range data, 3D model based vision system, scene understanding. Special systems for computer vision: Visual information processing architecture, language and control, Applications

Text Books:
1. D. H. Ballard and C. M. Brown: Computer Vision, Prentice Hall, New York,1986.
2. R. M. Haralick, L. G. Shapiro: Computer and Robot Vision, Addison-Wesley Pub Co, reading, Mass., 1992.

Reference Books:
1. Y. Shirai: Three-Dimensional Computer Vision, Springer-Verlag Berlin, 1988.
2. B. K. P. Horn: Robot Vision, MIT Press, Cambridge, 1986.

CS 34: Software Project Management   *3:0:0*

[3]

Module1:   Project Evaluation and Planning - Activities in Software Project Management, Overview Of Project Planning, Stepwise planning, contract management, Software processes and process models. Cost Benefit Analysis, Cash Flow Forecasting, Cost-Benefit Evaluation Techniques, Risk Evaluation. Project costing, COCOMO 2, Staffing pattern, Effect of schedule compression, Putnam's equation, Capers Jones estimating rules of thumb, Project Sequencing and Scheduling Activities, Scheduling resources, Critical path analysis, Network Planning, Risk Management, Nature and Types of Risks, Managing Risks, Hazard Identification, Hazard Analysis, Risk Planning and Control, PERT and Monte Carlo Simulation techniques.

Module2:   Monitoring And Control- Collecting Data, Visualizing Progress, Cost Monitoring, review techniques, project termination review, Earned Value analysis, Change Control, Software Configuration Management (SCM), Managing Contracts, Types Of Contracts, Stages In Contract Placement, Typical Terms of A Contract, Contract Management and Acceptance.

Module3:   Quality Management and People Management- Introduction, Understanding Behavior, Organizational Behaviour, Selecting The Right Person For The Job, Motivation, The Oldman – Hackman Job Characteristics Model , Working in Groups, Organization and team structures, Decision Making, Leadership, Organizational Structures, Stress, Health And Safety. ISO and CMMI models, Testing, and Software reliability, test automation, Overview of project management tools.

Text Books:
1.Bob Hughes, Mike Cotterell, "Software Project Management", Tata McGraw Hill. (2009)

Reference Books:
1. Royce, "Software Project Management", Pearson Education. (2005).
2. Robert K. Wysocki, "Effective Software Project Management", Wiley.(2006)

CS 35: Human Computer Interface   *3:0:0   [3]*

Module1:   Introduction0   The human, The computer, The interaction, Paradigms, Usability of Interactive Systems,   Guidelines, Principles, and Theories

Module2:   Design Process- Interaction design basics, HCI in the software process, Design rules, Implementation support, Evaluation techniques, Universal design, User support

Module3:   Models and Theories0 Cognitive models, Socio-organizational issues and stakeholder requirements, Communication and collaboration models,Task analysis, Dialogue notations and design, Models of the system, Modelling rich interaction

Module4:   Interaction Styles-   Direct Manipulation and Virtual Environments,   Menu Selection, Form Filling and Dialog Boxes,   Command and Natural Languages,   Interaction Devices,   Collaboration and Social Media Participation

Module5:   Design Issues-   Quality of Service,   Balancing Function and Fashion,   User Documentation and Online Help,   Information Search,   Information Visualization

Module6:   Outside the Box- Group ware,Ubiquitous computing and augmented realities, Hypertext, multimedia, and the world wide web

Text Books:

1,"Human Computer Interaction" by Alan Dix, Janet Finlay , ISBN :9788131717035, Pearson Education (2004)
2."Designing the User Interface - Strategies for Effective Human Computer Interaction", by Ben Shneiderman ISBN : 9788131732557, Pearson Education (2010).

Reference Books:
1.Usability Engineering: Scenario-Based Development of Human-Computer Interaction , by Rosson, M. and Carroll, J. (2002)
2.The Essentials of Interaction Design, by Cooper, et al. , Wiley Publishing(2007)
3.Usability Engineering, by Nielsen, J. Morgan Kaufmann, San Francisco, 1993. ISBN 0-12-518406-9
4.The Resonant Interface: HCI Foundations for Interaction Design , by Heim, S. , Addison-Wesley. (2007)
5.Usability engineering: scenario-based development of human-computer interaction, By Rosson, M.B & Carroll, J.M. , Morgan Kaufman.(2002)

Electives in one Group CS*

CS*36: Cloud Computing   *3:0:0*

[3]

Module1:   Introduction -   Shift from distributed computing to cloud computing; principles and characteristics of cloud computing- IaaS, PaaS, SaaS; service oriented computing and cloud environment

Module2:   Cloud Computing Technology -   Client systems, Networks, server systems and security from services perspectives; Accessing the cloud with platforms and applications; cloud storage

Module3: Working with Cloud-   Infrastructure as a Service – conceptual model and working Platform as a Service – conceptual model and functionalities Software as a Service – conceptual model and working Technologies and Trends in Service provisioning with clouds

Module4: Using Cloud Services- Cloud collaborative applications and services – technology, applications and case studies with calendars, schedulers and event management; cloud applications in project management.

Module5:   Case studies-Microsoft Azure, Google App Engine and Open source clouds- Open-Nebula and Eucalyptus , Current trends and research

Text Books:
1.Anthony T.Velte, Toby J.Velte and Robert E, Cloud Computing – A Practical Approach, TMH , 2010
2.Michael Miller, Cloud Computing – Web based Applications, Pearson Publishing, 2011

Reference Books:
1.Resources from Internet

CS*37: Web Service and Service Oriented Architecture   *3:0:0*

[3]

Module1:   Introduction – Service Oriented Enterprise – Service Oriented Architecture (SOA) – SOA and Web Services – Multi-Channel Access – Business Process management – Extended Web Services Specifications – Overview of SOA – Concepts – Key Service Characteristics – Technical Benefits – Business Benefits

Module2: SOA and Web Services – Web Services Platform – Service Contracts – Service-Level Data Model – Service Discovery – Service-Level Security – Service-Level Interaction patterns – Atomic Services and Composite Services – Proxies and Skeletons – Communication – Integration Overview – XML and Web Services - .NET and J2EE Interoperability – Service-Enabling Legacy Systems – Enterprise Service Bus Pattern

Module3: Multi-Channel Access – Business Benefits – SOA for Multi Channel Access – Tiers – Business Process Management – Concepts – BPM, SOA and Web Services – WSBPEL – Web Services Composition

Module4: Java Web Services – JAX APIs – JAXP – JAX-RPC – JAXM – JAXR – JAXB

Module5: Metadata Management – Web Services Security – Advanced Messaging – Transaction Management

Text Books:
1.Eric Newcomer, Greg Lomow, "Understanding SOA with Web Services", Pearson   Education, 2005.
2.James McGovern, Sameer Tyagi, Michael E Stevens, Sunil Mathew, "Java Web Services   Architecture", Elsevier, 2003.

Reference Books:
1.Thomas Erl, "Service Oriented Architecture", Pearson Education, 2005.
2. Frank Cohen, "FastSOA", Elsevier, 2007.

CS*38: Bioinformatics   3:0:0

[3]

Module1: Introduction - Bioinformatics – Overview and Definitions, Applications, Major Databases in Bioinformatics, Data Management and Analysis, Molecular Biology and Bioinformatics, Central Dogma of Molecular Biology.

Module2: Information Search and Data Retrieval - Introduction, Tools for Web Search, Data Retrieval Tools, Data Mining of Biological Databases.

Module3: Genome Analysis and Gene Mapping - Genome Analysis, Genome Mapping, The Sequence Assembly Problem, Genetic Mapping and Linkage Analysis, Physical Maps, Cloning the Entire Genome, Genome Sequencing.

Module4: Alignment of Pairs of Sequences - Biological Motivation of Alignment Problems, Methods of Sequence Alignments, Using Scoring Matrices, Measuring Sequence Detection Efficiency

Module5: Tools for Similarity Search and Sequence Alignment - Working with FASTA, BLAST, Filtering and Gapped BLAST, FASTA and BLAST Algorithms Comparison.

Module6: Gene Expression Microarrays - DNA Microarrays, Clustering Gene Expression Profiles, Data Sources and Tools for Microarray Analysis, Applications of Microarray Technology.

Module7: Protein Classification and Structure Visualization - Overview of Protein Structure, Visualization, Structure based Protein Classification, Protein Structure Databases, Tools, Protein Structure Alignment.

Module8: Protein Structure Prediction - Protein Identification and Characterization, Primary Structure analysis and Prediction, Secondary Structure Analysis and Prediction, Motifs, Profiles, Patterns and Fingerprints Search, Methods for Sequence based Protein Prediction.

Text Books:

1.S C Rastogi, N Mdndiratta, P Rastogi, Bioinformatics Methods and Applications, Genomics, Proteomics and Drug Discovery, PHI. 2006

2 BryanBergeron, Bioinformatics Computing, Pearson Education. 2003

CS*39: Script Programming   *3:0:0   [3]*

Module1: Introduction to Script programming in Linux and MS-Windows Perl programming

Module2: Python programming

Module3: Php programming

Module4: Windows Power shell programming

Module5: Applications development with Client/server architecture, graphs, GUI and graphics programming using script langauages searching and search engine development using script languages.

Text Books:
1. Programming Perl, 3rd Edition By Larry Wall, Tom Christiansen, Jon Orwant O'Reilly 2000
2. Beginning Python: From Novice to Professional, Magnus Lie Hetland, Apress, 2008, ISBN 1- 59059-982-9
3. PhP 5 Power programming available at:
http://ptgmedia.pearsoncmg.com/images/013147149X/downloads/013147149X_book.pdf
4. Professional Windows PowerShell Programming ISBN: 978-0-470-17393-0 Wrox book Professional

CS*40: Multimedia Computing   *3:0:0*

[3]

Module1: Introduction to Multimedia: Media and Data Streams; Sound/Audio, Images and Graphics, Video and Animation;

Module2: Data Compression, Optical Storage Media; Computer Technology, Multimedia Operating Systems;

Module 3: Networking Systems, Multimedia Communication Systems; Database Systems;

Module 4: Multimedia Architecture; Multimedia Documents, Hypertext and MHEG;

Module 5: User Interfaces, Synchronization, Abstractions for Programming; Multimedia Application Development;

Module 6: Virtual Reality; Future Directions;

Text Books:
1."Multimedia Computing Communications & Applications " by Ralf Steinmetz, Klara Nahrstedt , , Pearson Education (2004)
2.Principles of Multimedia by Parekh Ranjan,Tata McGraw-Hill(2007)

Reference Books:
1.Multimedia Systems, By John E Koegal, Buford, IIBK. (1994)
2.Virtual Reality Systems, John Vince, ACM Press (1995)
3.Computer Networks, A S Tanenbaum, Fourth Edition.(2004)
4.http://pet.ece.iisc.ernet.in/course/E0262/

CS P1: Project Work I   0:0:8 [4]

The object of *Project Work I* is to enable the student to take up investigative study in the broad field of *Computer Science & Engineering*, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on an individual basis or two/three students in a group, under the guidance of a Supervisor. This is expected to provide a good initiattion for the student(s) in R&D work. The assignment to normally include:

- Survey and study of published literature on the assigned topic;
- Working out a preeliminary Approach to the Problem relating to the assigned topic;
- Conducting   preliminary Analysis/Modelling/Simulation/Experiment/Design/Feasibility;
- Preparing a Written Report on the Study conducted for presentation to the Department;
- Final Seminar, as oral Presentation before a Departtmental Committtee.

CS P2: Project Work II & Dissertation   0:0:32 [16]

The object of *Project Work II & Dissertation* is to enable the student to extend further the investigative study taken up under *EC P1*, either fully theoretical/practical or involving both theoretical and practical work, under the guidance of a Supervisor from the Department alone or jointly with a Supervisor drawn from R&D laboratory/Industry. This is expected to provide a good training for the student(s) in R&D work and technical leadership. The assignment to normally include:

- In depth study of the topic assigned in the light of the Report prepared under *EC P1;*
- Review and finalization of the Approach to the Problem relating to the assigned topic;
- Preparing an *Action Plan* for conducting the investigation, including team work;
- Detailed Analysis/Modelling/Simulation/Design/Problem Solving/Experiment as needed;
- Final development of product/process, testing, results, conclusions and future directions;
- Preparing a paper for Conference presentation/Publication in Journals, if possible;
- Preparing a Dissertation in the standard format for being evaluated by the Departtment;
- Final Seminar Presentation before a Departmental Committee.

Annexure A

AICTE: AIB-UGS (E&T) Working Groups *(December 2010)*

S. No	Working Group	Coordinators	Members
1.	*HSS,* for all the programmes in 5-6 *Courses; (=14 Credits)*	Prof. Vijay Khole Ex. Vice Chancellor University of Mumbai, Mumbai. e-mail:vvkhole@gmail.com	• Prof. N. Rajaram, Dean School of Social Sciences, Central Univ., Gujrat, Sector-30 Gandhinagar, Gujrat-382030 • Prof. Xaxa, Dept. of Sociology, University of Delhi (North Campus) Delhi-110006 • Prof. E. Ramakrishna, Dean School of Languages and Culture Studies, Central Univ, Gujrat, Sector-30 Gandhinagar Gujrat-382030 • Prof. Abhay Pehte, Director, Dept. of Economics, Univ. of Mumbai, Vidyanagari, Kalina, Santacruz (E) Mumbai-400098 • Prof. Ms Rashmi Oza, Dept. of Law, Univ. of Mumbai, M.G. Road Fort Mumbai-400032
2	*BS,* for all the programmes in 10-12 *Courses; (=30 Credits)*	Prof. Vijay Khole Ex. Vice Chancellor University of Mumbai, Mumbai, email:vvkhole@gmail.com	For Physics • Dr. Sudhir Panse, Adjunct Prof., Dept of Physics, Institute of Chemical Technology (Deemed Univ.) Nathalal Parekha Marg, Matunga, Mumbai-400019. • Prof. Pandit Vidyasagar, Head Dept. of Physics, Univ. of Pune-411007. For Chemistry • Prof. Mansingh, Dean School of Chemical Sciences, Central Univ. Gujrat Sector-30 Gandhinagar, Gujrat-382030. • Prof. A. B. Pandit, Head, Dept.

| | | | of Chemical Engineering, Institute of Chemical Technology (Deemed Univ.) Nathalal Parekha Marg, Matunga, Mumbai-400019

For Biology

- Prof. Dilip Deobagkar, Vice Chancellor, Goa University, Goa.

- Prof. Sanjay Deshmukh, Head, Dept. of Life Sciences, Univ. of Mumbai, Vidyanagari, Kalina Santcruz (E) Mumbai-400098

For Mathematics

- Prof. S. B. Nimse, Vice Chancellor S.R.T. M. University Nanded-431606.

- Prof. C. Kannan, pro Vice Chancellor Central University Hyderabad. |
|---|---|---|---|
| 3 | *ES,* for all the programmes in 10-12 *Courses; (=30 Credits)* | Prof. D. N. Reddy Vice Chancellor JNTU, Hyderabad e-mail:vcjantu@yahoo.com | - Prof. T. K. K. Reddy, Professor of Mech. Engg., Director, Academic Audit Cell, JNT University Hyderabad.

- Prof. K. Seshagiri Rao, Professor of Civil Engg., JNTU College of Engg., Kukatpally Hyderabad.

- Prof. .D. Thukaram EE Dept., IISc, Bangalore e-mail: dtram@ee.iisc.ernet.in

- Prof. P. V.D. Somasekhara Rao, Professor of Elec. & Comm. Engg., JNT University Hyderabad.

- Prof. Kommaraiah, Professor of Mech., Engg., Malla Redy College of Engg., Misammaguda, Dhulapalli, |

			Hyderabad
4	*PS,* (covering *PSC & PSE* for each identified programme in 15-25 *Courses; (=50 + 20 Credits)*	*Computer Science (CS)* Prof. P. Venkataram Chairman, Centre for Continuing Education, Indian Institute ofScience Bangalore 560 012 e-mail: *pallapa@ece.iisc/ernet.in*	• Prof. Y. Narahari, CSA Dept., IISc, Bangalore 560 01 e-mail: hari@csa.iisc.ernet.in • Prof. Rajib Mull, CSE Dept., IIT- Kharagpur • Prof. C. Pandu Rangan, CSE Dept. IIT-Madras, Chennai • Prof. K. Chandrasekharan, CSE Dept, National Institute of Technology-Karnataka, Surathkal
5	*OSE,* for all the programmes in 15-20 *Courses (for 12 Credits to be chosen)*	Prof. P. Karunakaran Dept. of Mech.Engg., IIT, Mumbai e-mail: karuna@iitb.ac.in;	• Prof. K. Narsimhan, Dept., of Metallurgical Engg. And Material Sci. IIT Bombay, Powal, Mumbai-400076, Mob:- 9869264161 • Dr. B. Ramamoorthy, Head, Manufacturing Engg Section, Dept. of Mechanical Engg., Indian Institute of Technology Madras, IIT Madras, Guindy, Chennai-600036, Tel-044-22574674, 22575705, 22578578, Mob-9444468293, email- ramoo@iitm.ac.in • Prof. Manoj Kumar Tiwari, Professor, Dept. of Industrial Engineering and Management, Indian Institute of Technology Kharagpur-721302, Tel-03222-283746, Mob-9734444693/9918074565, Email- mkt09@hotmail.com • Prof Thampi, Principal Thadomal Shahani Engineering College (TSEC) P.G. Kher Marg (32nd Road), TPS-III, Off Linking Road, Bandra West, Mumbai-400050 Tel-022-26047087, 26495808, 28041631, mob – 9969015439, email-

			gtthampi@yahoo.com
			• Dr. Puneet Tandon, Professor, Discipline of Mechanical Engineering & Design Programme (M.Des. Programme) PDPM Indian Institute of Information Technology, Design and Manufacturing Damna Airport Road P.O. Khamaria Jabalpur-482005, Tel-0761-2632924, Mob- 9425324240, Email-ptandon@iitdmj.ac.in
			• Dr. P.K.Brahmankar, Dean Babasaheb Ambedkar Technological University, Lonere Tel-02140-275217/2757312, Mob-9423271887, Email-pkbrahma@yahoo.com
6	*Mandatory Courses,* for all the programmes in 3-5 *Courses (=8 Units)*;	Prof. Y. V. Rao Director, National Institute of Technology, Warangal e-mail:yvrao_48@yahoo.co.in	• Prof. R.V. Chalam, Mechanical Engg. Dept., National Institute of Technology, Warangal-506004, Mob-9866212198, Email- chalamry@yahoo.com
			• Prof. P.V. D. Somasekhar Rao, Director (Academic & Planning) JNTUH, Hyderabad-500085, Mob - 09440067346, email-pvds_sekhar@hotmail.com
			• Prof. G. Srinikethan, Dean (Academic) NITK, Surathkal, Srinivasnagar-575025, Ph.-0824-2473601, Fax-0824-2474033, email-srinikethan.g@gmail.com
			• Prof. Singam Jayanthu Dept. of Mining Engg., National Institute of Technology Rourkela -769008, Fax No-0661-2462999

			- Prof. L. Ajay Kumar, Dept. of Mining Engg., Anna University, Chennai (T.N.) - Dr. A.O. Surendransthan, Prof. Head Dept. of Met. & Mkt. Engg., NITK, Suranthkal, Srinivasnagar-575025.

Annexure B

All India Board of Undergraduate Studies in Engineering &Technology
Composition (2009-12)
(*Notified by AICTE, vide F. No.453-1/AIB-UGET/2009 dated 17/12/2009*)

S. No.	Constituency	Name/Designation/Address
1	Chairman to be nominated by the Chairman, AICTE	**Prof. B. S. Sonde** Former Vice Chancellor, Goa University, #274, Shree Ananth Nagar, Electronics City P.O., Bangalore 560 100
2-3	Representative of Industry and other major users, to be nominated by the Chairman, AICTE	**2 Shri Murli Ranganathan** Chief Executive Officer, Torrent Power Ltd. Torrent House, Ahmedabad 380 009 **3 Shri Bhaskar Chatterjee** Secretary, Department of Public Enterprises, Government of India, Ministry of Industry, CGO Complex, Block No. 14, Lodhi Road, New Delhi 110 003
4	Representative of Professional Bodies to be nominated by the Chairman, AICTE	**4 Shri Som Mittal** President National Association of Software & Service Companies (NASSCOM) International Youth Centre, Teen Murti Marg, Chanakyapuri, New Delhi 110 021
5-9	Experts in various fields of ET, Management etc., to be nominated by the Chairman, AICTE	**5 Dr. P. Karunakaran** Department of Mechanical Engineering, Indian Institute of Technology Mumbai Powai, Mumbai 400 076 **6Dr. S. K. Mahajan** Director of Technical Education, Government of Maharashtra, 3 Mahapalika Marg, Mumbai 400 001 **7 Prof. P. K. Bose** Director National Institute of Technology, Silchar 788 010 (Assam) **8 Prof. Y. V. Rao** Director, National Institute of Technology, Warangal 506 004 (A.P.) **9Prof. M. S. Mubaswhir** Director, National Institute of Technology, Hazratbal, Srinagar 190 006 , (J&K)
10	Representative of CII	**10 Vice President** Confederation of Indian Indudstry (CII), 23 Institutional Area, Lodhi Road, New Delhi 110 003
11	Representative of Indian Institute of Technology to be nominated by the Chairman, AICTE	**11 Prof. Surendra Prasad** Director Indian Institute of Technology Delhi, Hauz Khas, New delhi 110 016
12	Representative of Technological Universities including Deemed Universities to be nominated by	**12 Prof. D. Narasimha Reddy** Vice Chancellor, Jawaharlal Nehru Technological University, Kukatpally,

	the Chairman, AICTE	Hyderabad 500 072
13	Representative of General Universities to be nominated by the Chairman, AICTE	**13 Dr. Vijay Khole** Ex Vice Chancellor, Universsity odf Mumbai, Mumbai
14	An Officer of AICTE not below the rank of Asst. Director in AICTE dealing with the Board of Studies matter- Member Secretary (Ex Officio)	**Advisor, AICTE**