ALL INDIA COUNCIL FOR TECHNICAL EDUCATION, NEW DELHI

MODEL SCHEME OF INSTRUCTION AND SYLLABI FOR UG ENGINEERING DEGREE PROGRAMMES

(Civil Engineering)

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

October 2012

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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

Course Load per Semester			*Contact Hours/Week* *
No. of Courses	*Credits*/Course	Total *Credits*	
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

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

		Laboratory		
15	ES 15	Engineering Mechanics	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) ***Civil Engineering(CE):***

S. No.	Course No.	Course Title	Hrs/Wk L: T: P	Credits	Preferred Semester
1	CE 01	Structural Analysis I	2: 2: 0	3	III
2	CE 02	Building Materials	2: 0: 2	3	III
3	CE 03	Engineering Surveying I	3: 0: 2	4	III
4	CE 04	Fluid Mechanics	2: 2: 0	4	III
5	CE 05	Structural Analysis II	2: 2: 2	4	IV
6	CE 06	Engineering Surveying II	3: 0: 2	4	IV
7	CE 07	Hydraulics & Hydraulic Machinery	3: 2: 2	5	IV
8	CE 08	Soil Mechanics	2: 0: 2	3	V
9	CE 09	Transportation Engineering I	2: 0: 2	3	V
10	CE 10	Environmental Engineering I	2: 2: 0	3	V
11	CE 11	Reinforced Cement Concrete Design	2: 0: 2	3	V
12	CE 12	Engineering Geology & Rock Mechanics	3: 0: 2	4	VI
13	CE 13	Transportation Engineering II	2: 2: 0	3	VI
14	CE 14	Environmental Engineering II	2: 2: 0	3	VI
15	CE 15	Design of Steel Structures	2: 2: 0	3	VI
16	CE 16	Construction Technology	2: 0: 0	2	VII
17	CE 17	Quantity Survey & Estimation	2: 2: 0	3	VII
18	CE 18	Water Resources Engineering	2: 2: 0	3	VII
19	CE 19	Construction Project Management	2: 0: 0	2	VIII
20	CE 20	Foundation Engineering	2: 0: 0	2	VIII
21	CE* 21	Structural Dynamics	2: 2: 0	3	VI/VII
22	CE* 22	Earthquake Engineering	2: 2: 0	3	VI/VII
23	CE* 23	Advanced Design of Steel Structures	2: 2: 0	3	VI/VII

24	CE* 24	Advanced Design of RCC Structures	2: 2: 0	3	VI/VII
25	CE* 25	Pre-stressed Concrete	2: 2: 0	3	VI/VII
26	CE* 26	Soil Dynamics	2: 2: 0	3	VI/VII
27	CE* 27	Advanced Foundation Engineering	2: 2: 0	3	VI/VII
28	CE* 28	Geographic Data Analysis & Applications	2: 2: 0	3	VI/VII
29	CE* 29	Concrete Technology	2: 0: 2	3	VI/VII
30	CE* 30	Advanced Construction Materials	2: 0: 2	3	VII
31	CE* 31	Construction Equipment & Materials	2: 0: 2	3	VII
32	CE* 32	Building Maintenance & Repairs	2: 2: 0	3	VII
33	CE* 33	Water Resource Systems	2: 2: 0	3	VII
34	CE* 34	Pavement Management System	2: 2: 0	3	VII
35	CE* 35	Bridge Engineering	2: 2: 0	3	VII/VIII
36	CE* 36	Traffic Planning & Design	2: 2: 0	3	VII/VIII
37	CE* 37	Solid & Hazardous Waste Management	2: 2: 0	3	VIII
38	CE* 38	Environmental Impact Assessment & Audit	3: 4: 0	5	VIII
39	CE* 39	Construction & Law	2: 2: 0	3	III/IV
40	CE* 40	Systems Approach to Civil Engineering	3: 4: 0	5	V/VI
41	CE*41	Risk & Value Management	3: 4: 0	5	VIII
42	CE P1	Project Work I	0: 0: 8	4	VII
43	CE P2	Project Work II & Dissertation	0: 0:32	16	VIII

(Note: Electives in one group: CE)*

(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)*

(b) BASIC SCIENCES

(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)	=	(T – 10)	for	0 < T < 100
	=	(0.45 T + 900)	for	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

(d) OPEN ELECTIVES

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 ***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

(e) MANDATORY COURSES

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 IV
MODEL SCHEME OF INSTRUCTION & SYLLABI-

CHAPTER I
MODEL SCHEME OF INSTRUCTION & SYLLABI-
Branch: Civil Engineering *(CE)*

(a) Model Scheme of Instruction for UG Engineering Degree in *CE*

NOTE: Additional Core Courses listed in Chapter II may be considered here in place of those given below;

CE-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 15	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

CE-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

CE-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 12	Applied Physics III	2	0	0	2	2
3	BS 13	Applied Physics Laboratory II	0	0	2	2	1
4	ES 03	Materials Science	2	0	0	2	2
5	ES 07	Basic Electronics Engineering	3	0	0	3	3
6	ES 08	Basic Electronics Engineering Laboratory	0	0	2	2	1
7	CE 01	Structural Analysis I	2	2	0	4	3
8	CE 02	Building Materials	2	0	2	4	3
9	CE 03	Engineering Surveying I	3	0	2	5	4
		TOTAL	**17**	**2**	**8**	**27**	**22**
10	MC 04	Energy Studies	3	0	0	3	3

CE-Semester IV

S. No.	Course Code	Course Title	L	T	P	Course Load (hrs/wk)	Credits
1	BS 04	Complex Algebra	2	0	0	2	2
2	ES 11	Basic Simulation Laboratory	0	0	2	2	1
3	ES 17	Thermodynamics	3	0	0	3	3
4	ES 13	Solid Machanics & Fluid Mechanics	3	0	0	3	3
5	ES 14	Solid Mechanics & Fluid Mechanics Laboratory	0	0	2	2	1
6	CE 05	Structural Anaysis II	2	2	0	4	3
7	CE 06	Engineerring Survrying II	3	0	2	5	4
8	CE 07	Hydraulics & Hydraulic Machinery	3	2	2	7	5
		TOTAL	**16**	**4**	**8**	**28**	**22**

CE-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 06	Probability & Statistics	2	0	0	2	2
	CE 04	Fluid Mechanics	2	2	0	4	3
3	CE 08	Soil Mechanics	2	0	2	4	3
4	CE 09	Transportation Engineering I	2	0	2	4	3
5	CE 10	Envitonmental Engineering I	2	2	0	4	3
6	CE 11	Reinforced Cement Concrete Design	2	0	2	4	3
10	CE*	Elective Course to be chosen	2	2	0	4	3
		TOTAL	**16**	**6**	**6**	**28**	**22**

CE-Semester VI

S. No.	Course Code	Course Title	L	T	P	Contact hrs/wk	Credits
1	BS 07	Discrete Mathematics	2	0	0	2	2
2	CE 12	Engineering Geology & Rock Mechanics	3	0	2	5	4
3	CE 13	Transportation Engineering II	2	2	0	4	3
4	CE 14	Environmental Engineering II	2	2	2	6	4
5	CE 15	Design of Steel Structures	2	2	0	4	3
6	CE*	Elective Course to be chosen	2	2	0	4	3
7	CE*	Elective Course to be chosen	2	2	0	4	3
		TOTAL	**15**	**10**	**4**	**29**	**22**

CE-Semester VII

S. No.	Course Code	Course Title	L	T	P	Contact hrs/wk	Credits
1	CE 16	Construction Technology	2	0	0	2	2
2	CE 17	Quantity Survey & Estimation	2	2	0	4	3
3	CE 18	Water Resources Engineering	2	2	0	4	3
4	CE 19	Construction Project Management	2	0	0	2	2
5	CE 20	Foundation Engineering	2	0	0	2	2
6	CE*	Elective Course to be chosen	3	0	0	3	3
6	OE	Elective Course to be chosen	3	0	0	3	3
7	CE P1	Project Work I			8	8	4
		TOTAL	**16**	**4**	**8**	**28**	**22**

CE-Semester VIII

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

CE: 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	6	2	4	2	-	-	27
3	Engineering Sciences *(ES)*	9	8	6	8	-	-	-	-	31
4	Professional Subjects-Core *(EC)*	-	-	10	12	15	14	12	-	63
5	Professional Subjects–Electives *(CE*)*	-	-	-	-	3	6	3	3	15
6	Open Subjects- Electives *(OE)*	-	-	-	-	-	-	3	3	6
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 UG Engineering Degree in *CE*

CE 01: Structural Analysis I *2:2:0 [3]*

Module 1: General theorems : Theorems relating to elastic structures, Principle of virtual work, Strain energy in elastic structures, complementary energy, Castigliano's theorem, Betti's and Maxwell's reciprocal theorems.

Module 2: Deflection of statically determinate structures: Deflection of determinate beams by Double integration Macaulay's, Moment area and Conjugate beam methods, Principle of virtual work (unit load method) and Castigliano's theorem, Deflection of determinate pin jointed trusses and rigid jointed frames by principle of virtual work (unit load method),b Strain Energy and Castigliano's theorem.

Module 3: Influence lines for statically determinate structures : Influence lines for cantilever, simply supported beam, overhanging beam and pin jointed trusses, criteria for maximum shear force and bending moment under moving loads for simply supported beams, absolute maximum bending moment

Module 4: Elastic arches : determination of normal thrust, shear force and bending moment for parabolic and segmental three hinged arches, Influence lines for normal thrust, shear force and bending moment for three hinged parabolic arch.

Module 5: Suspension bridges: Suspension cable with three hinged stiffening girder, influence line diagrams for horizontal tension in the cable, shear force and bending moment at any section of the stiffening girder

Module 6: Struts: struts subjected to axial loads, concept of buckling, Euler's formula for strut with different support conditions, Euler's and Rankine's design formulae. Struts subjected to eccentric and lateral loads, struts with initial curvature.

Text Books:

1. Structural Mechanics Vol I & II, Junnarkar S B, Charotar Publishers

Reference Books:

1. Structural Analysis Volume – I , Devdas Menon, Narosa Publication
2. Structural Analysis Volume – I, Bhavikatti, 3rd edition, Vikas Publishers.
3. Basic Structural Analysis, C S Reddy, Tata McGraw Hill
4. Theory of Structures, Timoshenko & Young, Tata McGraw Hill
5. Intermediate Structural Analysis, C K Wang, McGraw Hill
6. Elementary Structural Analysis, Norries & Wilbur, McGraw Hill
7. Structural Analysis, Laursen H I, McGraw Hill
8. Structural theorems and their application, B G Neal, Pergamon Press.

CE 02: Building Materials *2:0:2 [3]*

Module 1: Building Materials-Classification of Building materials, requirements of building materials and products, functional, aesthetical and economic. Study of properties of materials: physical, mechanical, chemical, biological, aesthetical and other complex properties like durability, reliability, compatibility, and economic characteristics.

Module 2: Surface Finishes-Pointing: types, plastering: materials and types, painting, Building facia, Materials and products based on mineral binders, gypsum, lime, plaster of paris, cement, hydraulic lime, mortars and concrete, gypsum-concrete products.
Paints and Varnishes: types and uses.

Module 3: Bricks and Tiles- Structural Clay products, Classification, Common clay brick, face bricks and tiles, ceramic tiles, paving blocks. Brick masonry, stone masonry and block masonry.

Module 4: Doors and windows- Types, materials used, manufacture of doors and windows, fixtures. Grill work – materials used, manufacture. Metal and metal alloys: Products made of ferrous and non ferrous metals, Aluminum alloys, Types and Uses, Anticorrosive treatment. Glass types and uses. Wood varieties and uses, defects in timber, preservative treatments, and wood composites: particle and medium density fibre boards etc.

Module 5: Floors and roofs- Floors; types of floors, floor finishes, suitability. Roofs; materials used, types, wooden and steel trusses, roof coverings, roof drainage. Synthetic Polymer resins and resins based materials, floor covering, wall facing, heat insulating and sound proofing plastics, water proofing and sealing resins, adhesives.

Text/Reference Books:

1. Engineering Materials, Rangwala, Charotar Publication
2. Materials of Construction, Ghosh, Tata McGraw Hill Publications.
3. Relevant IS Codes
4. National Building Code 2003, Indian Standards Institution.

CE 03: Engineering Surveying I ***3:0:2 [4]***

Module 1: Introduction- Various types of surveying- based on methods and instruments, classifications, uses and necessity of geodetic surveying, photographic, astronomy and hydrographic surveying. Diagonal scale, various types of venires, micrometers on surveying instruments, principles of surveying. Chain surveying, instruments required for linear measurement, minor instruments for setting out right angle.

Module 2: Leveling and contouring-Definitions, technical terms, different types of levels such as dumpy, quickset, precise, auto temporary and permanent adjustments of dumpy and auto level. Different methods of leveling, reduction of levels,problems. Difficulties in leveling work, corrections and precautions to be taken in leveling work. Contour – definitions, contour interval, equivalent, uses and characteristics of contour lines, direct and indirect methods of contouring. Running a level line, L section, cross section, methods of interpolation. Grade contour- definition, use, setting out in field. Computation of volume by trapezoidal and prismoidal formula, volume from spot levels, volume from contour plan.

Module 3: Plane table surveying-Definitions, uses and advantages, temporary adjustments. Different methods of plane table surveying. Two point problem. Errors in plane table survey, use of telescopic alidade.

Module 4: Traverse Surveying-Compass: Bearings- different types, compass – prismatic, surveyor, whole circle, reduced bearings, Local Attraction. Theodolite:- Various parts and

axis of transit, technical terms, temporary and permanent adjustments of a transit, horizontal and vertical angles, methods of repetition and reiteration. Different methods of running a theodolite traverses, Gales' traverse table, balancing of traverse by Bow-Ditch's transit and modified transit rules.Problems on one-plane and two-plane methods, omitted measurements. Precautions in using theodolite, errors in theodolite survey. Use of theodolite for various works such as prolongation of a straight line, setting out an angle.

Module 5: Setting out works- General horizontal and vertical control, setting out of foundation plan for load bearing and framed structure, batter board, slope and grade stakes, setting out with theodolite. Setting out of sewer line, culvert, use of laser for works. Setting out center line for tunnel, transfer of levels to underground work Project / route survey for bridge, dam and canal. Checking verticality of high rise structures.

Module 6: Areas- Area of a irregular figure by Trapezoidal rule, average ordinate rule, Simpson's 1/3 rule, various co ordinate methods. Planimeter: types of planimeter including digital planimeter, area of zero circle, use of planimeter.

Practical Work:

1. Use of Amslar polar planimeter for finding the area of irregular figures and certifying it by using Digital Planimeter.
2. Use of optical theodolite / Electronic theodolite for measurement of horizontal and vertical angles.
3. Theodolite traverse, Gale's traverse table.
4. A two day project on theodolite traversing and plane table detailing.
5. Use of optical theodolite / Electronic theodolite for one plane and two plane methods.
6. Simple and compound leveling by using Dumpy / Auto Level, booking methods.
7. Methods of plane tabling:- Radiation . Intersection and Traversing.
8. Setting out a simple foundation plan in the field.

Text Books:

1. Surveying and Leveling. N.N.Basak,1st Edition ,Tata McGraw Hill

Reference Books:

1. Surveying and Leveling, Vol I & II, Kanetkar and Kulkarni, 24th edition, Pune Vidyarthi Griha, Pune.
2. Surveying, R Agor, Khanna Publishers

CE 04: Fluid Mechanics ***2:2:0 [3]***

Module1: Properties of Fluids- Mass density, specific weight, specific gravity, specific volume, vapour pressure, compressibility, elasticity, surface tension, capillarity; Newton's law of viscosity, classification of fluids, dynamic viscosity and kinematics viscosity, variation of viscosity with temperature; Basic concept applicable to fluid mechanics.

Module2: Fluid Statics-
*Measurement of Pressure:*Pressure variation in a static fluid, PASCAL's law, Units and scales of pressure measurement –Atmospheric pressure, Absolute Pressure, Gauge Pressure and Vacuum Pressure, Hydrostatic Paradox. Piezometer,U-Tube Manometer, Single Column Manometer,U-Tube Differntial Manometer , Inverterd U-Tube Differntial Manometer, Micromanometers. Mechanical Pressure Gauges.

Hydrostatic force on plane and curved surface- Total Pressure and Center of Pressure, Pressure Diagram, Total Pressure on Plane Surfaces and Depth of Center of Pressure, Total Pressure on Curved Surfaces, Practical applications of Total Pressure and Center of Pressure

Buoyancy and Flotation- Buoyant force, Buoyancy and Center of Buoyancy, Archimedes Principle, Principle of Floatation. Metacentre and Metacentric Height, Equilibrium of Floating bodies and Submerged bodies Evaluation of Metacentric Height –Theoretical Method and Experimental Method. Oscillation of Floating Body.

Fluids in Relative Equilibrium: Static fluid subjected to uniform linear acceleration. Liquid containers subjected to constant horizontal acceleration and constant vertical acceleration, Liquid containers subjected to constant rotation

Module3: Fluid Kinematics- Fluid flow Methods of analysis of fluid motion, Streamlines, Path lines, Streak lines and Stream tubes.Types of fluid flow Steady and unsteady flow, Uniform and non-uniform flow, Laminar, Transitional and Turbulent flow Reynolds number, Reynolds Experiment, Rotational and Irrotational flow, Subcritical , Critical and Supercritical flow, Compressible and Incompressible Flow , One , Two and Three dimensional Circulation and vorticity, Velocity potential and Stream function, Flow net

Module4: Fluid Dynamics- Euler's equation, Bernoulli's equation, Energy correction factor.

*Module5:*Flow Measuring Devices- Measurement of discharge- Venturi meter, Orifice meter, Nozzle meter, Bend meter, Rotometer. Measurement of velocity -Pitot tube. Orifice - Classification, Flow through a Reservoir Opening i.e. Orifice, Trajectory of free –jet, Hydraulic Coefficients, Experimental determination of hydraulic coefficient, Small and large orifice, Time of emptying a tank with orifice. Mouthpieces-Classification, External cylindrical mouthpiece, Convergent – divergent mouthpiece, Borda's mouthpiece. Notches and Weirs -Discharge over a rectangular notch and a triangular notch, Velocity of approach, End contractions, Cippoletti Notch, Discharge over a stepped notch, Time of emptying a tank with notch or weir, Ventilation of weir, Proportional Weir or Sutro Weir.

*Module6:*Flow Past immersed bodies- Drag and lift, Types of drag, Drag on a sphere, cylinder, flat plate and Airfoil, Karman Vortex Street, effect of free surface and compressibility on drag .Development of lift on immersed bodies, Lift, Magnus Effect and Circulation, lift characteristics of airfoils, polar diagram.

Module 7: Compressible flow-Basic equations of flow (elementary study), Mach number, Mach cone, Area – Velocity relationship, Stagnation Properties; Ideal fluid flow- Uniform flow, source and sink, doublet, free vortex.

Practical Work:To conduct experiments as per the following list:

1. Hydrostatics
2. Measurement of viscosity
3. Study of Pressure Measuring Devices
4. Stability of Floating Body
5. Hydrostatics Force on Flat Surfaces/Curved Surfaces
6. Bernoulli's Theorem
7. Calibration of Flowmeter
8. Calibration of Orifices

9. Calibration of Mouthpieces
10. Calibration of Notches
11. Calibration of Weirs
12. Flow Visualisation -Ideal Flow
13. Length of establishment of flow
14. Velocity distribution in pipes
15. Laminar Flow

Text Books:

1. Engineering Fluid Mechanics, K L Kumar, 8th Edition, S Chand & Company Ltd

Reference Books:

1. Hydraulics and Fluid Mechanics, P M Modi and S M Seth, Standard Book House
2. Theory and Applications of Fluid Mechanics, K. Subramanya, Tata McGraw Hill
3. Fluid Mechanics, A.K. Jain, 4th Edition, Khanna Publishers.

CE 05: Structural Analysis II ***2:2:2 [4]***

Module 1: General- Types of structures occurring in practice and their classification, Stable and unstable Structures, statical and kinematical determinacy and indeterminacy of structures, symmetric structure, Symmetrical and anti symmetrical loads, distinction between linear and non linear behavior, material and geometric non-linearity.

Module 2: Analysis of Indeterminate Structures by Flexibility Method- Flexibility coefficients and their use in formulation of compatibility equations, Castigliano's theorem of least work, application of above methods to propped cantilevers, fixed beams, continuous beams, simple pin jointed frames including effect of lack of members, simple rigid jointed frames and two-hinged arches

Module 3: Analysis of Indeterminate Structures by Stiffness Method: Stiffness coefficients for prismatic members and their use for formulation of equilibrium equation, direct stiffness method slope deflection method, moment distribution method, applications of the above methods to indeterminate beams and simple rigid jointed frames, rigid jointed frames with inclined member but having only one translational DoF in addition to rotational DoF's, including the effect of settlement of supports.

Text Books:

1. Matrix method in Structural Analysis, Pandit & Gupta; Tata McGraw Hill, 2008.
2. Structural Mechanics Vol. II, Junnarkar S.B; Charotar Publishers, 2008.

Reference Books:

1. Modern Methods in Structural Analysis, B.N. Thadani & J.P. Desai;Weinall Book Corporation, 1998.
2. Basic Structural Analysis, Reddy C.S; Tata McGraw Hill, 2004.
3. Intermediate Structural analysis, Wang C.K., Tata McGraw Hill. 2010.
4. Structural Analysis, L.S.Negi & R.S. Jangid, Tata McGraw Hill, 2008
5. Structural Analysis Vol. I and II, Gupta & Pandit, Tata McGraw Hill, 2008
6. Analysis of Framed Structure, Gare & Weaver, CBS Publication, 2nd Edition.

CE 06: Engineering Surveying II ***3:0:2 [4]***

Module 1: Curves-Definitions of different terms, necessity of curves and types of curves. Simple circular curves and compound curves, office and field work, linear methods of setting out of curves. Angular methods for setting out of curves, two theodolite and Rankine deflection angle methods. Reverse and transition curves, their properties and their advantages, design of transition curves, shift, spiral angle.Composite curves – office and field work, setting out of curve by angular method, composite curve problems.Vertical curves – definitions, geometry and types, tangent correction and chord gradient methods, sight distance on a vertical curve, difficulties in setting out curves and solutions for the same

Module2: Modern surveying instruments-Electronics in surveying, general principles used in the instruments. Auto levels, self compensating instrument, Digital Level. Electronic distance measurements - types, principles, applications of Total Station in surveying, corrections for field observations. Electronic digital theodolite – types, uses and applications, concept of total station. Use of computer in survey work for level computation and plotting contour plan.

Module 3: Tacheometric surveying-Principles and uses, advantages, stadia formula, different methods of tacheometer, subtense bar method, location details by tacheometer, stadia diagram and tables, error and accuracy in tacheometry survey work

Module 4: Global Positioning System (G.P.S)-G.P.S. Segments: Spaces Segment, Control Segment, User Segment, Features of G.P.S. Satellites, Principle of Operation, Surveying with G.P.S.: Methods of observations, Absolute Positioning, Relative Positioning, differential G.P.S., Kinematics of G.P.S., G.P.S. Receivers: Navigational Receivers, Surveying Receivers, Geodetic Receivers, Computation of Co- ordinates:- Transformation from Global to Local Datum , Geodetic Coordinates to map co- ordinates , G.P.S. Heights and mean sea level Heights. Applications of G.P.S.

Module 5: Remote Sensing(RS)-Electromagnetic remote sensing process. Physics of radiant energy: Nature of Electromagnetic radiation, Electromagnetic spectrum.Energy Source and its Characteristics. Atmospheric influences: Absorption, Scattering. Energy interaction with Earth Surfaces: Spectral reflectance Curve. Image Acquisition: Photographic sensors, Digital Data, Earth Resource satellites, Image resolution. Image Interpretation. Applications of RS.

Module 6: Geographical Information System-Information systems, spatial and non- spatial information, geographical concept and terminology, advantages of GIS, Basic component of GIS. Commercially available GIS hardware and Software. Field data, statistical data, maps, aerial Photographs, satellite data, points , lines, and areas features, vector and raster data, data entry through keyboard, digitizer and scanners, preprocessing of data rectification and registration, interpolation techniques.

Practical Work:

1. To find the constants of a tacheometer and to verify field distances.
2. A project for preparing L section and cross section, block contouring and tacheometric survey.
3. Height and distance problems in tacheometric surveying.
4. Study of satellite images and its interpretation
5. Determination of horizontal, sloping and vertical distance between any two points by using Total Station
6. Geo-registration of map and its digitization by using suitable GIS software.

7. Map editing, vector and raster analysis of digitized map by using suitable GIS software.
8. Collection of field data like point data, line data and area data by using surveying and mapping GPS receiver.

Text/Reference Books:

1. Surveying and Leveling, Vol I & II, III, B.C.Punmiya , Laxmi Publication
2. Surveying and Leveling, N N Basak, Tata McGraw Hill
3. Surveying, R Agor, Khanna Publishers
4. Concepts and Techniques of GIS, Lo C.P.Yeung A K W, Prentice Hall, India
5. Introduction to GIS, Kang-tsung Chang, Tata McGraw Hil
6. Remote sensing and GIS, K. Anjali Rao , BS Publications

CE 07: Hydraulics and Hydraulic Machinery ***3:2:2 [5]***

Module 1: Laminar Flow- Laminar flow through: circular pipes, annulus and parallel plates. Stoke's law, Measurement of viscosity.

Module 2: Turbulent Flow- Reynolds experiment, Transition from laminar to turbulent flow. Definition of turbulence, scale and intensity, Causes of turbulence, instability, mechanism of turbulence and effect of turbulent flow in pipes. Reynolds stresses, semi-empirical theories of turbulence, Prandtl's mixing length theory, universal velocity distribution equation. Resistance to flow of fluid in smooth and rough pipes, Moody's diagram.

Module 3: Boundary Layer Analysis-Assumption and concept of boundary layer theory. Boundary-layer thickness, displacement, momentum & energy thickness, laminar and Turbulent boundary layers on a flat plate; Laminar sub-layer, smooth and rough boundaries. Local and average friction coefficients. Separation and Control.

*Module 4:*Dimensional Analysis and Hydraulic Similitude: Dimensional homogeneity, Rayleigh method, Buckingham's Pi method and other methods. Dimensionless groups. Similitude, Model studies, Types of models. Application of dimensional analysis and model studies to fluid flow problem.

Module 5: Introduction to Open Channel Flow-Comparison between open channel flow and pipe flow, geometrical parameters of a channel, classification of open channels, classification of open channel flow, Velocity Distribution of channel section.

*Module 6:*Uniform Flow-Continuity Equation ,Energy Equation and Momentum Equation , Characteristics of uniform flow , Chezy's formula , Manning's formula. Factors affecting Manning's Roughness Coefficient 'n '.Most economical section of channel. Computation of Uniform flow, Normal depth.

Module 7 Non-Uniform Flow- Specific energy, Specific energy curve, critical flow, discharge curve Specific force Specific depth, and Critical depth.Channel Transitions. Measurement of Discharge and Velocity – Venturi Flume, Standing Wave Flume, Parshall Flume, Broad Crested Weir. Measurement of Velocity- Current meter, Floats, Hot-wire anemometer. Gradually Varied Flow-Dynamic Equation of Gradually Varied Flow, Classification of channel bottom slopes, Classification of surface profile, Characteristics of surface profile.

Computation of water surface profile by graphical, numerical and analytical approaches. Direct Step method, Graphical Integration method and Direct integration method.

Module 8: Hydraulic Jump- Theory of hydraulic jump, Elements and characteristics of hydraulic jump in a rectangular Channel, length and height of jump, location of jump, Types ,applications and location of hydraulic jump. Energy dissipation and other uses, surge as a moving hydraulic jump. Positive and negative surges. Dynamics of Fluid Flow-Momentum principle, applications: Force on plates, pipe bends, moments of momentum equation,

Module 9: Flow through Pipes:
Loss of head through pipes, Darcy-Wiesbatch equation, minor losses, total energy equation, hydraulic gradient line, Pipes in series, equivalent pipes, pipes in parallel, flow through laterals, flows in dead end pipes, siphon, power transmission through pipes, nozzles.
Analysis of pipe networks:
Hardy Cross method, water hammer in pipes and control measures , branching of pipes , three reservoir problem

Module 10: Computational Fluid Dynamics:
Basic equations of fluid dynamics, Grid generation, Introduction to in viscid incompressible flow, Boundary layer flow as applicable to C.F.D.
Hydro informatics:
Concept of hydro informatics –scope of internet and web based modeling in water resources engineering.

Practical Work:

1. Flow Visulization
2. Studies in Wind Tunnel
3. Boundary Layer
4. Flow around an Aerofoil / circular cylinder
5. Uniform Flow
6. Velocity Distribution in Open channel flow
7. Venturi Flume
8. Standing Wave Flume
9. Gradually Varied Flow
10. Hydraulic Jump
11. Flow under Sluice Gate
12. Flow through pipes
13. Turbulent flow through pipes
14. Flow visualization
15. Laminar flow through pipes
16. Major losses / Minor losses in pipe

Text Books:

1. Hydraulics and Fluid Mechanics, P.M. Modi and S.M. Seth, Standard Book House.

Reference Books:

1. Theory and Applications of Fluid Mechanics, K. Subramanya, Tata McGraw Hill.
2. Fluid Mechanics, A.K.Jain, Khanna Publishers.
3. Fluid Mechanics and Fluid Pressure Engineering, S.S.Kumar, F.K. Kothari & Sons.
4. Open channel Flow, K. Subramanya, Tata McGraw Hill.
5. Open Channel Hydraulics, Ven Te Chow, Tata McGraw Hill.

CE 08: Soil Mechanics ***2:0:2 [3]***

Module 1: Introduction-Definitions: soils, soil mechanics, soil engineering, rock mechanics, geotechnical engineering. Scope of soil engineering.Comparison between soil and rock.Basic Definitions and Relationships-Soil as three-phase system in terms of weight, volume, voids ratio, and porosity. Definitions: moisture content, unit weights, degree of saturation, void ratio, porosity, specific gravity, mass specific gravity etc. Relationship between volume-weight, void ratio- moisture content, unit weight- percent air voids, saturation- moisture content, moisture content- specific gravity etc.Determination of various parameters such as: Moisture content by oven dry method, pycnometer, sand bath method, torsional balance method radioactivity method, and alcohol method. Specific gravity by density bottle method, pycnometer method, measuring flask method. Unit weight by water displacement method, submerged weight method, core cutter method, sands replacement method.

Module 2: Plasticity Characteristics of Soil-Introduction to definitions of: plasticity of soil, consistency limits-liquid limit, plastic limit, shrinkage limit, plasticity, liquidity and consistency indices, flow & toughness indices, definitions of activity and sensitivity. Determination of: liquid limit, plastic limit and shrinkage limit.Use of consistency limits. Classification of Soils-Introduction of soil classification: particle size classification, textural classification, unified soil classification, Indian standard soil classification system.Identification: field identification of soils, general characteristics of soil in different groups.

Module 3: Permeability of Soil-Introduction to hydraulic head, Darcy's law, validity of Darcy's law. Determination of coefficient of permeability: Laboratory method: constant head method, falling head method. Field method: pumping- in test, pumping- out test.Permeability aspects: permeability of stratified soils, factors affecting permeability of soil. Seepage Analysis- Introduction, stream and potential functions, characteristics of flow nets, graphical method to plot flow nets.

Module 4: Effective Stress Principle-Introduction, effective stress principle, nature of effective stress, effect of water table.Fluctuations of effective stress, effective stress in soils saturated by capillary action, seepage pressure, quick sand condition.Compaction of Soil-Introduction, theory of compaction, laboratory determination of optimum moisture content and maximum dry density. Compaction in field, compaction specifications and field control.

Module 5: Consolidation of Soil-Introduction, comparison between compaction and consolidation, initial, primary & secondary consolidation, spring analogy for primary consolidation, consolidation test results, basic definitions, Terzaghi's theory of consolidation, final settlement of soil deposits, consolidation settlement: one- dimensional method, secondary consolidation.

Module 6: Shear Strength-Principle planes parallel to the coordinate axes, Mohr's circle, important characteristics of Mohr's circle, Mohr-Coloumb theory, types of shear test: direct shear test, merits of direct shear test, triaxial compression tests, test behaviour of UU, CU and CD tests, relation between major and minor principal stresses, unconfined compression test, vane shear test.

Module 7: Stability of Slopes-Introduction, different factors of safety, types of slope failures, analysis of finite and infinite slopes, wedge failure Swedish circle method, friction circle method, stability numbers and charts. Soil Exploration- Introduction, methods of investigation, methods of boring, soil samplers and sampling, number and deposition of trail pits and borings, penetrometer tests, borehole logs, geophysical methods.

Practical Work: List of tests on-

1. Field Density using Core Cutter method.
2. Field Density using Sand replacement method.
3. Natural moisture content using Oven Drying method.
4. Field identification of Fine Grained soils.
5. Specific gravity of Soil grains.
6. Grain size distribution by Sieve Analysis.
7. Grain size distribution by Hydrometer Analysis.
8. Consistency limits by Liquid limit
9. Consistency limits by Plastic limit
10. Consistency limits by Shrinkage limit.
11. Permeability test using Constant Head test method.
12. Permeability test using Falling Head method.
13. Compaction test: Standard Proctor test.
14. Compaction test: Modified Proctor test.
15. Relative density.
16. Consolidation Test.
17. Triaxial Test (UU)
18. Direct Shear Test.
19. Unconfined Compression Strength Test.
20. California Bearing Ratio.

Text Books:

1.Soil Mechanics & Foundation Engineering by B C Punmia,16th Edition, Laxmi Publications

Reference Books:

1.Fundamentals of Soil Engineering by Taylor, John Wiley & Sons
2.An Introduction to Geotechnical Engineering, by Holtz R.D., Prentice Hall, NJ
3.Soil Mechanics by Craig R.F., Chapman & Hall

CE 09: Transportation Engineering I ***2:0:2 [3]***

Module 1: Highway planning-Classification of roads, brief history of road development in India, present status of roads in India, road patterns, saturation systems, highway alignment: basic requirements for an ideal alignment, factors governing highway alignment, highway location surveys and studies, highway alignment in hilly areas, drawings and reports, highway project preparation.

Module 2: Geometric design of highways-Terrain classification, design speed, vehicular characteristics, highway cross-section elements Sight distance: introduction to sight distance, reaction time, analysis of safe sight distance, analysis of overtaking sight distance, intersection sight distance. Design of horizontal alignment: horizontal curves, design of super elevation and its provision, radius at horizontal curves, widening of pavements at horizontal curves, analysis of transition curves. Design of vertical alignment: different types of

gradients, grade compensation on curves, analysis of vertical curves, summit curves, valley curves. Intersection: at grade and grade separated intersections, speed change lanes, Canalization, Design of rotary intersection and mini roundabout.

Module 3: Traffic engineering & control-Traffic engineering definitions: functions, organization and importance, necessity of understanding the behaviour of road user and vehicle characteristics, human factors governing the road user behaviour- power performance and other vehicular characteristics. Traffic studies and surveys: Speed studies: presentation of data, journey time and delay studies, uses and various methods, relative merits and demerits Vehicular volume counts: types, various available methods, relative merits and demerits, planning of traffic counts, vehicle occupancy surveys. Origin: destination surveys, need and uses, various available methods, checks for accuracy, presentation of data. Parking surveys: needs and types. Study of various photographic techniques available for traffic studies.Traffic signs and marking: types, location, height etc., miscellaneous traffic control aids like roadway delinators, hazard markers, object marker, speed breakers, rumble strips etc., Street lighting: needs, definitions, laws of illumination, methods of discernment, glare problem, light lantern arrangement, types of lamps, planning and designing.

Module 4: Pavement materials- Stone aggregates: desirable properties, tests, requirements of aggregates for different types of pavements. Bituminous materials: types, tests on bitumen, desirable properties, selection of grade of bitumen. Bituminous mix design: principle, methods, modified binders.

Module 5: Design of pavements-Types of pavements, comparison of different types of pavements, functions of pavement components, pavement design factors, design wheel load, equivalent single wheel load, repetition of loads, equivalent wheel load factors, strength characteristics of pavement materials, climatic variation; design of flexible highway pavement as per IRC approach, design of flexible airport pavements, Stresses in rigid highway pavements, critical load positions, stresses due to loads, stresses due to temperature change, combined loading and temperature stresses, Joints in rigid pavements: transverse joints, longitudinal joints, fillers and sealers.

Module 6: Highway construction- Equipment used for construction, embankment design and construction, construction of different Types of roads: water bound macadam, different types of bituminous pavements, cement concrete pavements, Construction of soil stabilized roads: different soil stabilization methods, use of geo-textiles and geo-grids.

Module 7: Highway drainage- Necessity, surface draining, highway sub drainage, draining of city streets’

Module 8: Highway maintenance & rehabilitation- Pavement failures: flexible pavement failures, rigid pavement failures, maintenance of different types of pavements: assessment and need for maintenance, pavement management system, evaluation of pavements: structural evaluation of pavements, functional evaluation of pavements, strengthening of existing pavements: object of strengthening, types of overlays, design of different types of overlays.

Text Books:

1. L R Kadiyali, N B Lal, Principles and practice of highway engineering, Khanna Publications, 2005
2. Principles Of Transportation Engineering, Partha Chakroborty, PHI Learning, 1st edition
3. Principles of Highway Engineering and Traffic Analysis, 4th Edition, Fred L. Mannering, Scott S. Washburn, Walter P. Kilareski, John Wiley

Reference Books:

1. Morlok, E.R., An Introduction to Transportation Engineering and Planning, McGraw Hill, NY, 1970
2. Hay W.W., Introduction to transportation Engineering, John Wiley & Sons, NY, 1988.
3. Papacostas C.S., Fundamentals of transportation Engineering, Prentice Hall of India, 1987.

CE 10: Environmental Engineering I ***2:2:0 [3]***

Module 1: Water:- Water Supply systems, Need for planned water supply schemes, Sources of Water, Water demand and Potable, industrial and agricultural water requirements, Components of water supply system; Transmission of water, Distribution system, Various valves used in W/S systems, service reservoirs and design.

Module 2: Sewage- Domestic and Storm water, Quantity of Sewage, Sewage flow variations. Conveyance of sewage- Sewers, shapes design parameters, operation and maintenance of sewers, Sewage pumping; Sewerage, Sewer appurtenances, Design of sewerage systems. Storm Water- Quantification and design of Storm water; Sewage and Sullage, Pollution due to improper disposal of sewage, National River cleaning plans, recycling of sewage – quality requirements for various purposes.

Module 3: Air - Composition and properties of air, Quantification of air pollutants, Monitoring of air pollutants, Air pollution- Occupational hazards, Urban air pollution- automobile pollution, Chemistry of combustion, Automobile engines, quality of fuel, operating conditions and interrelationship. Air quality standards, Control measures for Air pollution, construction and limitations

Module 4: Noise- Basic concept, measurement and various control methods.

Module5: Solid waste management-Municipal solid waste, Composition and various chemical and physical parameters of MSW, MSW management: Collection, transport, treatment and disposal of MSW. Special MSW: waste from commercial establishments and other urban areas, solid waste from construction activities, biomedical wastes, Effects of solid waste on environment: effects on air, soil, water surface and ground health hazards. Disposal of solid waste-segregation, reduction at source, recovery and recycle. Disposal methods- Integrated solid waste management. Hazardous waste: Types and nature of hazardous waste as per the HW Schedules of regulating authorities.

Module 6: Building Plumbing-Introduction to various types of home plumbing systems for water supply and waste water disposal, high rise building plumbing, Pressure reducing valves, Break pressure tanks, Storage tanks, Building drainage for high rise buildings, various kinds of fixtures and fittings used.

Module 7: Government authorities and their roles in water supply, sewerage disposal. Solid waste management and monitoring/control of environmental pollution.

Text Books:

1. Introduction to Environmental Engineering by P. Aarne Vesilind, Susan M. Morgan, Thompson / Brooks/Cole; Second Edition 2008
2. Introduction to Environmental Engineering, Vesilind, PWS Publishing Company 2000

Reference Books:

1. Water Supply and Sewerage, E.W. Steel
2. CPHEEO Manual on Water Supply & Treatment
3. Manual on Water Supply and Treatment, (latest Ed.), Ministry of Works & Housing, New Delhi.
4. Plumbing Engineering. Theory, design and Practice, S.M. Patil, 1999
5. Integrated Solid Waste Management, Tchobanoglous, Theissen & Vigil. McGraw Hill Publication
6. Environmental Engineering by H.S.Peavy, D.R. Rowe, G.Tchobanoglous; 1991, Tata-Mcgraw Hill

CE 11: Reinforced Cement Concrete Design ***2:0:2 [3]***

Module 1: Reinforced Concrete Fundamentals (working Stress Method)- Concept of reinforced concrete, stress strain characteristics of concrete and steel reinforcement, elastic theory, singly reinforced, balanced section, under reinforced section and over reinforced section, analysis and design of singly reinforced doubly reinforced rectangular and T-sections, design of one way and two way slab as per IS-456, shear and bond stresses and design for shear and bond, design of axially loaded columns, analysis of sections subjected to bending and axial forces(tension or compression).

Module 2: Brief introduction to fundamentals of ultimate strength theory: curved stress distribution, compressive stress block, simplified rectangular stress block as per Whitney's approach, ultimate moment of resistance of singly reinforced section

Module 3: Limit state method of design as per IS 456- Concepts of probability and reliability, characteristic loads, characteristic strength, partial safety factors for loads and materials, introduction to limit states of collapse in flexure, direct compression, shear and limit states of serviceability in deflection and cracking, design of singly and doubly reinforced rectangular and T sections for flexure, design of members in shear and bond, design of axially loaded columns, design of one-way and two-way slabs, design of beam subjected to bending and torsion.

Text/Reference books:

1. Plain and Reinforced Concrete, Vol. I, Jain & Jaikrishna, Nemchand Brothers.
2. Design of Reinforced Concrete Structures, Dayaratnam P, Oxford & IBH.
3. Design of Pre-stressed Concrete Structures, Lin T Y & Ned Burns John Wiley.
4. Prestressed Concrete, Krishna Raju, Tata McGraw Hill.
5. Ultimate Strength Design for Structural Concrete, Arthur P D & Ramkrishnan V, Wheeler & Co.
6. Limit State Theory for Reinforced Concrete Design, Huges B P, Pitman.
7. Limit State design - Reinforced Concrete. Jain A K,
8. Reinforced Concrete, Warner R F, Rangan B C & Hall A S, Pitman.
9. Reinforced Concrete, H.J. Shah, Charotar Publisher.
10. Theory of Reinforced Concrete, Shina & Roy
11. Prestressed Concrete, Evans R H & Benett E W, Chapman & Hall.
12. Limit State Design - Reinforced Concrete, Shah & Karve,
13. Illustrated Reinforced Concrete Design, V.L. Shah & S.R. Karve, Structures

CE 12: Engineering Geology and Rock Mechanics ***3:0:2 [4]***

Module 1: Introduction-Branches of geology useful to civil engineering, scope of geological studies in various civil engineering projects. Department dealing with this subject in India and their scope of work- GSI, Granite Dimension Stone Cell, NIRM. Mineralogy-Mineral, Origin and composition. Physical properties of minerals, susceptibility of minerals to alteration, basic of optical mineralogy, SEM, XRD., Rock forming minerals, megascopic identification of common primary & secondary minerals.

Module 2: Petrology-Rock forming processes. Specific gravity of rocks. Ternary diagram. Igneous petrology- Volcanic Phenomenon and different materials ejected by volcanoes.Types of volcanic eruption. Concept of Hot spring and Geysers. Characteristics of different types of magma. Division of rock on the basis of depth of formation, and their characteristics.
Chemical and Mineralogical Composition. Texture and its types. Various forms of rocks. IUGS Classification of phaneritic and volcanic rock.. Field Classification chart. Structures. Classification of Igneous rocks on the basis of Chemical composition. Detailed study of Acidic Igneous rocks like Granite, Rhyolite or Tuff, Felsite, Pegmatite, Hornfels. Metamorphic Aureole, Kaolinization. Landform as Tors. Engineering aspect to granite. Basic Igneous rocks Like Gabbro, Dolerite, Basalt. Engineering aspect to Basalt. Sedimentary petrology- mode of formation, Mineralogical Composition. Texture and its types, Structures, Gradation of Clastic rocks. Classification of sedimentary rocks and their characteristics. Detailed study of Conglomerate, Breccia, Sandstone, Mudstone and Shale, Limestone Metamorphic petrology- Agents and types of metamorphism, metamorphic grades, Mineralogical composition, structures & textures in metamorphic rocks. Important Distinguishing features of rocks as Rock cleavage, Schistosity, Foliation. Classification. Detailed study of Gneiss, Schist, Slate with engineering consideration.

Module3: Physical Geology- Weathering. Erosion and Denudation. Factors affecting weathering and product of weathering. Engineering consideration. Superficial deposits and its geotechnical importance: Water fall and Gorges, River meandering, Alluvium, Glacial deposits, Laterite (engineering aspects), Desert Landform, Loess, Residual deposits of Clay with flints, Solifluction deposits, mudflows, Coastal deposits.

Module 4: Strength Behavior of Rocks- Stress and Strain in rocks. Concept of Rock Deformation & Tectonics. Dip and Strike. Outcrop and width of outcrop. Inliers and Outliers. Main types of discontinuities according to size.Fold- Types and nomenclature, Criteria for their recognition in field. Faults: Classification, recognition in field, effects on outcrops. Joints & Unconformity; Types, Stresses responsible, geotechnical importance. Importance of structural elements in engineering operations. Consequences of failure as land sliding, Earthquake and Subsidence. Strength of Igneous rock structures.

Module 5: Geological Hazards- Rock Instability and Slope movement: Concept of sliding blocks. Different controlling factors. Instability in vertical rock structures and measures to prevent collapse. . Types of landslide. Prevention by surface drainage, slope reinforcement by Rock bolting and Rock anchoring, retaining wall, Slope treatment. Case study on black clay.
Ground water: Factors controlling water bearing capacity of rock. Pervious & impervious rocks and ground water. Lowering of water table and Subsidence. Earthquake: Magnitude and inten.sity of earthquake. Seismic sea waves. Revelation from Seismic Records of structure of earth. Case Study on Elevation and Subsidence in Himalayan region in India. Seismic Zone in India.

Module 6: Rock masses as construction material: Definition of Rock masses. Main features constituting rock mass. Main features that affects the quality of rock engineering and design. Basic element and structures of rock those are relevant in civil engineering areas. Main types of works connected to rocks and rock masses. Important variables influencing rock properties and behavior such as Fresh rock Influence from some minerals. Effect of alteration and weathering. Measurement of velocity of sound in rock. Classification of Rock material strength. Core logging .Rock Quality Designation. Rock mass description.

Module 7: Geology of dam and reservoir site- Required geological consideration for selecting dam and reservoir site. Failure of Reservoir. Favorable & unfavorable conditions in different types of rocks in presence of various structural features, precautions to be taken to counteract unsuitable conditions, significance of discontinuities on the dam site and treatment giving to such structures.

Module 8: Rock Mechanics- Sub surface 9nvestigations in rocks and engineering characteristics or rocks masses; Structural geology of rocks. Classification of rocks, Fieldd & laboratory tests on rocks, Stress deformation of rocks, Failure theories and sgeer strength of rocks, Bearing capacity of rocks.

Practical Work:

1. Study of physical properties of minerals.
2. Study of different group of minerals.
3. Study of Crystal and Crystal system.
4. Identification of minerals: Silica group: Quartz, Amethyst, Opal; Feldspar group: Orthoclase, Plagioclase; Cryptocrystalline group: Jasper; Carbonate group: Calcite; Element group: Graphite; Pyroxene group: Talc; Mica group: Muscovite;Amphibole group: Asbestos, Olivine, Hornblende, Magnetite, Hematite, Corundum, Kyanite, Garnet, Galena, Gypsum.
5. Identification of rocks (Igneous Petrology):Acidic Igneous rock: Granite and its varieties, Syenite, Rhyolite, Pumice, Obsidian, Scoria, Pegmatite, Volcanic Tuff. Basic rock: Gabbro, Dolerite, Basalt and its varieties, Trachyte.
6. Identification of rocks(Sedimentary Petrology): Conglomerate, Breccia, Sandstone and its varieties , Laterite, Limestone and its varieties, Shales and its varieties.
7. Identification of rocks (Metamorphic Petrolody): Marble, slate, Gneiss and its varieties, Schist and its varieties. Quartzite, Phyllite.
8. Study of topographical features from Geological maps. Identification of symbols in maps.

Text Books:

1. Engineering and General Geology, Parbin Singh ,8th Edition, S K Kataria & Sons.

Reference Books:

1. Text Book of Engineering Geology, Kesavvalu, MacMillan India.
2. Geology forGeotechnical Engineers, J.C.Harvey, Cambridge University Press.

CE 13: Transportation Engineering II ***2:2:0 [3]***

Module 1: Introduction- Role of transportation in society, Objectives of transportation system, different types of modes, planning & co-ordination of different modes for Indian conditions

Module 2: Railway Engineering- Merits of rail transportation, railway gauges and gauge problems; Cross section of permanent way and track components: Sleepers-functions and types, sleeper density, ballast functions and different ballast materials. Rails: Coning of wheels and tilting of rails, rail cross sections, wear and creep of rails, rail fastenings. Geometric design: Gradients, transition curves, widening of gauges on curves, cant and cant deficiency. Point and crossing: Design of turnouts and description of track junctions.Yards: details of different types of railway yards and their functions. Signaling and interlocking: classification of signals, interlocking of signals and points, control of train movements. Construction and maintenance of railway track, methods of construction, material requirements, special measures for high speed track, maintenance of tracks and traffic operations

Module 3: Airport Engineering- Aircraft characteristics and their influence on airport planning. Airport planning: topographical and geographical features, air traffic characteristics, and development of new airports, factors affecting airport site selection. Airport obstruction: Zoning laws, classification of obstruction, imaginary surfaces, approach zones, turning zones. Airport layout: runway orientation, wind rose diagrams, and basic runway length. Correction of runway length, airport classification, geometric design, airport capacity, run way configuration, taxiway design, geometric standards, exit taxiways, holding aprons, location of terminal buildings, aircraft hangers and parking. Airport marking and lighting: marking and lighting of runways, taxiways and approach areas.Terminal area and airport layout: Terminal area, planning of terminal building, Apron: size of the gate position, number of gate position, aircraft parking system; Hanger: general planning considerations, blast considerations. Air traffic control: Air traffic control aids, Enroute aids, landing aids. Airport Drainage: requirement of airport drainage, design data, surface drainage design, subsurface drainage design.

Module 4: Water Transportation-Harbors: Selection of site, entrance and channel requirement, ship characteristics and their influence on ports management and operations, harbor maintenance. Harbor layout: harbor works, break waters, jetties, wharves, piers, berthing facilities, types and construction, dolphins. Navigational aids: buoys & lighthouses. Port facilities: docks, transit sheds and warehouses, general layout, containers and container yard, layout and handling equipment.

Text Books:

1. Saxena S.C. and Arora S. P., A Course of Railway Engineering, Dhanpat Rai, New Delhi
2. Khanna and Arora, Airport Planning & Design, Nemchand Bros, Roorkee
3. Agarwal, M. M. (1991). Indian Railway Track, Sachdeva Press, New Delhi
4. Bindra S.P., Docks & Harbor Engineering, Dhanpat Rai, New Delhi
5. R Shrinivasan, Harbor Dock and Tunnel Engineering
6. Rao G.V., Airport Engineering, Tata McGraw Hill

Reference Books:

1. Horonjeff &Mcklerey, Planning & Design of Airport
2. Quinn A D, Design and Construction of Ports and Marine Structures.

CE 14: Environmental Engineering II ***2:2:2 [4]***

Module 1: Water-Man's environment: Importance of environmental sanitation. Quality of water: Wholesomeness and palatability; physical, chemical, bacteriological standards. Treatment of water; impurities in water-processes for their removal – typical flow-sheets. Sedimentation: factors affecting efficiency, design values of various parameters, tube settlers. Coagulation and flocculation: mechanisms, common coagulants, rapid mixing and flocculating devices, G and GT values, Jar test, coagulant aids - polyelectrolyte etc. Filtration: classification, slow and rapid sand filters, dual media filters, sand, gravel and under-drainage system, mode of action, cleaning, limitations, operational difficulties, performance, basic design consideration, pressure filters: construction and operation. Water softening: lime soda and Base Exchange methods, principle reactions, design considerations, sludge disposal. Miscellaneous treatments: removal of iron and manganese, taste, odour and colour, principles and methods; de-fluoridation, reverse osmosis. Disinfection: chlorination, chemistry of chlorination, kinetics of disinfection, chlorine demand, free and combined chlorine, break point chlorination, super chlorination, de-chlorination, chlorine residual, use of iodine, ozone, ultraviolet rays and chlorine dioxide as disinfectants, well water disinfection. Introduction to advanced treatment methods : reverse osmosis, electro – dialysis, floatation, micro filtration, ultra filtration, Nan filtration.

Module 2: Sewage- Characteristics of sewage: composition, chemistry of sanitary sewage, B.O.D., C.O.D., aerobic and anaerobic decomposition. Sewage Disposal: discharge of raw and treated sewage on land and water, standards for disposal of raw and treated sewage on land and water, limits of dilution. Self purification of streams: oxygen economy, sewage farming. Sewage treatment: aims, methods of treatment and various flow-sheets for preliminary, primary, secondary and tertiary treatment, screens, grit chambers, primary and secondary clarifiers, disposal of screenings and grit. Biological treatment methods; principles, trickling filter operation, re-circulation, activated sludge process and its modifications, hydraulic design of trickling filter and activated sludge process, sludge volume index, operational problems in activated sludge process and trickling filters, stabilization ponds. Sludge digestion: principles of anaerobic digestion, quantity and characterizations of sludge, design of sludge digestion tanks, disposal of digested sludge, drying beds. Low cost sanitation: septic tanks and Anaerobic Filter - principles, operation and suitability, design values, disposal of treated effluent. Tertiary Treatment methods – general description

Practical Work: List of experiments on water and sewage samples-
1. Alkalinity
2. Hardness
3. pH
4. Turbidity
5. Jar test
6. Residual chlorine
7. Chlorides
8. Solids: suspended solids, dissolved solids, total solids, volatile solids
9. Dissolved oxygen
10. Chemical oxygen demand (COD)
11. Biochemical oxygen demand (BOD)
12. Sludge volume index (SVI)
13. Most probable number (MPN)

Text books:

1.Water Supply and Sanitary Engineering , S.K.Hussain
2.Manual on Sewerage and Sewage Treatment and Manual on Water Supply and Treatment, Ministry of Works and Housing, New Delhi.

Reference books:

1.Water supply and sewerage, E.W. Steel
2.Water supply and sewerage, T.J.McGhee
3.Water supply & pollution control, J.W.Clark, W.Viesman, M.J.Hammer.
4.Relevant Indian Standard Specifications.
5.CPHEEO Manual on Water supply and treatment
6.CPHEEO Manual on Sewerage and sewage treatment

CE 15: Design of Steel Structures ***2:2:0 [3]***

Module 1: Joints- Introduction to riveted connection, Design of bolted and welded connections, axially and eccentrically loaded joints, simple connection of bracket plates to columns, beam to beam and beam to column connections, design of framed, un-stiffened and stiffened seat connections.

Module 2: Roofing System- Imposed loads on flat and sloping roofs and floors, wind loads on sloping roofs and vertical cladding including effect of degree permeability and wind drag, analysis of pin- jointed trusses under various loading cases, computation of design forces in members, design and detailing of connections and supports, wind bracing for roof system, supported on columns.

Module 3: Flooring System- Concept of floor system with secondary beams, main beams and columns, design of simply supported beams using rolled steel sections, design of built-up sections.

Module 4: Welded Plate Girder- Proportioning and design of section and connections, curtailment of flange plates, design of web splices, design of stiffeners.

Module 5: Columns and Bases- Design of columns under axial loads using single or multiple rolled steel sections, design of lacing and battens, columns subjected to axial load and bending, design of slab and Gusseted base.

Text Books:

1. Limit State Design of Steel Structures IS:800-2007, V.L.Shah and Veena Gore, Structures Publications, 2010.
2. Design of Steel Structures , S.S.Bhavikatti , I.K. International Publishing House Limited, 2010.

Reference Books:

1. Design of Steel Structures, N. Subramanian, Oxford University Press, 2010
2. Relevant IS Codes

CE 16: Construction Technology ***2:0:0 [2]***

Module 1: Construction Equipment-Standard types of equipment , special equipment, cost of owning and operating equipment, depreciation costs, investment and operating costs,

economic life, sources of construction equipment, factors affecting selection of construction equipment, balancing of equipment. Study of equipment with reference to available types and their types and their capacities, factors affecting their performance.Earthmoving Equipment- Tractors and attachments, dozers and rippers, scrapers , shovels, draglines, trenching machines, clamshell, hoes, trucks and wagons, dumpers, rollers and compactors. Drilling and blasting equipments- Bits, jackhammers, drifters, drills, blasting material, firing charge, safety fuse, electric blasting caps, drilling patterns, transporting and handling of explosives. Pile driving equipment- Types, pile driving hammers, single acting and double acting, differential acting hammers, hydraulic and diesel hammers, vibratory drivers. Pumping equipment- Reciprocating, diaphragm & centrifugal pumps, well point system. Stone crushing equipment- jaw, gyratory and cone crushers, hammer mills, roll crushers, rod and ball crushers, aggregate screens and screening plants, portable plants. Concrete manufacture, transport, placing and compacting equipment, mixers, central batching and mixing plants, pavers, transit mixers, concrete pumps shotcrete. Air Compressor. Equipment for moving materials, builder's hoists, forklifts , cranes, belt-conveyors, cableways, ropeways.

Module 2: Tunneling- Geo-technical investigations, selection of alignment, methods of tunneling in soft soils and in hard rock, sequence of operations for drilling and blasting method, mechanical moles, boomers, tunnel boring machines, mucking, ventilation of tunnels, dust control, types of tunnel supports, sequence of lining operation, lining with pneumatic placers and by pump crete method.

Module 3: Bridge Construction- Geo-technical investigation , Site selection , Launching of bridges by incremental launching, using false work, balanced cantilever construction method.

Module 4: Steel Construction- Planning for field operations, selection of equipments and erection tools and method of welding, tools and methods of cutting and joining, safety measures during fabrication and erection.

Module 5: Concrete Construction- Concreting under water, concreting in different weather conditions, mass concreting, vacuum concreting, Self Compacted Concrete, Roller Compacted Concrete.

Module 6: Ground Improvement Techniques- Sand drains, stone column, diaphragm wall, rock anchors, Reinforced earth technology.

Module 7: Special equipments and their application to Off-shore construction, cofferdams, Foundation grouting.

Text/Reference Books:

1. Varma Mahesh , Construction Equipment and its Planning & Applications
2. R.L. Purifoy & Ledbetter - Construction Equipment and its Planning , McGraw hill
3. Jagdish Lal , Construction Equipment
4. Thomas baron , Erection of Steel Structures
5. Stubbs, Handbook of Heavy Construction
6. Dr. P. Purushothama Raj, Ground Improvement Techniques , Laxmi Publications
7. Punnoswami, Bridge Construction
8. Wadell , Concrete Construction Handbook

CE 17: Quantity Survey and Estimation ***2:2:0 [3]***

Module 1: Estimates-Various types, their relative importance. factors to be considered, complete set of Estimate. Approximate estimates- importance, purpose, different methods. Use of CBRI Equations for the same. Methods of preparation of estimates for projects such as: Building R.C.C., Load bearing, Road, Culvert, Irrigation; Water supply and sewerage: miscellaneous works like Manhole, water storage tank, septic tanks; Trusses of steel, Industrial Shed.

Module 2: Measurements for various items- Use of relevant Indian Standard Specifications for the same, taking out quantities from the given requirements of the work, comparison of different alternatives, Bar bending schedules, Mass haul Diagrams, Earthwork Calculations

Module 3: Material survey-Thumb rules for computation of materials requirement for different materials for buildings, percentage breakup of the cost, cost sensitive index, market survey of basic materials.

Module 4: Specifications-Types, requirements and importance, detailed specifications for the buildings, roads, minor bridges and industrial structures.

Module 5: Rate analysis-Purpose, importance and necessity of the same, factors affecting, task work, daily output from different equipment.

Module 6: Tender- Preparation of tender documents, importance of inviting tenders, contract types, relative merits, prequalification. general and special conditions, termination of contracts, extra work and items, penalty and liquidated charges, Settlement of disputes, R.A. Bill & Final Bill, Payment of advance, insurance, claims, price variation, etc.

Module 7: Introduction to acts pertaining to-Minimum wages, Workman's compensation, Contracts, Arbitration, Easement rights.

Module 8: Use of computers in quantity surveying.

Term Work Assignments to include:

1. To find out the approximate estimate of a multistoried building by approximate method.
2. Detailed estimate of the following with the required material survey for the same.

a. ground plus three storied building (RCC)
b. bridge with minimum 2 spans
c. factory building
d. road work
e. cross drainage work
f. load bearing structure

3. Preparation of valuation report in standard Government form.
4. Assignments on rate analysis, specifications and simple estimates.
5. Detailed estimate of minor structure.
6. Bar bending schedule.

Text Books:

1. M Chakravarty, Estimating, Costing Specifications & Valuation

2. Joy P K, Handbook of Construction Management, Macmillan
3. B.S. Patil , Building & Engineering Contracts

Reference Books:

1. Relevant Indian Standard Specifications.
2. World Bank Approved Contract Documents.
3. FIDIC Contract Conditions.
4. Acts Related to Minimum Wages, Workman's Compensation, Contract, and Arbitration.

CE 18: Water Resources Engineering ***2:2:0 [3]***

Module 1: Introduction- irrigation, water resources in India, need of irrigation in India, development of irrigation in India, impact of irrigation on human environment, irrigation systems: minor and major, command area development.

Module 2: Hydrology- hydrologic cycle, rainfall – runoff process, factors affecting runoff, runoff hydrograph, runoff computations, flood discharge calculations, unit hydrograph method, S-hydrograph.

Module 3: Water requirement of crops-Crops and crop seasons in India, cropping pattern, duty and delta; Quality of irrigation water; Soil-water relationships- soil characteristics significant from irrigation considerations, root zone soil water, infiltration, consumptive use, irrigation requirement, frequency of irrigation; Methods of applying water to the fields: surface, sub-surface, sprinkler and trickle / drip irrigation.

Module 4: Ground water and well hydrology- Ground water resources, occurrence of ground water, methods of ground water exploration, well irrigation; Well hydraulics: steady state flow in wells, equilibrium equations for confined and unconfined aquifers, aquifer tests, design of water wells.

Module 5: Distribution system-Canal systems, alignment of canals, canal losses, estimation of design discharge. Design of channels- rigid boundary channels carrying clear and sediment laden water, alluvial channels carrying clear and sediment laden water, Kennedy's and Lacey's theory of regime channels. Canal outlets: non-modular, semi-modular and modular outlets. Water logging: causes, effects and remedial measures. Lining of canals-economics of lining, types of lining. Drainage of irrigated lands: necessity, methods.

Module 6: Canal structures- Surface and sub-surface flow considerations for design of canal structures: hydraulic jump, seepage forces, uplift forces. Canal falls, cross regulator, distributory head regulator, canal escapes: types, components and design considerations
6.3 Cross drainage works: need, types, design considerations.

Module 7: Canal head works- Weir and barrage, different units of head works, types of weirs, sediment control in canals, river training for canal head works.Theories of seepage for design of weirs: Bligh's creep theory, Lane's weighted creep theory, Khosala's method of independent variables.

Module 8: Dams and spillways-Embankment dams: Classification, selection of site for dam, design considerations, estimation and control of seepage, slope protection. Gravity dams: forces on gravity dams, causes of failure, stress analysis, elementary and practical

profile, structural joints, keys and water seals, galleries, outlets. Arch and buttress dams-types. Spillways: components of spillways, types, terminal structures, types of gates for spillway crests; Reservoirs- Types, capacity of reservoirs, yield of reservoir, reservoir regulation, sedimentation, economic height of dam, selection of suitable site, flood routing.

Text Books:

1. G L Asawa, Irrigation Engineering, Wiley Eastern
2. S K Garg, Irrigation Engineering & Hydraulic Structures, Khanna Publishers
3. P N Modi, Irrigation Engineering & Hydraulic Structures

Reference Books:

1. J D Zimmerman, Irrigation, John Wiley & Sons
2. Varshney, Gupta & Gupta, Theory and Design of Irrigation Structures, Nem Chand & Bros.
3. Punmia B C & Pande B B Lal, Irrigation Engineering and Water Power Engineering, Laxmi Publications

CE 19: Construction Project Management ***2:0:0 [2]***

Module 1: Construction- Unique features of construction, construction project, types and features, phases of a project, agencies involved and their methods of execution.

Module 2: Construction project planning- Stages of project planning: pre-tender planning, pre-construction planning, detailed construction planning, role of client and contractor, level of detail. Process of development of plans and schedules, work break-down structure, activity lists, assessment of work content, estimating durations, sequence of activities, activity utility data

Module 3: Techniques of planning- Bar charts, Networks: basic terminology, types of precedence relationships: finish to start, start to start, finish to finish, start to finish, preparation of CPM networks: activity on link and activity on node representation, analysis of single relationship (finish to start) networks, computation of float values, critical and semi-critical paths, calendering networks.

Module 4: Resource Scheduling- Bar chart, line of balance technique, resource constraints and conflicts, resource aggregation, allocation, smoothening and leveling.

Module 5: PERT- Assumptions underlying PERT analysis, determining three time estimates, analysis, slack computations, calculation of probability of completion.

Module 6: Planning and organizing construction site and resources- Site: site layout, developing site organization, record keeping at site, Manpower: planning, organizing, staffing, motivation, Materials: concepts of planning, procurement and inventory control, Equipment: basic concepts of planning and organizing, Funds: cash flow, sources of funds.

Module 7: Construction costs- Classification of costs, time cost trade-off in construction projects, compression and decompression/

Module 8: Monitoring & control-Supervision, record keeping, periodic progress reports, periodical progress meetings. Updating of plans: purpose, frequency and methods of updating. Common causes of time and cost overruns and corrective measures. Quality control: concept of quality, quality of constructed structure, use of manuals and checklists for

quality control, role of inspection, basics of statistical quality control. Safety and health on project sites: accidents; their causes and effects, costs of accidents, occupational health problems in construction, organizing for safety and health.

Text/Reference Books:

1. Barrie D.S. & Paulson B C, Professional Construction Management, McGraw Hill
2. Chitkara K K, Construction Project Management, Tata McGraw Hill
3. P K Joy, Handbook of Construction Management
4. King & Hudson, Construction Hazard and Safety Handbook, Butterworths
5. Antill J M & Woodhead R W, Critical Path Methods in Construction Practice, Wiley

CE 20: Foundation Engineering ***2:0:0 [2]***

Module 1: Lateral Earth Pressures Theories- Introduction: applications of earth pressure theories, different types of earth pressure at rest, active and passive pressure. Rankine's Earth Pressure Theory, active earth pressure and passive earth pressure for horizontal and inclined backfill including the direction of failure Planes for cohesion-less and cohesive soils. Coulomb's Wedge Theory: Coulomb's active pressure in cohesion-less soils, expression For active pressure, Coulomb's passive earth pressure. Rebhann's Construction for Active Pressure, Culmann's graphical solutions for active soils, Wedge Method, passive pressure by friction circle method for cohesion-less and cohesive soils.

Module 2: Earth Retaining Structures- Rigid and flexible retaining structures, stability analysis of retaining walls, cantilever retaining Walls, construction details, drainage and wall joints.

Module 3: Bearing Capacity of Shallow Foundation- Definitions of ultimate bearing capacity, gross, net and safe pressures, allowable bearing pressure, types of shallow foundations modes of failures. Bearing capacity theories: Rankine's approach, Prandtl's approach and Terzaghi's approach, concept behind derivation of equation, general bearing capacity equation, bearing capacity equations for square and circular footings, factors influencing bearing capacity, performance of footings in different soils, Vesic's chart, ultimate bearing capacity in case of local shear failure. Plate load test in detail with reference to IS1888 and its applications and estimation of settlements, bearing capacity based on Standard Penetration Test.

Module 4: Axially Loaded Pile Foundations: 4.1 Introduction to pile foundations, necessity of pile foundation, classification of piles, construction methods of bored piles, concrete bored piles, driven cast in-situ piles. Pile capacity based on static analysis, piles in sand, piles in clay, dynamic methods and their limitations, in- situ penetration tests and pile load test as per IS 2911 specifications, negative skin friction. Pile groups ultimate capacity of groups, settlement of pile groups in sand and in clay as per IS 2911 and critical depth method.

Module 5: Underground Conduits- Classes of underground conduits, load on a ditch conduit, settlement ratio, ditch condition and projection condition, imperfect ditch conduit.

Module 6: Open Cuts: Difference in open cuts and retaining walls, apparent pressure diagrams, average apparent pressure diagrams for sand and stiff clay, estimation of loads on struts.

Text Books:

1. Soil Mechanics and Foundation Enggineeering, B.C.Punmia, Laxmi Publications, 2010
2. Soil Mechanics and Foundattion Engineering, K.R.Arora, Standard Publishers, New Delhi

Reference Books:

1. Soil Mechanics in Engineering Practice by K. Terzaghi & R.B. Peck Wiley 3rd Ed.
2. Design Aids in Soil Mechanics and Foundation Engineering by S.R. Kaniraj, TMH New Delhi, 2004
3. Foundation Design Manual by N.V. Nayak, Dhanpat Rai Publications, New Delhi
4. Relevant Indian Standard Specifications and Codes.

(Electives under one Group CE)*

CE*21: Structural Dynamics ***2:2:0 [3]***

Module 1: Introduction to structural dynamics, definition of basic problem in dynamics, static versus dynamic loads, different types of dynamic loads.

Module 2: Introduction to single degree of Freedom (SDOF) systems- Un-damped vibration of SDOF system, natural frequency and period of vibration, damping in structures, viscous damping and coulomb damping, effect of damping on frequency of vibration and amplitude of vibration, logarithmic decrement, forced vibration, response to periodic loading, response to periodic loading, response to pulsating forces, dynamic load factors, response of structure subjected to general dynamic load, Dulhamel's integral, numerical evaluation of dynamics response of SDOF systems, response of structure in frequency domain subjected to general periodic and non-periodic/impulsive forces of short duration, use of complex frequency response function, use of Fourier Series for periodic forces, introduction to vibration isolation, distributed mass system idealized as SDOF system, use of Rayleigh's method, response of SDOF system subjected to ground motion.

Module 3: Generalized Single Degree of Freedom System-Generalized properties: Assemblages of Rigid Bodies, Systems with distributed mass and elasticity, expressions for generalized system properties.

Module 4: Lumped mass multi degree of freedom (MDOF) system- Coupled and uncoupled systems, direct determination of frequencies of vibration and mode shapes, orthogonality principle, vibration of MDOF systems with initial conditions, approximate methods of determination of natural frequencies of vibration and mode shapes-vector iteration methods. Energy methods and use of Lagrange's method in writing equations of motions, decoupling of equations of motion, modal equation of motion, concept of modal mass and modal stiffness, forced vibration of MDOF system, modal analysis, application to multi-storey rigid frames subjected to lateral dynamic loads.

Module 5: Structure with distributed mass system- Use of partial differential equation, free vibration analysis of single span beams with various boundary conditions, determination of frequencies of vibration and mode shapes, forced vibration of single span beams subjected to the action of specified dynamic loads.

Module 6: Random Vibrations-Random processes, stationary and ergodic processes, autocorrelation function, power spectral density function, relationship between power spectral and autocorrelation functions, power spectral density and autocorrelation functions for derivatives of processes, superposition of stationary processes, stationary Gaussian processes, stationary white noise, probability distribution for maxima and extreme values.

Module 7: Stochastic Response of Linear SDOF Systems- Transfer functions, relationship between input and output autocorrelation functions, relationship between input and output power spectral density functions, response characteristics for narrowband systems.

Practical Work:
Experimental determination of frequency of vibration and damping coefficient using simple displacement pickups.

Text/Reference Books:

1. Structural Dynamics-An Introduction to Computer Methods, John Wiley & Sons.
2. Dynamics of Structures, Anil K. Chopra, Prentice Hall, India.
3. Dynamics of Structures, Cloguh & Penzein, Tata McGraw Hill. New Delhi
4. Structural Dynamics, John M. Biggs, Tata McGraw Hill. New Delhi

CE*22: Earthquake Engineering ***2:2:0 [3]***

Module 1: Definitions of basic problems in dynamics, static versus dynamic loads, different types of dynamic loads, un-damped vibration of SDOF system, natural frequency and periods of vibration, damping in structure, response to periodic loads, response to general dynamic load, response of structure subject to gravitational motion, use of Fourier series for periodic forces.

Module 2: Direct determination of frequencies and mode shapes, orthogonality principle, approximate methods for determination of frequencies and mode shapes, modal error of forced vibration of MDOF system, modal analysis, applications to multistoried rigid frames subject to lateral dynamic loads.

Module 3: Seismological background: Seismicity of a region, earthquake faults and waves, structure of earth, plate tectonics, elastic-rebound theory of earthquake, Richter scale, measurement of ground motion, seismogram.

Module 4: Characterization of ground motion: earthquake response spectra, factors influencing response spectra, design response spectra for elastic systems, peak ground acceleration, response spectrum shapes, deformation, pseudo-velocity, pseudo-acceleration response spectra, peak structural response from the response spectrum, response spectrum characteristics.

Module 5: Deterministic earthquake response: types of earthquake excitation, lumped SDOF elastic systems, translational excitation, lumped MDOF elastic systems, translational excitation time history analysis, multistoried buildings with symmetric plans, multistoried buildings with unsymmetric plans, torsional response of symmetric plan building, distributed-parameter elastic systems, translational excitation, combining maximum modal responses using mean square response of a single mode, SRSS and CQCC combination of modal responses.

Module 6: I. S. code method of seismic analysis: seismic co-efficient method and its limitation, response spectrum method, I. S. code provision for seismic analysis of buildings and water towers.

Module 7: Review of damages during past earthquakes and remedial measures, seismic design considerations, allowable ductility demand, ductility capacity, reinforcement detailing for members and joints.

Text/Reference Books:

1. Structural Dynamics-An introduction to Computer Methods, Roy R. Craig.
2. Dynamics of Structures, Anil K. Chopra, Prentice Hall, India.
3. Dynamics of Structures, Cloguh & Penzien, Tata McGraw Hill, New Delhi
4. Structural Dynamics, John M. Biggs, Tata McGraw Hill, New Delhi
5. Fundamentals of Earthquake Engineering, N. M. Newmarks & E. Rosenblueth, Prentice Hall.
6. Earthquake Design Practice for Building, D. Key, Thomas Telford, London, 1988.
7. Earthquake Engineering, R. L. Wiegel, 2nd Edition, Prentice Hall, London, 1989
8. Design of Multistoried Buildings for Earthquake Ground Motions, J. A. Blume, Portland Cement Association, Chicago, 1961
9. Proceedings on World Conference on Earthquake Engineering, 1956-2000.
10. I. S. codes No. 1893, 4326, 13920. (Latest Editions).

CE*23: Advanced Design of Steel Structures ***2:2:0 [3]***

Module 1: Moment Resistant Beam End Connections- Design of moment resistant riveted and welded beam end connections.

Module 2: Round tubular structural members- Properties of steel tubes. Design of tension and compression members, Design of welded connections. Design of flexural members. Analysis and design of tubular trusses including purlins and supports.

Module 3: Elevated steel tanks and stacks- Loads acting on tanks including wind and earthquake. Design of circular tanks with conical bottom, supporting ring beam, staging for circular tanks. Design of rectangular steel tanks. Design of foundation for columns.

Module 4: Gantry Girder - Loads acting on gantry girder. Analysis & design of gantry girder.

Module 5: Lattice Tower-Loads acting on lattice towers. Analysis and design of lattice tower including welded or riveted connections for members.

Module 6: Steel Chimney:-Forces acting on chimney. Design of self supporting welded chimney including design of foundation.
(Note: Relevant provisions of IS codes shall be referred in design of aforesaid topics.)

Term Work:
This shall consist of a design report and detailed drawings on three projects as indicated below:

1. Design of tubular trusses.
2. Design of elevated circular tank with conical bottom or rectangular steel tank.
3. Design of lattice tower or steel chimney.

The drawings to be made with pencil only on minimum of A-1 size drawing sheets. Each student to appear for at least one written test during the term. The graded answer paper of the test to be submitted as *Term Work.*

Text/Reference Books:

1. Design of Steel Structures, Negi L.S., Tata McGraw Hill, New Delhi

2. Design of Steel Structures, Kazimi S.M. A. & Jindal R.S., Prentice Hall of India.
3. Design of Steel Structures, Krishnamachar B.S., & Ajitha Sinha D.,
4. Design of Steel Structures, Arya and Ajmani, New Chand & Bros.
5. Design of Steel Structures, Vol I & II, Ramchandran.
6. Design of Steel Structures, Dayaratnam.
7. Design of Steel Structures, Breslar, Lin and Scalzi.
8. Design of Steel Structures, Mac. Ginely T.
9. Structural Steel Work, Reynolds T.J., Kent L.E. & Lazenby, D.W.
10. Relevant I.S. codes.
11. Comprehensive Design of Steel Structures, Punma, A.K. Jain & Arun Kumar Jain, Laxmi Publications.
12. Design of Steel Structures, IC Sayal & Satinder Singh, Standard Publishers & Distributors.

CE*24: Advanced Design of R.C.C. Structures ***2:2:0 [3]***

Module 1: Design of Flat Slabs- Modes of failure of flat slabs. I.S code Provisions for the design of simple and continuous flat slabs. Special detailing requirements of flat slabs.

Module 2: Large Span Roofs- Folded Plate Roofs - Whitney's Method , Simpson's Method and Design of single and multi-bay folded plate roofs, design based on IS codes of practice.

Module 3: Circular Cylindrical Shell Roofs-Beam theory of cylindrical shells, single and multiple bays with various edge conditions.

Module 4: Silos and Bunkers-Lateral Pressures in bunkers as per Rankine's and Coulomb theories, Lateral pressures in silos as per Janssen's and Airy's theories , design considerations for square, rectangular and circular shapes of silos , design of hoppers and supporting structures of bins. I. S. Code Provisions for design of Silos and Bunkers.

Module 5: Design OF Deep Foundations- Design considerations for piles and pile groups. Codal provisions for the design of pile caps, Rectangular, circular and triangular pile caps for group of piles. Truss Analogy method for the analysis of pile caps.

Module 6: Design Of R.C.C, Chimney- I.S. Code provisions, principles of design under various types of loadings, behaviour of chimneys and stack structures under wind.

Module 7: Design of Cooling Towers-Principles of design of various types of cooling towers. I.S. Code provisions for the design, analysis and design umder wind and earthquake loads.

Text/Reference Books:

1. V.Ramakrishna and P.D. Arthur, Ultimate Strength Design for Structural Concrete, Wheeler.
2. Karve S.R. and Shah V.C., Design of Reinforced Cement Concrete Structures using Limit State Approach, Structures Publishers.
3. G.S. Ramaswamy , Design and Construction of Concrete shell Roofs, McGraw Hill.
4. Jain O.P. and Jaikrishna , Plain and Reinforced Concrete , Vol. II, Nemchand.
5. Markfintel Hand Book Of Concrete Design

CE*25: Pre-stressed Concrete ***2:2:0 [3]***

Module 1: Introduction to pre-stressed concrete: basic concept and general principles, materials used and their properties, methods and techniques of pre-stressing, pre-stressing systems, loss of pre-stress/

Module 2: Analysis of pre-stressed concrete sections: loading stages and computation of section properties, critical sections under working load for pre-tensioned and post-tensioned members, load balancing method of analysis of pre-stressed concrete beams.

Module 3: Design of pre-stressed concrete sections for flexure: general philosophy of design, design approaches in working stress method and limit stress method, critical conditions for design, limit state of collapse in flexure, permissible stresses in concrete and steel, kern points, choice and efficiency of sections, cable profiles and layouts, cable zone, deflections of pre-stressed concrete members.

Module 4: Design for shear: calculation of principle tension under working load, permissible principle tension, shear strength calculation under limit state of collapse for both sections cracked and un-cracked in flexure.

Module 5: End zone stresses in pre-stressed concrete members: pretension transfer bond, transmission length, end block of post-tensioned members

Module 6: Design of pre-stressed concrete beams: design of simply supported pre-tensioned and post tensioned slabs and beams, introduction to application of pre-stressing to continuous beams, linear transformation and concordancy of cables.

Term Work:
This shall include a project report on design of a post tensioned prestressed concrete beam with one A1 size drawing sheet on design.

Text/Reference Books:

1. Plain and Reinforced Concrete Vol. I, Jain & Jaikrishna, Nemchand.
2. Design of Reinforced Concrete Structures, Dayaratnam P, Oxford & IBH.
3. Reinforced Concrete Structures, Sayal & Goel, Wheeler.
4. Design of Pre-stressed Concrete Structures, T. Y. Lin & N. H. Burns
5. Pre-stressed Concrete, R. H. Evans & E.W. Bennet.
6. Pre-stressed Concrete, N. Krishna Raju.
7. Modern Pre-stressed Concrete, James Libby,
8. Prestressed Concrete Analysis and Design, Antoine F. Naaman.
9. Pre-stressed Concrete, Vol. I, I. Y. Guyon

CE*26: Soil Dynamics ***2:2:0 [3]***

Module 1: Vibration of elementary system, Degrees of freedom, Analysis of system with one degree of freedom, spring-mass system, harmonic vibration, uniform circular motion, natural frequency, free and forced vibrations with and without damping, types of damping.

Module 2: Wave propagation in elastic rods, in an elastic infinite medium, and in semi-elastic half space, wave generated by surface footing.

Module 3: Liquefaction of soils, criterion and factor affecting liquefaction of soil, laboratory and field studies on liquefaction, liquefaction studies in oscillatory simple shear, evaluation of liquefaction potentials, liquefaction of clay.

Module 4: Principles of machine foundation, design criteria for satisfactory machine foundation, degrees of freedom of a block foundation analysis of vertical and sliding vibration of a machine foundation, mass of soil participating in vibration.

Module 5: Vibration isolation and screening methods, improvement of distressed machine foundation.

Module 6: Field and laboratory tests for evaluation of dynamic properties of soil under vertical vibration, coefficient of elastic uniform compression, coefficient of elastic uniform shear, spring constant damping modulus of elasticity typical values of soils.

Module 7: IS code method of design and IS code provisions for dynamic analysis of buildings.

Term Work:

This shall include a project report covering the selection of design parameters, design analysis including drawing if any aspect of soil dynamics included in the above course.

Text/Reference Books:

1. Soil Dynamics by Shamsher Prakash
2. Fundamentals of Soil Mechanics by B. M. Das, Elsevier
3. Dynamics of Bases and foundations by D. D. Brakan. McGraw Hill.
4. Vibration Analysis and Foundation Dynamics by N. S. V. Rao, Wheeler.

CE*27: Advanced Foundation Engineering ***2:2:0 [3]***

Module 1: Planning of subsurface investigation- Purpose and scope, Influence of soil conditions and type of foundation on exploratory programme, Subsurface soundings – static and dynamic methods, Planning of subsurface investigations, Type and sequence of operations, Lateral extent and depth of exploration, Interpretation of field and laboratory data

Module 2: Consolidation: Terzaghi's theory of one-d consolidation – derivation of equation (solution in detail need not be covered), Estimation of Cc and Cv from laboratory tests, Estimation of Pc by various methods, Field consolidation curves, Quasi pre-consolidation and secondary consolidation, practical applications

Module 3: Stress and strain behavior of soil: Triaxial test - drained and un-drained behavior of sand and clays, Failure criteria in soils – only Mohr – Coulomb's criteria, Ideal, plastic and real soil behavior, Shear strength of sand and clays.

Module 4: Estimation of stresses: Boussinesq's theory, Westergard's theory, Newmarks charts.

Module 5: Bearing capacity and settlement analysis of shallow foundations: Modes of failure, Failure criteria, Prandtl Reissner solutions, Buisman – Terzaghi solution, Assumptions in estimates of ultimate loads, Effect of shape, embedment of footing, eccentricity in loading, compressibility (including critical rigidity index), Choice of factor of safety, Settlement of foundations on sand – Schmertmann method, Foundations on

collapsing and swelling soils, non-uniform soils, compressible soils and on rock, R.C.C. design of isolated and combined footings.

Module 6: Pile foundations: Use of load tests, Estimation of single pile capacity by static and dynamic methods, Group capacity, Separation of skin friction and end bearing capacity, Settlement of single and group of piles.

Module 7: Ground improvement: Improvement of deep cohesionless soils and cohesive soils (including stone columns), geological properties of reinforced soils, Instrumentation – mainly pore pressure gauges and settlement gauges and their applications.

Text/Reference Books:

1. Soil Mechanics and Foundation Engineering, Volume I and II, V. N. S. Murthy, Saitech Publication
2. Soil Mechanics in Engineering Practice, K. Terzaghi and R. B. Peck – Second Edition, Wiley International
3. Principles of Foundation Engineering, Das B M, PWS Publications
4. Foundation Engineering Handbook, Winterkorn and Fang, Galgotia Publications

CE*28: Geographic Data Analysis and Applications ***2:2:0 [3]***

Module 1: Basic concepts of GIS- Information systems, spatial and non-spatial information, geographical concepts and terminology, advantages of GIS, basic components of GIS, commercially available GIS hardware and software, organization of data in GIS.

Module 2: GIS data- Field data, statistical data, Maps, aerial photographs, satellite data, points, lines and areas features, vector and raster data, advantages and disadvantages, data entry through keyboard, digitizers and scanners, digital data, preprocessing of data-rectification and registration, interpolation techniques.

Module 3: Data management- DBMS, various data models, run-length encoding, quadtrees, data analysis-data layers, analysis of spatial and non-spatial data, data overlay and modeling, data processing: raster based and vector based, data presentation –hardcopy devices, softcopy devices.

Module 4: Remote sensing and GIS integration- Principles of electromagnetic remote sensing, imaging characteristics of remote sensing systems, extraction of metric and descriptive information from remotely sensed images, integration of remote sensing and GIS.

Module 5: Applications of GIS- Map revision, land use, agriculture, forestry, archaeology, municipal geology, water resources, soil erosion, land suitability analysis, change detection

Term Work:

Each student to appear for at least one written test during the semester. At least 10 assignments based on above syllabus and the graded answer paper for the semester test to be submitted.

Text/Reference Books:

1.Lo C P, Yeung A K W, Concepts and Techniques of Geographic Information Systems, Prentice Hall. India.
2.Kang-tsung Chang, Introduction to Geographic Information Systems, Tata McGraw Hill

CE*29: Concrete Technology ***2:0:2*** ***[3]***

Module 1: Properties of Ingredients-Properties of coarse and fine aggregates and their influence on concrete, types of cement and their use, physical properties of 33 Grade, 43 Grade, 53 Grade ordinary Portland cement, Portland pozzolana cement, rapid hardening Portland cement, hydrophobic cement, low heat Portland cement and sulphate resisting Portland cement as per relevant I.S. codes. Stone types and properties, preservative treatments, stone aggregates.

Module 2: Grades of concrete- Concrete for ordinary work, light weight concrete, high density concrete, workability, durability and strength requirements, effect of w/c ratio, acceptability criteria, laboratory testing of fresh and hardened concrete.

Module 3: Concrete mix design-Mix design for compressive strength by I.S. methods, road note method and British method, mix design for flexural strength.

Module 4: High performance concrete-Constituents of high grade concrete, various tests and application of high performance concrete.

Module 5: Admixtures-Plasticizers, retarders, accelerators and other admixtures, test on admixtures, chemistry and compatibility with concrete.

Module 6: Ready mix concrete: requirements of ready mix concrete, transit mixer details, mix design of RMC.

Module 7: Concrete for repairs and rehabilitation of structures-Polymer concrete, fiber reinforced concrete, polymer impregnated concrete, polymer modified cement concrete and Ferro cement, different tests.

Module 8: Non-Destructive testing of concrete-hammer test, ultrasonic pulse velocity test, load test, carbonation test, half cell potentio-meter, corrosion of steel, core test and relevant provision of I.S. codes.

Practical Work:
The following list of experiments to be performed by the students:

(a) Effect of w/c ratio o workability (slump cone, compaction factor, V-B test, flow table)
(b) Effect of w/c ratio on strength of concrete,
(c) Mix design in laboratory
(d) Non destructive testing of concrete – some applications (hammer, ultrasonic)
(e) Secant modulus of elasticity of concrete & indirect tensile test on concrete.
(f) Study of admixtures & their effect on workability and strength of concrete.
(g) Modulus of rupture of concrete.
(h) Permeability test on concrete.
(i) Tests on polymer modified mortar / concrete.
(j) Tests on fiber-reinforced concrete.
(k) Flexure test on beam (central point load and two point load) (plotting of load deflection curve and finding value of E)

Text/Reference Books:

1. Plain & reinforced concrete, Vol. I, O.P. Jain & Jaikrishna,
2. Concrete technology, theory and practice, M.S. Shetty.
3. Properties of concrete, Neville, El, Society & Pub.
4. Relevant I.S. codes.
5. Special Publication of ACI on Polymer concrete and FRC.
6. Proceedings of International Conferences on Polymer Concrete and FRC.

CE*30: Advanced Construction Materials ***2:0:2 [3]***

Module 1: Recent developments in construction materials for Cladding, Waterproofing, Tiles, Paints, Formwork, Decorative interiors etc.

Module 2: Specifications: their properties, methods of use, benefits and limitations.

Module 3: Economic analysis of using new materials, recycling and reuse.

Module 4: Specific precautions to be taken while using new materials.

Text/Reference Books:
Manufacturers' Catalogs, Data Sheets and Application Notes.

CE*31: Construction Equipment and Materials ***2:0:2 [3]***

Module 1: Large and heavy engineering projects- characteristics and complexities, methods statement for major activities like excavation, concreting, steel fabrication and erection for projects like earthen dams, hydropower projects, nuclear power plant, refineries and other industrial projects,

Module 2: Excavation for heavy engineering projects- Excavation in various types of soils, selection of equipment, safety measures in excavation, drainage in excavation.

Module 3: Concrete construction for heavy engineering projects-Selection of equipment for batching, mixing, transporting, placing and compacting for various types of jobs, safety measures during concreting, Special concretes and mortars-preplaced aggregate concrete, roller compacted concrete, grouting

Module 4: Prefabricated construction- Planning for pre-casting, selection of equipment for fabrication, transport and erection, quality measures, safety measures during erection.

Module 5: Steel construction-Planning for field operations, selection of equipment and erection tools, tools and methods of welding, tools and methods of cutting and joining, bridge erection, quality measures, safety measures during fabrication and erection.

Module 6: Specific issues related to planning, site layouts, equipment selection and pre-project activities for large size construction projects like earthen dams, concrete dams, thermal power stations, nuclear power stations, light houses, airports and ports, bridges.

Module 7: Information related to special equipments and their applications to off-shore construction, underground utility construction.

Module 8: New materials and equipment for construction; Case studies of heavy construction projects.

Text/Reference Books:

1. Thomas baron, Erection of steel structures
2. Stubbs, handbook of heavy construction
3. Journals of Civil Engineering and Construction Engineering

CE*32: Building Maintenance and Repairs ***2:2:0 [3]***

Module 1: General-Quality Assurance for concrete construction as Built Concrete property Strength, Permeability, Thermal Properties and Cracking.

Module 2: Influence on Serviceability and Durability-Effects due to climate, Temperature, Chemicals, Wear and Erosion, Design and Construction errors, Corrosion Mechanism, Effects of Cover thickness and Cracking, Methods of Corrosion protection, Corrosion Inhibitors, Corrosion Resistant Steels, Coatings, Cathodic Protection.

Module 3: Maintenance and Repair Strategies-Definitions-Maintenance, repair and rehabilitation, Facets of Maintenance, Importance of Maintenance, Preventive Measures on Various Aspects, Inspection, Assessment Procedure for Evaluating for Damaged Structures, Causes of Deterioration, Testing Techniques.

Module 4: Materials for Repair-Special Concretes and Mortar, Concrete chemicals, Special Elements for accelerated strength gain, Expansive cement, Polymer Concrete, Sulphur Infiltrated Concrete, Ferro Cement, Fiber Reinforced Concrete.

Module 5: Techniques for Repair-Rust Eliminators and polymers coating for rebars during repair, foamed concrete, mortar and dry pack, vacuum concrete, Gunite and shotcrete, Epoxy Injection, Mortar Repairs for cracks, shoring and underpinning.

Module 6: Examples of Repair to Structures-Repairs to overcome low member strength, deflection, cracking, chemical disruption, weathering wear, fire, leakage, marine exposure.

Module 7: Engineered demolition techniques for dilapidated structures – case studies.

Text Books:

1. "Concrete Structures – Materials, Maintenance and Repair", Dennison Campbell, Allen and Harold Roper, Longman Scientific and Technical UK, 1991.
2. "Repair of Concrete Structures", R.T. Allen and S.C. Edwards, Blakie and Sons, UK, 1987.

Reference Books:

1. "Concrete Technology -Theory and Practice" M.S. Shetty, S. Chand, New Delhi, 1992.
2. "Training Course Notes on Damage Assessment and Repair in Low Cost Housing", "RHDC – NBO" Santhakumar A.R., Anna University, 1992.
3. "Learning from Failures – Deficiencies in Design", R.N. Raikar, Construction and Service – R & D Centre (SDCPL), Raikar Bhavan, Mumbai, 1987.
4. "Estate Management, Anna Institute of Management", N. Palaniappan, Chennai, 1992.

5. Metal Lecture Notes of Workshop on “Repairs and Rehabilitation of Structures”, Lakshmipathy, 1999.

CE*33: Water Resource Systems ***2:2:0 [3]***

Module 1: Planning for water resources development, levels of planning and objectives, project formulation and evaluation. System analysis in planning, trends in water resources development.

Module 2: Objectives and evaluation criteria: Technological objectives, social benefit-cost analysis, practical project appraisal, environmental - ecological objectives and evaluation criteria, Multi-objective analysis.

Module 3: Hydrologic input analysis: surface sub-system (watershed) functional analysis, hydrograph and IUH, wash and Clark model, hydrologic forecasting computer simulation of basin. Soil sub-system analysis, ground water sub-system, stream flow generation.

Module 4: Demand analysis: categories of demand, demand projections and policy formulation for various demands.

Module 5: System elements and sub-system planning, water conveyance and distribution systems, reservoir systems, conjunctive surface and ground water development.

Module 6: Multipurpose developmental issues- flood management, conjunctive flood mitigation and water resources enhancement, hydro-electric development and the power sector, inland water transportation, micro-level planning, erosion and sedimentation, water shed management, conjunctive use of surface water and ground water, rainwater harvesting

Text/Reference Books:

1. Arthur Mass et.el., Design of Water Resources Systems, Macmillan.
2. L D James & R R Leo, Economics of Water Resources Planning, McGraw Hill
3. W A Hall & J A Dracup, Water Resources Systems Engineering, McGraw Hill
4. M C Chaturvedi, Water Resources Systems Planning and Management, Tata McGraw Hill
5. K N Duggal, J P Soni, Elements of Water Resources Engineering, New Age India
6. Wurbs R A, James W P, Water Resources Engineering, Prentice Hall, India

CE*34: Pavement Management System ***2:2:0 [3]***

Module 1: Pavement distresses Distresses in flexible/rigid pavements causes and remedies. Visual Surface distress survey procedures and techniques. Serviceability Indicators for roads. Measurement of Serviceability Indicators using various equipments like Bump Indicator, Skid tester, Distress surveys & Benkelman Beam.Functional evaluation of pavements- Serviceability Concepts, Visual Rating, Pavement Serviceability Index, Roughness Measurements, Skid Resistance, Roughness, and Safety Aspects. Inventory System.

Module 2: Maintenance operations/alternatives- Classification of maintenance operations, Routine, Periodic, Special. Common types of maintenance: Potholes, Cracked surface, Ruts & undulations, Resurfacing, Interface treatments, Bituminous Thin Surface Courses- Seal ..Coat, Surface Dressing, Premixed carpet, Mixed seal surfacing, Micro asphalt concrete

(MAC), Bituminous Surface Courses: Semi-Dense Bituminous Concrete, Bituminous Concrete, and Bitumen Mastic. Road maintenance in high rainfall areas. Choice of materials. Modified bitumen & geo-fabrics. Maintenance alternatives including recycling.

Module 3: Pavement Management/ Maintenance Management System-Components of PMS and their Activities, Major Steps in Implementing PMS, Inputs, Design, Construction and Maintenance, Rehabilitation and Feedback Systems, Examples of HDM package, Highway Financing, Fund Generation, Evaluating Alternate Strategies and Decision Criteria.

Module 4: Prediction Deterioration Models- Factors that affect performance, Types of prediction models, Prediction deterioration model development, Method to assess the precision and accuracy of the developed model.

Module 5: Pavement Structural Design and Economic Analysis; Emerging Technology in Pavement Management Systems.

Text/Reference Books:

CE*35: Bridge Engineering ***2:2:0 [3]***

Module 1: Introduction-Types of bridges, economic spans, aesthetics, selection of suitable type of bridge,

Module 2: Design loads and their distribution-IRC loads, railway loading, analysis of deck slab and IRC loads, load distribution among longitudinal beams of a bridge.

Module 3: Design of superstructures- Design of balanced cantilever concrete bridge, introduction to design of RC arch bridge, pre-stressed concrete and box girder bridge. Design of lattice girder rail way bridge.

Module 4: Design of substructure-Different types of foundations, their choice and method of construction, design of well foundation, design of piers and abutments, various types of bearings and their design.

Module 5: Construction methods-Erection of bridge superstructures, cantilever construction.

Text/Reference Books:

1. Victor D J, essentials of Bridge Engineering, Oxford & IBH
2. Raju N K, Design of Bridges, Oxford & IBH
3. Ponnuswamy S, Bridge Engineering, Tata McGraw Hill
4. Raina V K, Concrete Bridge Practice, Tata McGraw Hill

CE*36: Traffic Planning and Design ***2:2:0 [3]***

Module 1: Traffic Engineering and control-Review of various traffic surveys and traffic Studies; Statistical methods for traffic engineering and their applications - Distributions, sampling theory and Significance testing, Regression and Correlation; Intersection design-Principles, various available alternatives, rotary design, mini roundabout, traffic signals: types of traffic signals, advantages, determination of optimal cycle time and signal setting

for an intersection with fixed time signals, co-ordination of signals, types, area traffic control, delay at signalized intersection. Accident and road safety: accident causes, recording system, analysis and preventive measures, accident cost, alternative methodologies for calculation. Traffic management- various measures and their scope, relative merits and demerits. Highway capacity: passengers car units, level of service, factor affecting capacity and level of service, influence of mixed traffic.

Module 2: Transportation Planning and management-Introduction to the process of urban transport planning. Travel demand forecasting=Trip generation analysis, trip classification, multiple regression analysis, category analysis. Modal split analysis: introduction, earlier modal split models, modal split models with behavioral basis.Trip distribution analysis: introduction, methods of trip distribution, uniform and average factor method, Fratar method, Furness method, The Gravity model, Intervening and competing, Linear programming approach to trip distribution. Traffic Assignment: purpose of traffic assignment, traffic flow characteristics, Assignment techniques=All or nothing assignment, Multiple route assignment, Capacity restraint assignment, Diversion curves. Rout building algorithms. Land-use transport models: Introduction, selection of Land-use transport models, The Lowry model, Grain – Lowry model, Applications of Lowry model.

Module 3: Theory of traffic flow- Scope, definitions and basic relationship, review of flow density speed studies, hydrodynamic analogies, Application of hydrodynamic analogy, Car-following theory and its application to traffic engineering, probabilistic description of traffic flow, an introduction to queuing theory as applied to traffic flow problems for study state conditions, simulation studies.

Module 4: Transport Economics-Economic evaluation of highway schemes, need for economic evaluation, cost and benefits of transportation projects, basic principles of economic evaluation, Net present value method, benefit/cost ratio method, internal rate of return method. Vehicle operating costs, Value of travel time saving, Accident costs.

Module 5: Public Transportation-Mass transit systems: Bus and rail transit, characteristic capacities.

Module 6: Introduction to intelligent transportation systems, Introduction to advanced computational techniques for transportation planning.

Term Work:
This shall include a project report on one of the following: Traffic studies- data collection and analysis, proposals for new facilities or improvement to existing facilities or Project work based on transportation planning or economic analysis of a highway project.

Text/Reference Books:

1. Traffic engineering and transport planning by L.R. Kadiyali, Khanna Publishers Delhi
2. G.J. Pingnataro, Principles of Traffic Engineering, McGraw Hill, 1970.
3. Wohl and Martin, Traffic System Analysis for Engineering and Planners, McGraw Hill, 1983.
4. B.G. Hutchinson, Introduction to Urban Transport Systems, Planning, McGraw Hill,1970.
5. Fair and Williams, Economics of Transportation, Harper & Bros., Publishers, NY, 1959.
6. Winfrey, Robley, Economic Analysis for Highway ,International Textbook Co., PA,USA, 1969.
7. Partha Chakraborty and Animesh das, Principles of Transportation Engineering, Prentice Hall, India
8. Subhash Saxena, A Course in Traffic Engineering and Design, Dhanpat Rai & Sons
9. Manual of Economic Evaluation of Highway Projects in India (SP30), Indian Roads Congress

CE*37: Solid and Hazardous Waste Management ***2:2:0*** ***[3]***

Module 1: Solid Wastes – sources, types, composition, physical, chemical, and biological properties of solid wastes / sources and types of hazardous and infectious wastes in municipal solid wastes.

Module 2: Solid waste generation and collection, Handling, Storage, Processing, Transportation.

Module 3: Disposal of Solid waste – materials separation and processing, thermal conversion, biological and chemical conversion, recycling of material in municipal solid wastes, Land-filling, Composting, gas generation, closure of land-fills.

Module 4: Hazardous Wastes – Fundamentals, fate, and Transport of contaminants, Toxicology origin, quantity and quality parameters.

Module 5: Biomedical / infectious Waste: Composition, Collection, Handling and Disposal.

Module 6: Legal aspects of Hazardous Waste Management: Collection, Conveyance, Treatment and Disposal.

Module 7: Hazardous Waste Management Practices: Environmental Audits, Pollution Prevention.

Module 8: Treatment and Disposal Methods; Physicochemical processes, Biological Methods, Stabilization & Solidification, Thermal Methods, Land Disposal.

Module 9: Site Remediation- Site & Subsurface Characterization, Remedial Technologies.

Text/Reference Books:

1.Integrated Solid Waste Management, Techobanglous, Thiesen and Vigil, McGraw Hill, N.Y.
2.Hazardous Wadte Management, Lagrega, Buckingham and Evans, McGraw Hill, N.Y.
3.Solid waste management in developing countries, A D Bhide, Nagpur Publications.

CE*38: Environmental Impact Assessment *(EIA)* and Audit ***2:2:0*** ***[3]***

Module 1: Environmental Impact-Environmental inventories, Environmental assessment, evaluation.

Module 2: Socioeconomic Impact Assessment-Financing of capital expenditure, increase in user charges, sociological impacts.

Module 3: Role of EIA in Planning and Decision making Processes, Rapid EIA.

Module 4: Environmental Impact Statement.

Module 5: Environmental Auditing-Post Audit reviews of EIA.

Module 6: Case studies.

Term Work:
This shall include a project report on at least one aspect of EIA.

Text/Reference Books:
"Environmental Impact Analysis", R.K. Jain, L.V. Urban, and G.S. Stacay ,Van Nostrand Reinhold, 1997.

CE*39: Construction amd Law ***2:2:0*** ***[3]***

Module 1: Indian Contract Act 1972 – Valid Contract, Voidable Contract, Void – Sections related to these. Definitions, Interpretation.

Module 2: Arbitration and Conciliation Act of 1996- Arbitration agreement, Arbitrator tribunal, Qualifications of Arbitrator, Arbitration Proceedings Award. Conciliation agreement, proceedings, settlement.

Module 3: Provisions of various labor laws-Workmen's Compensation Act 1923; Disablement, Total Permanent disablement, Temporary disablement, Formula for compensation; Minimum wages act, 1948; Payment of bonus Act, 1965; Weekly holidays Act, 1942; Payment of Wages Act, 1936; Inter-State Migrant Labor Act, 1979; Employees Insurance Act, 1948.

Module 4: The building and other construction workers (regulation of employment and conditions of service) Act, 1996 and Rules 1998.

Text/Reference books:
1.B.S. Patil, Legal Aspects of Building and Engineerring Contracts, 1974.
2.Bare Acts referred to above.

CE*40: Systems Approach to Civil Engineering ***2:2:0*** ***[3]***

Module 1: Concept of systems approach: system, boundaries of system, goals and objectives, optimality, mathematical models, objective function and constraints, problem solving mechanism, types of problems, modeling / problem formulation, sub-optimization, solution techniques, sensitivity analysis

Module 2: Basic concepts of probability and probability distributions, regression and curve fitting.

Module 3: Decision theory: classification of decision situations, decision tables and decision tree, criteria for decision making under certain, uncertain and risk conditions.

Module 4: Index numbers: basic requirements of index numbers, constructing index numbers: using relatives, using aggregates.

Module 5: Linear programming: general nature of problem, graphical method of solution, simplex method, dual, sensitivity analysis.

Module 6: Distribution models: transportation and assignment problems and their solutions.

*Module 7:*Queuing models: various situations, queue discipline and customer behavior, single server model.

Module 8: Simulation: general approach, Monte Carlo simulation, simple problems using hand calculations.

Text/Reference Books:

1. Benjamin J R & Cornell C A, "Probability, Statistics and Decisions for Civil Engineers", McGraw Hill
2. Jewell T K, " A Systems Approach to Civil Engineering Planning and Design",Harper & Row
3. Ossenbruggen P J, "Systems Analysis for Civil Engineers".
4. Shrivastava, Shenoy and Sharma, "Quantitative Techniques for Managerial Decisions", Wiley Eastern.

CE*41: Risk & Value Management ***2:2:0 [3]***

Module 1: Project Risks- Definition, dynamic and static risk, uncertainty and risk, Risk and construction project time, money and technology, the people and the risks, processes and risks, risks and clients, consultants and contractors, risk allocation in contracting.

Module 2: Human Aspects-Personnel attitude towards risk, perceptions and risks, individuals and groups , communication in risk management, concept of utility and risks.

Module 3: Risk management system- Risk identification, sources of risks, risk classification, types, impact and consequences of risk, risk analysis, Sensitivity analysis, breakeven analysis ,scenario analysis, risk response: retention, reduction, transfer, avoidance/

Module 4: Qualitative and quantitative methods in risk management-Qualitative risk assessment, risk register, probability – Impact matrix, project appraisal, cost benefit analysis, Monte- Carlo technique, portfolio theory, Delphi method, influence diagrams, decision trees.

Module 5: Disasters-Natural and manmade, possible effects, Disaster recovery plan.

Module 6: Value Engineering-Value, Reasons of poor value in constructed facilities, habits, road blocks and attitudes.

Module 7: Value management-Value Engineering job plan, function analysis, purpose and implications of life cycle costs, Impact of energy on cost of constructed facilities, managing value engineering study.

Module 8: Disaster recovery plan: basic requirements, documenting disaster recovery plan, rehearsing the disaster recovery plan, example disaster recovery plan.

Text/Reference Books:

1. N J Smith , Managing Risk in Construction Projects
2. R Flagnan R and G Norman, Risk Management and Construction, Blackwell Scientific

3. Thompson P A and Perry J G, Engineering Construction Risks- A Guide to Project Risk Analysis and risk Management, Thomas Telford
4. L W Zimmerman and G D Hart, Value Engineering, CBS Publishers.

CE 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 *Civil 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.

EC 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)*	*Civil Engineering(CE)* Prof. Vinay Topkar HOD,Civil Engg., VJTI,Bombay *Email: vmtoper@vjti.org.in*	• Prof. Rafat Siddique, Structural Engineering, Thapar University Patiala, email rsiddhique@thapar.edu • Prof. P L Patel, Hydraulics, SVNIT, Surat, email-plpatel@ced.svnit.ac.in • Prof. Deepak Killedar, Environment Engineering, SGSITS, Indore, email-dkilledar@sgsits.co.in • Prof. D. K. Soni, Soil Engineering, NIT, Kurukshetra, email- dksoni@nitkkr.ac.in • Prof. Saroj Mandal, Concrete, Jadavpur University Kolkata, e-mail smandal@civil.jdvu.ac.in • Prof. Satish Chandra , Transportation engineering IIT, Roorkee, e-mail- satisfce@iitr.ernet.in
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 the Chairman, AICTE	**12 Prof. D. Narasimha Reddy** Vice Chancellor, Jawaharlal Nehru Technological University, Kukatpally, 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**