

**AR - 18**

**COURSE STRUCTURE  
AND  
DETAILED SYLLABUS,  
(I-I, I-II Sem Syllabus)  
&  
Academic Regulations**

**CIVIL ENGINEERING**

**For**

**B. TECH. FOUR YEARS DEGREE PROGRAMME**

(Applicable for the batches admitted from 2018-19)



**ADITYA INSTITUTE OF TECHNOLOGY AND MANAGEMENT  
(AUTONOMOUS)**

Approved By AICTE, New Delhi  
Recognized under 2(f),12(b) of UGC  
Permanently Affiliated to JNTUK, Kakinada.  
K. Kotturu, TEKKALI-532 201, Srikakulam, Andhra Pradesh

# ADITYA INSTITUTE OF TECHNOLOGY AND MANAGEMENT (AUTONOMOUS)

Approved by AICTE, Accredited by NBA & NAAC, Recognized under 2(f) and 12(b) of UGC  
Permanently Affiliated to JNTUK, Kakinada.  
K.Kotturu, Tekkali, Srikakulam-532201, Andhra Pradesh

## Academic Regulations 2018 for B. Tech.

(Effective for the students admitted into I year from the Academic Year 2018-2019 and onwards)

### 1. Award of B.Tech. Degree

A student will be declared eligible for the award of the B. Tech. Degree if he/she fulfills the following academic regulations.

- (a) Pursued a course of study for not less than four academic years and not more than eight academic years.
- (b) Registered for **160** credits and he/she must secure total **160** credits.

2. Students, who fail to complete their Four years Course of study within **8** years or fail to acquire the 160 Credits for the award of the degree within **8** academic years from the year of their admission, shall forfeit their seat in B. Tech course and their admission shall stand cancelled.

### 3. Courses of study

The following courses of study are offered at present with specialization in the B.Tech. Course.

Sl. No.	Branch Code-Abbreviation	Branch
01	01-CE	Civil Engineering
02	02-EEE	Electrical and Electronics Engineering
03	03-ME	Mechanical Engineering
04	04-ECE	Electronics and Communication Engineering
05	05-CSE	Computer Science and Engineering
06	12-IT	Information Technology

And any other course as approved by the authorities of the University from time to time.

### 4. Credits (Semester system from I year onwards):

Sl. No	Course	Credits
1	Theory Course	2/3/4
2	Open Electives	02
3	Laboratory Course	1.5
4	Internship	1.5
5	Employability skills	1.5
6	Mini Project	2/3
7	Project	07

## 5. Open Electives:

There is one open elective in each semester from 2-2 Semester to 4-1 semester. The student can choose one open elective of respective semester. The pattern of Midterm examinations and end examinations of these courses is similar to regular theory courses and the valuation is purely internal.

## 6. MOOCs:

Explore all possibilities to run at least one subject in every semester from 2-1 semester onwards as a MOOCs.

## 7. Evaluation Methodology:

The performance of a student in each semester shall be evaluated subject - wise with a maximum of **100** marks for theory course, laboratory and other courses. The project work shall be evaluated for **200** marks.

### 7.1 Theory course:

For theory courses the distribution shall be **40** marks for internal midterm evaluation and **60** marks for the External End - Examinations.

Out of 40 internal midterm marks – **25** marks are allotted for descriptive exam, **10** marks for two assignments or one case study (group wise), and 5 marks for objective test.

#### (i) Pattern for Internal Midterm Examinations (30 marks):

For theory courses of each semester, there shall be **2** Midterm exams. Each descriptive exam is to be held for **30** marks with the duration of **90** minutes.

For final calculation of internal marks, weightage of 70% will be given to the student who performed well either in first Mid or second Mid and 30% weightage will be given to other Midterm examinations.

Mid paper contains three descriptive type questions with internal choice. Each question carries 10 marks ( $3 \times 10 = 30M$ ) and scale down to 25 marks. The first Midterm examination to be conducted usually after 8 weeks of instruction or after completion of 50 percent syllabus, the second Midterm examination to be conducted usually at the end of instruction after completion of remaining 50 percent syllabus.

#### (ii) Pattern for External End Examinations (60 marks):

The question paper shall have descriptive type questions for 60 marks. There shall be one question from each unit with internal choice. Each question carries 12 marks. Each course shall consist of five units of syllabus. The student should answer total 5 questions. ( $5 \times 12M = 60M$ )

### 7.2. Laboratory Course:

- (i) For practical subjects there shall be continuous evaluation during the semester for **40** internal marks and **60** semester end examination marks. Out of the **40** marks for internal: **25** marks for day to day work, **5** marks for record and **10** marks to be awarded by conducting an internal laboratory test. The end examination shall be conducted by the teacher concerned and external examiner from outside the college.
- (ii) For the course Engineering Graphics and Design, the distribution shall be 40 marks for internal evaluation (20 marks for day-to-day work, and 20 marks for internal tests) and 60 marks for end examination.  
For award of marks for internal tests weightage of 80% will be given to the student who performed well either in first test or second test and 20% weightage will be given to other test.

### 7.3 Minor Project:

Out of a total of 100 marks for the minor project work 40 marks shall be for internal evaluation and 60 marks for end semester examination. The end semester examination ( Viva-Voce) shall be conducted by the committee. The committee consists of an external examiner, Head of the dept and supervisor of the project. The internal evaluation shall be made on the basis of seminar given by each student on the topic of his/her project, which was evaluated by internal committee. Out of 40 internal marks -10 marks allotted for literature survey, 15 marks for results and analysis and 15 marks for seminar.

### 7.4 Project Work:

Out of a total of 200 marks for the project work, **80** marks shall be for Project Internal Evaluation and **120** marks for the End Semester Examination. The End Semester Examination (Viva – Voce) shall be conducted by the committee. The committee consists of an external examiner, Head of the Department and Supervisor of the Project. The evaluation of project work shall be made at the end of the IV year. The Internal Evaluation shall be made on the basis of two seminars given by each student on the topic of his project which was evaluated by an internal committee. Out of 80 internal marks - 20 marks allotted for literature survey, 30 marks for results and analysis, 15 marks for first seminar (usually after 8 weeks) and 15 marks for second seminar (at the end of semester).

### 7.5 Mandatory Courses:

Mandatory course is one among the compulsory courses and does not carry any Credits. The list of mandatory courses is shown below:

- i) Induction Program
- ii) Constitution of India
- iii) Environmental sciences

### 7.6 Employability Skills:

Employability skills shall be evaluated for **100** marks. **40** marks for day-to-day evaluation and **60** marks on the basis of end (internal) examination. There is no external examination for employability skills. It will be evaluated in IV-I semester.

### 7.7 Internship:

All the students shall undergo the internship period minimum of **4** weeks and the students have an option of choosing their own industry which may be related to their respective branch. A self study report for the internship shall be submitted and evaluated during the IV year II-Semester and will be evaluated for a total of **100** marks consists of **40** marks for internal assessment and **60** marks for end examination.

Internal assessment for **40** marks shall be done by the internship supervisor. Semester end examination (Viva – Voce) for **60** marks shall be conducted by committee consists of Head of the Department, internal supervisor and an external examiner.

For a few merit students, internship for six months will be allowed based on their performance in academics. Those who want to go for internship for six months are required to intimate the same to the college through proper channel at the end of III-II semester and they require completing all the subjects of IV B.Tech., either in IV-I Semester or IV-II Semester. However, project work will be evaluated only in IV-II Semester.

## 8. Attendance Requirements:

- (i.) A student shall be eligible to appear for End Semester examinations, if he/she acquires a minimum of **75%** of attendance in aggregate of all the subjects.
- (ii.) Condonation of shortage of attendance in aggregate up to **10% (65% and above and below 75%)** in each semester with genuine reasons and shall be approved by a committee duly appointed by the college. The condonation approved otherwise it can be reviewed by the College academic committee.
- (iii.) A Student will not be promoted to the next semester unless he satisfies the attendance requirement of the present semester. They may seek re-admission for that semester when offered next.
- (iv.) Shortage of Attendance below **65%** in aggregate shall in NO case be condoned.
- (v.) Students whose shortage of attendance is not condoned in any semester are not eligible to take their end examination of that class and their registration shall stand cancelled.
- (vi.) A fee stipulated by the college shall be payable towards condonation of shortage of attendance.

## 9. Minimum Academic Requirements:

### 9.1 Conditions for pass and award of credits for a course:

- a) A candidate shall be declared to have passed in individual course if he/she secures a minimum of 40% aggregate marks i.e 40 out of 100 (Internal & Semester end examination marks put together), subject to a minimum of 35% marks i.e 21 marks out of 60 in semester end examination.
- b) On passing a course of a programme, the student shall earn assigned credits in that Course.

### 9.2 Method of Awarding Letter Grades and Grade Points for a Course.

A letter grade and grade points will be awarded to a student in each course based on his/her performance as per the grading system given below.

Table: Grading System for B.Tech. Programme

Percentage	Grade Points	Letter Grade
95-100%	10	O
85-<95%	9	A+
75-<85%	8	A
65-<75%	7	B <sup>+</sup>
55-<65%	6	B
45-<55%	5	C
40%-<45%	4	P
< 40%	0	F (Fail)

### 9.3. Calculation of Semester Grade Points Average (SGPA)\* for semester

The performance of each student at the end of the each semester is indicated in terms of SGPA. The SGPA is calculated as below:

$$\text{SGPA} = \frac{\Sigma(\text{CR} \times \text{GP})}{\Sigma\text{CR}} \quad (\text{for all courses passed in semester})$$

Where CR = Credits of a Course

GP = Grade points awarded for a course

\*SGPA is calculated for the candidates who passed all the courses in that semester.

### 9.4. Calculation of Cumulative Grade Points Average (CGPA) and Award of Division for Entire Programme.

The CGPA is calculated as below:

$$\text{CGPA} = \frac{\Sigma(\text{CR} \times \text{GP})}{\Sigma\text{CR}} \quad (\text{For entire programme})$$

Where CR = Credits of a course

GP = Grade points awarded for a course

Table: Award of Divisions

CGPA	DIVISION
$\geq 7.5$ (with single attempt)	First Class with distinction
$\geq 6.5$ and $< 7.5$	First Class
$\geq 5.5$ and $< 6.5$	Second Class
$\geq 4.0$ and $< 5.5$	Pass Class
$< 4.0$	Fail

$$\text{9.4.1 Equivalence percentage} = (\text{CGPA} - 0.5) \times 10 \%$$

### 9.5 Supplementary Examinations:

Supplementary examinations will be conducted in every semester.

### 9.6 Conditions for Promotion:

- (i.) A student will be promoted to second year, if he/she put up the minimum attendance requirement.
- (ii.) A student shall be promoted from II to III year only if he fulfills the academic requirement of total **50%** credits (if number credits is in fraction, it will be rounded off to lower digit) from regular and supplementary examinations of I year and II year examinations, irrespective of whether the candidate takes the examination or not.
- (iii.) A student shall be promoted from III year to IV year only if he fulfills the academic requirements of total **50%** credits (if number of credits is in fraction, it will be rounded off to lower digit) from regular and supplementary examinations of I Year, II Year and III Year examinations, irrespective of whether the candidate takes the examinations or not.

#### **10. Course pattern:**

- (i.) The entire course of study is of four academic years and each year will have TWO Semesters (Total EIGHT Semesters).
- (ii.) A student is eligible to appear for the end examination in a subject, but absent for it or failed in the end examinations may appear for that subject's **supplementary** examinations, when offered.
- (iii.) When a student is detained due to lack of credits / shortage of attendance, he may be re-admitted when the semester is offered after fulfillment of academic regulations. Whereas the academic regulations hold good with the regulations he/she first admitted.

#### **11. Minimum Instruction Days:**

The minimum instruction days for each semester shall be **95** clear instruction days.

#### **12. There shall be no branch transfer after the completion of admission process.**

#### **13. General:**

- (i.) Where the words “he” “him” “his”, occur in the regulations, they include “she”, “her”, “hers”.
- (ii.) The academic regulation should be read as a whole for the purpose of any interpretation.
- (iii.) In the case of any doubt or ambiguity in the interpretation of the above rules, the decision of the principal is final.
- (iv.) The College may change or amend the academic regulations or syllabi at any time and the changes or amendments made shall be applicable to all the students with effect from the dates notified by the college.

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**ADITYA INSTITUTE OF TECHNOLOGY AND MANAGEMENT: TEKKALI**  
**SRIKAKULAM-532201, Andhra Pradesh (India)**  
**Academic Regulations 2018 (AR18) for B. Tech. (Lateral Entry Scheme)**

(Effective for the students getting admitted into II year from the Academic Year 2018- 2019 and onwards)

**1. Award of B. Tech. Degree**

A student will be declared eligible for the award of the B. Tech. Degree if he/she fulfills the following academic regulations.

- (a) Pursued a course of study for not less than three academic years and not more than six academic years.
  - (b) Registered for all the credits of 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> year of respective branches and he/she must secure total credits of 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> year of respective branches. .
2. Students, who fail to complete their three year Course of study within six years or fail to acquire the total credits for the award of the degree within 6 academic years from the year of their admission, shall forfeit their seat in B. Tech course and their admission shall stand cancelled.

**3. Promotion Rule:**

- (a.) A lateral entry student will be promoted to II year to III year if he puts up the minimum required attendance in II year.
- (b.) A student shall be promoted from III year to IV year only if he fulfills the academic requirements of total **50%** of credits (if number of credits is in fraction, it will be rounded off to lower digit) from the II Year and III Year examinations , whether the candidate takes the examinations or not.

**4. Minimum Academic Requirements:**

**4.1 Conditions for pass and award of credits for a course:**

- a) A candidate shall be declared to have passed in individual course if he/she secures a minimum of 40% aggregate marks i.e 40 out of 100 (Internal & Semester end examination marks put together), subject to a minimum of 35% marks i.e 21 marks out of 60 in semester end examination.
- b) On passing a course of a programme, the student shall earn assigned credits in that Course.

**4.2 Method of Awarding Letter Grades and Grade Points for a Course.**

A letter grade and grade points will be awarded to a student in each course based on his/her performance as per the grading system given below.

Table: Grading System for B.Tech. Programme

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40%-<45%	4	P
< 40%	0	F (Fail)



### 4.3 Calculation of Semester Grade Points Average (SGPA)\* for semester

The performance of each student at the end of the each semester is indicated in terms of SGPA. The SGPA is calculated as below:

$$\text{SGPA} = \frac{\Sigma(\text{CR} \times \text{GP})}{\Sigma\text{CR}} \quad (\text{for all courses passed in semester})$$

Where CR = Credits of a Course

GP = Grade points awarded for a course

\*SGPA is calculated for the candidates who passed all the courses in that semester.

### 4.4 Calculation of Cumulative Grade Points Average (CGPA) and Award of Division for Entire Programme.

The CGPA is calculated as below:

$$\text{CGPA} = \frac{\Sigma(\text{CR} \times \text{GP})}{\Sigma\text{CR}} \quad (\text{for entire programme})$$

Where CR = Credits of a course

GP = Grade points awarded for a course

Table: Award of Divisions

CGPA	DIVISION
$\geq 7.5$ (with single attempt)	First Class with distinction
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$\geq 5.5$ and $< 6.5$	Second Class
$\geq 4.0$ and $< 5.5$	Pass Class
$< 4.0$	Fail

$$4.4.1 \text{ Equivalence percentage} = (\text{CGPA} - 0.5) \times 10 \%$$

**5. All other regulations as applicable for B. Tech. Four- year degree course (Regular) will hold good for B. Tech. (Lateral Entry Scheme)**

## DISCIPLINARY ACTION FOR MALPRACTICES / IMPROPER CONDUCT IN EXAMINATIONS

	<b>Nature of Malpractices/Improper conduct</b>	<b>Punishment</b>
1	If the student possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, Cell phones, pager, palm computers or any other form of material concerned with or related to the subject of the examination (theory or practical) in which he is appearing but has not made use of (material shall include any marks on the body of the student which can be used as an aid in the subject of the examination)	Expulsion from the examination hall and cancellation of the performance in that subject only.
(a)		
(b)	If the student gives assistance or guidance or receives it from any other student orally or by any other body language methods or communicates through cell phones with any student or students in or outside the exam hall in respect of any matter.	Expulsion from the examination hall and cancellation of the performance in that subject only of all the students involved. In case of an outsider, he will be handed over to the police and a case is registered against him.
2	If the student has copied in the examination hall from any paper, book, programmable calculators, palm computers or any other form of material relevant to the subject of the examination (theory or practical) in which the student is appearing.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the student has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the subjects of that Semester/year.
3	If the student impersonates any other student in connection with the examination.	The student who has impersonated shall be expelled from examination hall. The student is also debarred and forfeits the seat. The performance of the original student, who has been impersonated, shall be cancelled in all the subjects of the examination (including practicals and project work) already appeared and shall not be allowed to appear for examinations of the remaining subjects of that semester/year. The student is also debarred for two consecutive semesters from class work and all semester end examinations. The continuation of the course by the student is subject to the academic regulations in connection with forfeiture of seat. If the imposter is an outsider, he will be handed over to the police and a case is registered against him.

4	If the student smuggles in the Answer book or additional sheet or takes out or arranges to send out the question paper during the examination or answer book or additional sheet, during or after the examination.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the student has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The student is also debarred for two consecutive semesters from class work and all semester end examinations. The continuation of the course by the student is subject to the academic regulations in connection with forfeiture of seat.
5	If the student uses objectionable, abusive or offensive language in the answer paper or in letters to the examiners or writes to the examiner requesting him to award pass marks.	Cancellation of the performance in that subject.
6	If the student refuses to obey the orders of the Chief Superintendent/Assistant -Superintendent / any officer on duty or misbehaves or creates disturbance of any kind in and around the examination hall or organizes a walk out or instigates others to walk out, or threatens the officer-in charge or any person on duty in or outside the examination hall of any injury to his person or to any of his relations whether by words, either spoken or written or by signs or by visible representation, assaults the officer-in-charge, or any person on duty in or outside the examination hall or any of his relations, or indulges in any other act of misconduct or mischief which result in damage to or destruction of property in the examination hall or any part of the College campus or engages in any other act which in the opinion of the officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination.	In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that subject and all other subjects the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the subjects of that semester/year. The students also are debarred and forfeit their seats. In case of outsiders, they will be handed over to the police and a police case is registered against them.

7	If the student leaves the exam hall taking away answer script or intentionally tears off the script or any part thereof inside or outside the examination hall.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the student has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The student is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
8	If the student possesses any lethal weapon or firearm in the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the student has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The student is also debarred and forfeits the seat.
9	If student of the college, who is not a candidate for the particular examination or any person not connected with the college indulges in any malpractice or improper conduct mentioned in clause 6 to 8.	Student of the college, expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the student has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat. Person(s) who do not belong to the College will be handed over to police and a police case will be registered against them.
10	If the student comes in a drunken condition to the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the student has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year.
11	Copying detected on the basis of internal evidence, such as, during valuation or during special scrutiny.	Cancellation of the performance in that subject and all other subjects the student has appeared including practical examinations and project work of that semester/year examinations.

**Aditya Institute of Technology and Management, Tekkali**  
**R18 – COURSE STRUCTURE**

**CIVIL DEPARTMENT**

**I YEAR - I Semester**

Year/Sem	Subject Code	Category	Theory/Lab	L	T	P	C
<b>I B. Tech. (1<sup>st</sup> Sem)</b>	18MCT101	MC	Induction Program	3 weeks			0
	18HST101	HSMC	English	2	0	0	2
	18BST107	BSC	Engineering Physics	3	1	0	4
	18BST101	BSC	Linear Algebra and Calculus	3	1	0	4
	18EST102	ESC	Programming for problem solving	3	0	0	3
	18ESL104	ESC	Engineering Graphics & Design	0	0	4	2
	18BSL101	BSCL	Physics Lab	0	0	3	1.5
	18ESL102	ESCL	Programming for Problem Solving Lab	0	0	3	1.5
	18HSL101	HSMCL	Language Proficiency Lab	0	0	3	1.5
				<b>11</b>	<b>2</b>	<b>13</b>	<b>19.5</b>

**I YEAR - II Semester**

Year/Sem.	Subject Code	Category	Theory/Lab	L	T	P	C
<b>I B. Tech. (2<sup>nd</sup> Sem)</b>	18MCT103	MC	Constitution of India/Essence of Indian Traditional Knowledge	3	0	0	0
	18BST108	BSC	Chemistry	3	1	0	4
	18BST103	BSC	Differential Equations	3	1	0	4
	18EST103	ESC	Engineering Mechanics	3	1	0	4
	18CET101	PC	Building Materials	2	0	0	2
	18EST101	ESC	Basic Electrical Engineering	3	1	0	4
	18ESL103	ESCL	Workshop and Manufacturing practice	0	0	3	1.5
	18BSL102	BSCL	Chemistry Lab	0	0	3	1.5
	18ESL101	ESCL	Basic Electrical Engineering Lab	0	0	3	1.5
<b>Total</b>				<b>17</b>	<b>4</b>	<b>9</b>	<b>22.5</b>

## II YEAR - I Semester

Year/Sem.	Subject Code	Category	Theory/Lab	L	T	P	C
<b>II B. Tech. (1<sup>st</sup> Sem)</b>	18MCT202	MC	Environmental Science	3	0	0	0
	18BST209	BSC	Biology	2	1	0	3
	18CET202	PC	Fluid Mechanics-I	2	1	0	3
	18CET203	PC	Mechanics of solids-I	2	1	0	3
	18CET204	PC	Surveying and Geomatics	2	1	0	3
	18CET205	PC	Concrete Technology	2	1	0	3
	18CEL201	PCL	Surveying lab-I	0	0	3	1.5
	18CEL202	PCL	Strength of Materials lab	0	0	3	1.5
	18CEL203	PCL	Concrete Technology Lab	0	0	3	1.5
<b>Total</b>				<b>13</b>	<b>5</b>	<b>9</b>	<b>19.5</b>

## II YEAR - II Semester

Year/Sem.	Subject Code	Category	Theory/Lab	L	T	P	C
<b>II B. Tech. (2<sup>nd</sup> Sem)</b>	18BST204	BSC	Complex Variables and Statistical Methods	2	1	0	3
	18CET206	PC	Engineering Geology	2	0	0	2
	18CET207	PC	Fluid Mechanics-II	3	0	0	3
	18CET208	PC	Mechanics of Solids-II	2	1	0	3
	18CET209	PC	Structural Analysis-I	3	0	0	3
	XXXX	OE	Open elective – 1	2	0	0	2
	18CEL204	PCL	Building planning and Drawing	0	0	3	1.5
	18CEL205	PCL	Surveying Lab-II	0	0	3	1.5
	18CEL206	PCL	FM&HM LAB	0	0	3	1.5
<b>Total</b>				<b>14</b>	<b>2</b>	<b>9</b>	<b>20.5</b>

### Open Elective -1:

Subject Code	Offered by Dept.	Open Elective I	Offered for Dept.
18OET211	BS&H	Transform Theory	MECH/CIVIL
18OET212	BS&H	Numerical Methods	ECE/EE
18OET213	BS&H	Computational Number Theory	CSE/IT
18OET214	CIVIL	Water Shed Management	MECH
18OET215	CIVIL	Computer aided engineering drawing	ECE/EEE/CSE/IT
18OET216	EEE	Introduction to MATLAB	ECE/MECH/CIVIL/CSE/IT
18OET217	MECH	Fundamentals of Material Science	ECE/EEE/CIVIL
18OET218	MECH	Engineering Optimization Techniques	CSE/IT
18OET219	ECE	Introduction to Electronic Measurements	EEE/MECH/CIVIL/CSE/IT
18OET21A	CSE	UNIX Utilities	ECE/EEE/MECH/CIVIL/IT
18OET21B	IT	IT systems Management	ECE/EEE/MECH/CIVIL/CSE

### III YEAR - I Semester

Year/Sem.	Subject Code	Category	Theory/Lab	L	T	P	C
<b>III B. Tech. (1<sup>st</sup> Sem)</b>	18CET310	PC	Transportation Engineering-I	2	1	0	3
	18CET311	PC	Geotechnical Engineering-I	3	0	0	3
	18CET312	PC	Water Resources Engineering	3	0	0	3
	18CET313	PC	Structural Analysis-II	3	0	0	3
	18CET314	PC	Design of Concrete Structures	3	0	0	3
	XXXX	OE	Open elective – 2	2	0	0	2
	18CEP301	Project	Mini Project – 1	0	0	4	2
	18CEL307	PCL	GTE LAB	0	0	3	1.5
	18HSL302	HSMC	Professional \communication Skills Lab	0	0	3	1.5
<b>Total</b>				<b>16</b>	<b>1</b>	<b>10</b>	<b>22</b>

#### Open Elective -2:

Subject Code	Offered by Dept.	Open Elective II	Offered for Dept.
18OET321	BS&H	Fundamentals of Fuzzy Logic	All
18OET322	CIVIL	Fundamentals of building planning	MECH
18OET323	CIVIL	Remote Sensing	ECE/EEE/CSE/IT
18OET324	EEE	Renewable energy sources	ECE/MECH/CIVIL/CSE/IT
18OET325	MECH	Principles of Mechanical Measurements	ECE/EEE/CIVIL
18OET326	MECH	Linear programming and its applications	CSE/IT
18OET327	ECE	Principles of communications	EEE/MECH/CIVIL/CSE/IT
18OET328	CSE	Introduction to JAVA	ECE/EEE/MECH/CIVIL
18OET329	IT	Introduction to PYTHON	ECE/EEE/MECH/CIVIL/CSE

### III YEAR - II Semester

Year/Sem.	Subject Code	Category	Theory/Lab	L	T	P	C
<b>III B. Tech. (2<sup>nd</sup> Sem)</b>	18HST302	HSMC	Human Values	2	0	0	2
	18CET315	PC	Environmental Engineering-1	2	0	0	2
	18CET316	PC	Geotechnical Engineering-II	3	0	0	3
	18CET317	PC	Design of Steel Structures	3	0	0	3
	XXXX	PE-1	Professional Elective-1	3	0	0	3
	XXXX	OE	Open elective – 3	2	0	0	2
	18CEP302	Project	Mini Project – 2	0	0	6	3
	18CEL308	PCL	Computer Aided Engineering Drawing and Practice Lab	0	0	3	1.5
	18CEL309	PCL	Transportation Engineering Lab	0	0	3	1.5
<b>Total</b>				<b>15</b>	<b>0</b>	<b>12</b>	<b>21</b>

#### Professional Elective-1

Subject Code (PE-1)	Subject
18CEE311	Advanced Design of Concrete Structures
18CEE312	Advanced Structural Analysis
18CEE313	Finite Element Methods

#### Open Elective -3:

Subject Code	Offered by Dept.	Open Elective III	Offered for Dept.
18OET331	MBA	HRD & Organizational behavior	All
18OET332	CIVIL	Environmental impact assessment	ECE/EEE/MECH
18OET333	CIVIL	GPS & Survey Methods	CSE/IT
18OET334	EEE	Energy audit conservation and management	ECE/EEE/MECH/CSE/IT
18OET335	MECH	Elements of workshop technology	ECE/EEE/CIVIL/CSE/IT
18OET336	ECE	Introduction to Signal Processing	EEE/MECH/CIVIL
18OET337	ECE	Fundamentals of Signals & Systems	CSE/IT
18OET338	CSE	Simulation and Modeling	ECE/EEE/MECH/CIVIL/IT
18OET339	IT	Fundamentals of Computer Graphics	ECE/EEE/MECH/CIVIL/CSE



**IV YEAR - I Semester**

Year/Sem.	Subject Code	Category	Theory/Lab	L	T	P	C
<b>IV B. Tech. (1<sup>st</sup> Sem)</b>	18CET418	PC	Estimation , Costing and Quantity Surveying	2	1	0	3
	XXXX	PE-2	Professional Elective-2	3	0	0	3
	XXXX	PE-3	Professional Elective-3	3	0	0	3
	18CET419	PC	Environmental Engineering-II	3	0	0	3
	XXXX	OE	Open elective – 4	2	0	0	2
	18HSL406	Project	Employability Skills			3	1.5
	18CEL410	PCL	Geographical Information System and Computer Aided Design lab	0	0	3	1.5
	18CEL411	PCL	Environmental Engineering Lab	0	0	3	1.5
<b>Total</b>				<b>13</b>	<b>1</b>	<b>9</b>	<b>18.5</b>

Professional Elective-2

Subject Code (PE-2)	Subject
18CEE414	Transportation Engineering-II (Railway, Airport and Docks and Harbors)
18CEE415	Pavement Analysis and design
18CEE416	Design and drawing of irrigation structures
18CEE417	Pre stressed concrete

Professional Elective-3

Subject Code (PE-3)	Subject
18CEE418	RS&GIS
18CEE419	Earth quake resistant and design
18CEE420	Watershed Management
18CEE421	Environmental Impact Assessment

**Open Elective -4:**

Subject Code	Offered by Dept.	Open Elective IV	Offered for Dept.
18OET441	MBA	Project Management	ECE/EEE/CIVIL/CSE/IT
18OET442	MBA	Industrial Engineering and Management	MECH
18OET443	MBA	Entrepreneurial Development	ECE/EEE/MECH/ CIVIL/CSE/IT
18OET444	CIVIL	Geographical Information Systems	ECE/EEE/MECH/ CSE/IT
18OET445	EEE	Power quality management	ECE/MECH/ CIVIL/CSE/IT
18OET446	MECH	Fundamentals of ROBOTICS	ECE/EEE/ CIVIL/CSE/IT
18OET447	ECE	Basics of Mobile Communications	EEE/MECH/CIVIL
18OET448	ECE	Introduction to Wireless Networks	CSE/IT
18OET449	CSE	Introduction to Cloud Computing	ECE/EEE/MECH/CIVIL/IT
18OET44A	IT	Introduction to DBMS	ECE/EEE/MECH/ CIVIL
18OET44B	IT	Embedded Systems	CSE

### IV YEAR - II Semester

Year/Sem.	Subject Code	Category	Theory/Lab	L	T	P	C
<b>IV B. Tech. (2<sup>nd</sup> Sem)</b>	18HST404	HSMC	Managerial Economics and Managerial Studies	3	0	0	3
	18CET420	PC	Disaster Management	2	0	0	2
	XXXX	PE-4	Professional Elective-4	3	0	0	3
	18CEP403	Project	Internship				1.5
	18CEP404	Project	Project			14	7
<b>Total</b>				<b>8</b>	<b>0</b>	<b>14</b>	<b>16.5</b>

Subject Code (PE-4)	Subject
18CEE422	Ground Improvement Techniques
18CEE423	Soil Dynamics and Machine Foundations
18CEE424	Ground Water Development and Management
18CEE425	Prefabricated structures

	L	T	P	C
Total	107	15	85	160

**Total credits: 160.0**

**NOTE:      L: Lecture                      T: Tutorial                      P: Practical                      C: Credits**

**HSMC:      Humanities and Social Sciences including Management courses**  
**BS:          Basic Science courses**  
**ES:          Engineering Science courses**  
**PC:          Professional core courses**  
**PE:          Professional Elective**  
**OE:          Open Electives**  
**PCL:        Professional core Lab**  
**Project:     Project work, Seminar, Internship etc**

## I YEAR - I Semester

Year/Sem	Subject Code	Category	Theory/Lab	L	T	P	C
I B. Tech. (1 <sup>st</sup> Sem)	18MCT101	MC	Induction Program	3 weeks			0
	18HST101	HSMC	English	2	0	0	2
	18BST107	BSC	Engineering Physics	3	1	0	4
	18BST101	BSC	Linear Algebra and Calculus	3	1	0	4
	18EST102	ESC	Programming for problem solving	3	0	0	3
	18ESL104	ESC	Engineering Graphics & Design	0	0	4	2
	18BSL101	BSCL	Physics Lab	0	0	3	1.5
	18ESL102	ESCL	Programming for Problem Solving Lab	0	0	3	1.5
	18HSL101	HSMCL	Language Proficiency Lab	0	0	3	1.5
				<b>11</b>	<b>2</b>	<b>13</b>	<b>19.5</b>

**AR-18 – B.Tech – Civil**

**I year I Sem**

**Induction Program  
(Common to all branches)**

**Subject Code: 18MCT101  
Credits : 0**

**External Marks: 0  
Internal Marks: 0**

**English**  
(Common to all branches)

**Subject Code: 18HST101**  
**Credits : 02**

**External Marks: 60**  
**Internal Marks: 40**

**Course Objectives**

- To enable students build vocabulary appropriate to their levels and to make students understand printed texts of different genres
- To enhance basic writing skills of the students in different forms of written communication
- To assist students implicitly synthesize the rules of grammar for the production of accurate sentences
- To aid students acquire appropriate and adequate letter writing skills
- To get students produce written texts using appropriate vocabulary and expression, coherence devices and logical arguments

**Course Outcomes**

- Students will be able to comprehend printed texts of different genres more easily and they will be able to make appropriate word choice.
- Students will be able to write short texts masterly.
- Students will be able to construct grammatically correct sentences.
- Students will be able to communicate through letters and emails effectively.
- Students will be able to comprehend unfamiliar passages, and will be able to write *précis and essays*.

**Course Syllabus**

**Unit–I:** Father’s Help by R K Narayan

Vocabulary Building: Word Formation—Root Words—Prefixes and Suffixes—  
Synonyms and Antonyms—Idioms —Phrasal Verbs—One-word Substitutes—  
Standard Abbreviations

**Unit–II:** My Early Days by A P J Abdul Kalam

Basic Writing Skills: Tense— Voice— Reported Speech—Degrees of Comparison  
—If Clauses— Simple, Compound, Complex Sentences—Punctuation—Correction  
of Sentences

**Unit–III:** Politics and the English Language by George Orwell

Identifying Common Errors in Writing: Subject-Verb Agreement—Noun-Pronoun  
Agreement—Misplaced modifiers—Articles—Prepositions—Redundancies—Clichés

**Unit–IV:** Sacrifice by Rabindranath Tagore

Writing Practice: Letter Writing—Email Writing

**Unit–V:** Stopping by Woods on a Snowy Evening by Robert Frost

Writing Practice: Comprehension—*Précis Writing*— Essay Writing

**Suggested Readings:**

On Writing Well. William Zinsser. Harper Resource Book. 2001  
Practical English Usage. Michael Swan. Oxford University Press. 1995.  
Remedial English Grammar. F.T. Wood. Macmillan. 2007.  
Step by Step. K. Nirupa Rani and others. Pearson. Delhi. 2013.  
Study Writing. Liz Hamp-Lyons and Ben Heasley. Cambridge University Press. 2006.

**Engineering Physics**  
(Common for MECHANICAL & CIVIL ENGINEERING)

Subject Code: 18BST107

Credits : 04

External Marks: 60

Internal Marks: 40

**COURSE DESCRIPTION:**

This course encompasses Fundamental Concepts of Physics that include

- Waves and Oscillations
- Wave Optics
- Lasers
- Fiber Optics
- Materials Science

that are inevitable for any Engineering student so that these prerequisites aid the student to readily understand Day to Day Engineering Problems with Pragmatic Approach.

**COURSE OBJECTIVES**

- To realize the nature of Oscillation in terms of energy exchange by giving various examples.
- To realize the principles of optics in designing optical devices
- To comprehend the Principles of Lasers
- To comprehend the Principles of Fiber Optics
- To possess an insight on Magnetic properties and Superconducting properties pertaining to material fabrication

**COURSE OUTCOME****Will be able to**

- CO1 Interpret the knowledge of Oscillation in terms of energy exchange by giving various examples
- CO2 Apply the principles of optics in designing optical devices
- CO3 Outline the Principles of Lasers.
- CO4 Outline the Principles of Fiber Optics.
- CO5 Interpret the knowledge of Magnetic properties and Superconducting properties in material fabrication.

**UNIT- I : WAVES & OSCILLATIONS**

- **Damped Oscillations:** Harmonic oscillator; Differential Equation of Wave Motion, Over-Damped, Critically Damped and Under-Damped Oscillations
- **Forced oscillations:** Resonance & Quality Factor

**UNIT- II : WAVE OPTICS**

- **Interference** - Introduction, Huygen's Principle, Principle of Superposition of Waves, Interference of Light by Division of Wavefront – Young's Double Slit Experiment, Interference of Light by Division of Amplitude - Newton's Rings under Reflected Light

- **Diffraction** - Introduction, Fraunhofer Diffraction due to Single Slit – Fraunhofer Diffraction due to Double Slit, Diffraction Grating

### UNIT-III : LASERS

- **Lasers** - Introduction, Characteristics of Lasers- Principle of Laser – Absorption, Spontaneous and Stimulated Emission, Einstein Coefficients, Population Inversion, Optical Resonator and Lasing Action.
- **Types of Lasers** - Nd-YAG Laser, Helium-Neon Laser, Semiconductor Laser, Applications of Lasers.

### UNIT-IV : Fiber Optics

- **Principles of Optical Fiber** - Optical Fiber Construction, Total Internal Reflection, Numerical Aperture and Acceptance Angle
- **Types of Fibers** - Differences between Step Index Fibers and Graded Index Fibers, Differences between Single Mode Fibers and Multimode Fibers, Fiber Optic Communication System and Applications

### UNIT-V : Materials Science

- **Magnetic Materials:** Types of Magnetic Materials (Dia, Para, Ferro, Ferri & Antiferro), Hysteresis, Weiss Theory of Ferromagnetism, Soft and Hard Magnetic Materials, Ferrites & its Applications.
- **Superconductivity:** Introduction, Meissner Effect, Type-I & Type-II Superconductors, Applications

### Texts

1. A Textbook of Engineering Physics, [M N Avadhanulu](#) & [P G Kshirsagar](#), S.Chand Publishers
2. Fundamentals of Physics by Resnick, Halliday and Walker

### References

1. University Physics by Young and Freedman
2. Solid State Physics by S. O. Pillai, New Age International Publishers
3. Engineering Physics, Volume-I&II, P.K.Palani Swamy, Scitech Publications Hyderabad
4. Engineering Physics Volume I&II Dr.K.Vijaykumar, S.Chand Publishing Company, New Delhi
5. Engineering Physics Dr. S. Mani Naidu, Pearson Publications Chennai

## Linear Algebra and Calculus (Common to all branches)

**Subject Code: 18BST101**  
**Credits : 04**

**External Marks: 60**  
**Internal Marks: 40**

### Course Objectives:

- The application of the essential tool of matrices and linear algebra including linear transformation, eigen values, diagonalization and orthogonalization.
- The application of Taylor's and Maclaurin's series to calculate maxima and minima of two variable functions.
- The application of integration to length, surface area and volume.
- The mathematical tools needed in evaluating multiple integrals and their usage.
- The essential tool of vector differentiation to calculate gradient, divergence, curl and apply Green's, Stokes and Gauss Divergence theorems in converting one integral form to another.

### Course Outcomes:

The student will be able to:

- To calculate rank, eigen values, eigen vectors of matrices, solve linear system of equations including diagonalization and orthogonalization.
- To estimate maxima and minima of functions of two variables
- To apply single integrals to estimate length, surface area and volume.
- To evaluate multiple integral in both Cartesian and polar coordinates and estimate area and volume.
- To calculate gradient, divergence, curl of a scalar and vector point functions; line, surface and volume integrals and apply Green's, Stokes and Gauss Divergence theorems to convert from single to double or double to triple integrals.

### **UNIT-I: Matrices**

Matrices – Rank - Systems of linear equations - linear dependence and independence –Eigen values, eigenvectors, symmetric, skew-symmetric, orthogonal matrices -Diagonalization.

Vector Space – Basis - Dimension, rank and nullity - Inner product spaces- Gram-Schmidt orthogonalization.

### **UNIT-II: Differential Calculus**

Functions of single Variables: Rolle's, Lagrange's, Cauchy's mean value theorems (without proof) - Taylor's and Maclaurin's Series.

Functions of several Variables: Limits and continuity for two variables - Partial derivative - Total derivative- Taylor's and Maclaurin's Series (without proof) - Maxima, minima of functions without constraints and functions with constraints (Lagrange method of undetermined multipliers).

### **UNIT-III: Single Integrals:**

Definite Integrals, Applications of Integration to Lengths, Volumes and Surface areas of revolution in Cartesian and Polar Coordinates.



**UNIT-IV: Multiple Integrals :**

Double integral (Cartesian and polar form) -Change of order of integration -Change of variables (Cartesian to polar)- area by double integration. Triple integrals – Change of variables (Cartesian to spherical, cylindrical) - Volume by triple integration.

**UNIT-V: Vector Calculus:**

Scalar and vector point functions- Vector differentiation - Directional derivatives - Gradient, Curl and Divergence –Vector Integration -Line, Surface, Volume Integrals - Green, Stokes and Gauss divergence theorems (without proofs) .

**Suggested Text Books**

1. B.V. Ramana, Higher Engineering Mathematics, 44<sup>th</sup> Edition, Tata McGraw Hill New Delhi, 2014.
2. Dr.B.S.Grewal, Higher Engineering Mathematics, 43<sup>rd</sup> Edition, Khanna Publishers, 2015.

**Reference Books**

3. Erwin Kreyszig, Advanced Engineering Mathematics, 9<sup>th</sup> Edition, John Wiley & Sons, 2006.
4. **G.B. Thomas and R.L. Finney**, Calculus and Analytic geometry, 9<sup>th</sup> Edition, Pearson, Reprint, 2002.
5. **Veerarajan T.**, Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
6. **D. Poole**, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
7. **N.P. Bali and Manish Goyal**, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.

**Programming for problem solving  
(Common to all branches)**

**Subject Code: 18EST102**  
**Credits : 03**

**External Marks: 60**  
**Internal Marks: 40**

**Course Objective**

The course is designed to provide complete knowledge of C language. Students will be able to develop logics which will help them to create programs, applications in C. Also by learning the basic programming constructs they can easily switch over to any other language in future.

**Course Outcomes**

1. Understand the fundamentals of C programming
2. Choose the loops and decision making statements to solve the problem
3. Make use of pointers to access arrays, strings and implements different operations on arrays, and work with textual information, characters and strings.
4. Apply programming to write modular programs, user defined functions to solve real time problems and allocate memory using dynamic memory management functions.
5. Create user defined data types including structures and unions to solve problems and implement file operations in C programming for a given application.

**Unit - I**

**Introduction to Programming :** Introduction to components of Computer system, Algorithm, Flow chart, Program development steps, C Tokens, Structure of C program, Basic I/O statements, Operators, Operator precedence.

**Unit - II**

**Control Structures: Decision statements:** if, if-else, nested if and switch, **Iterative statements:** for, while, do while and nested loops **Branching:** Break, continue, goto.

**Unit - III**

**Arrays:** Definition, Types: 1D, Multi Dimensional arrays, declaration, initialization, accessing elements, Matrix operations and String Handling.

**Functions:** Definitions, Declaration, Types of Functions, Parameter passing, Passing Arrays to functions, Recursion, library functions and Storage classes,

**Unit - IV**

**Pointers:** Definition, Declaration, Initialization, Pointer arithmetic, Pointer to pointer, functions and pointers, arrays and pointers, Dynamic memory allocation

**Unit - V**

**Structures:** Definition, Declaration, Accessing the structure elements, Array of structures, Arrays with in structures, pointer to structure, passing structure to function, nested structures, and unions.

**Files:** Definition, types of files, Opening modes, file IO Functions, Random access functions, Preprocessor directives.

**Text Books**

1. B. W Kernighan, Dennis M. Ritchie. The C – Programming Language. 2<sup>nd</sup> Edition, PHI.
2. A Structured Approach Using C by Behrouz A. Forouzan, Richard F. Gilberg 3<sup>rd</sup> Edition

**References**

1. Yashwant Kantikar. 2012. Let Us C, 8th Ed. PBP Publications.
2. E. Balagurusamy. 2011. C Programming. Tata Mc Graw Hills, New Delhi, India.
3. <https://www.tutorialspoint.com> › Cprogramming › C – Home
4. <https://www.programiz.com/c-programming>

**ENGINEERING GRAPHICS AND DESIGN**  
(Common to all branches)

**Subject Code: 18ESL104**  
**Credits : 02**

**External Marks: 60**  
**Internal Marks: 40**

**COURSE OBJECTIVES:**

- Able to develop drawing skills.
- To draw orthographic views from the given isometric view and vice versa
- To understand the fundamentals of computer aided design and drafting

**COURSE OUTCOMES:**

- Draw projection of points and straight lines in first angle projection.
- Project plane surfaces and simple solids inclined to one reference plane.
- Convert orthographic views into isometric projections and vice-versa.
- Draw basic lines and profiles with commonly used operations in drafting software.
- Generate 2D drawings along with dimensioning in drafting software.

**LIST OF EXERCISES:****PART-A: Conventional Engineering drawing**

- 1 Projections of points
- 2 Projections of straight lines inclined to one reference plane only.
- 3 Projections of planes inclined to one reference plane only.
- 4 Projections of simple solids inclined to one reference plane only.
- 5 Conversion of isometric views into orthographic views
- 6 Conversion of orthographic views into isometric views.

**PART-B: Basic Computer aided engineering drawing (2-D drawings)**

1. Commands – Axes, Coordinate points, Creation of lines, Polylines, Square, Rectangle, Polygons, Spines, Circles, Ellipse, Text.
2. Move, Copy, Offset, Mirror, Rotate, Trim, Extend, Break, Chamfer, Fillet, Curves.

**Note: Six Exercises are to be completed by using AutoCAD software**

**TEXT BOOKS:**

1. Engineering Drawing, N. D. Bhatt, V. M. Panchal, Charotar Pub.
2. Engineering Drawing, K. L .Narayana, P.Kanniah, Scitech Pub.

**REFERENCE BOOKS:**

1. Engineering Drawing and Graphics, 2nd ed., K. Venugopal, New Age International Pub.
2. Fundamentals of Engineering Drawing, 11th ed., Luzadder, J. Warren, D.M. Jon, Prentice Hall India Pub.

**Physics Lab**  
(Common to all branches)

**Subject Code: 18BSL101**  
**Credits : 1.5**

**External Marks: 60**  
**Internal Marks: 40**

**Course Description:**

This Laboratory course is intended to apply the scientific method to expedite experiments the include

- Error analysis
- Waves Fundamentals
- Wave Optics
- Lasers and Fiber Optics
- Semiconductor devices

So that student can verify theoretical ideas and concepts covered in lecture through host of analytical techniques, statistical analysis and graphical analysis.

**Course Objectives:**

- To operate optical systems and design Instrumentation with precision measurements to estimate error for targeted accuracy
- To Interpret the results of mechanical parameters such as modulus of elasticity and acceleration due to gravity through simple oscillatory experiments using torsional pendulum or physical pendulum
- To understand the phenomenon of Interference and Diffraction using Travelling Microscope and Spectrometer.
- To attain ability to use Techniques and Skills associated with Modern Engineering Tools such as Lasers and Fiber Optics
- To characterize semiconducting material devices.

**Course Outcomes:**

Will be able to

- CO1 demonstrate the ability to measure properties of optical systems and design instrumentation with precision measurements to estimate error for targeted accuracy
- CO2 infer the results of mechanical parameters such as modulus of elasticity and acceleration due to gravity through simple oscillatory experiments using torsional pendulum or physical pendulum
- CO3 Apply the knowledge of Optics to calculate geometrical parameters of thickness of thin object and radius of curvature of a lens
- CO4 illustrate techniques and skills associated with Modern Engineering Tools such as Lasers and Fiber Optics
- CO5 evaluate characteristics of semiconducting material devices.

**LIST OF EXPERIMENTS**

1. Precision Measurements and Instruments
2. Error Analysis and Graph Drawing
3. Determination of Rigidity Modulus of the Material of Wire using Torsional Pendulum
4. Determination of Acceleration due to Gravity (g) using Compound Pendulum
5. Newton's Rings – Determination of the Radius of Curvature of a given Plano Convex Lens
6. Determination of Thickness of Thin Object using Wedge Method
7. Determination of Wavelength of Monochromatic Source using LASER Diffraction
8. Determination of width of a single slit using LASER
9. Determination of Numerical Aperture and Bending Loss of an Optical Fiber
10. Determination of Energy Band Gap using the given Semiconductor

**Manual / Record Book**

1. Manual cum Record for Engineering Physics Lab, by Prof. M. Rama Rao, Acme Learning.
2. Lab Manual of Engineering Physics by Dr.Y. Aparna and Dr. K. Venkateswara Rao (VGS books links, Vijayawada)

**Programming for Problem Solving Lab**  
(Common to all branches)

**Subject Code: 18ESL102****Credits : 1.5****External Marks: 60****Internal Marks: 40****Course Objectives:**

- To gain experience about structured programming
- To help students to understand the implementation of C language
- To understand various features in C

**Course Outcomes:**

At the end of the course students will be able to

1. Solve the given problem using the syntactical structures of C language.
2. Design programs involving decision structures and loops.
3. Apply programming to solve different operations on arrays and strings.
4. Develop modularity concept using functions and write programs for allocating memory dynamically.
5. Construct C program that uses structures and unions and implement file operations on given application.

**List of Experiments**

1. Write the C programs to calculate the following
  - a) Area of triangle when sides are given.
  - b) Program for Type Casting.
  - c) Interchanging values of two variables.
2. Write the C programs to perform the following
  - a) Read lower case character and convert into upper case.
  - b) Find maximum of 3 values using conditional operator.
  - c) Calculate area and perimeter of circle.
3. Write C programs for the following using decision making statements
  - a) Program to find roots of quadratic equation.
  - b) Find the Largest among 3 values.
  - c) Calculate the grades of a student.
4.
  - a) Arithmetical operations using switch-case.
  - b) Read a number and display in reverse.
  - c) Check for Armstrong number property
5.
  - a) Check for strong number property
  - b) Generate Fibonacci series.
  - c) Generate Prime numbers between two numbers.
6. Implement the following using arrays
  - a) Largest and smallest from a list of elements.
  - b) Program for Linear Search.
  - c) Program for Bubble Sort.

7. Implement the following using arrays
  - a) Matrix addition.
  - b) Matrix Multiplication.
  - c) Program using string handling functions.
8. Implement C Program using any Numerical methods
9.
  - a) Factorial using recursion and non recursion.
  - b) GCD using recursion and non recursion.
10.
  - a) Find the sum and average of list of elements using DMA Functions
  - b) Implementation of call by reference and call by value.
11.
  - a) Implementation of array of structure.
  - b) Demonstration of Union.
12.
  - a) Copy the contents of one file into another.
  - b) Count the number of characters, words and lines in a file.

#### **Text Books**

1. B. W Kernighan, Dennis M. Ritchie. The C – Programming Language. 2<sup>nd</sup> Edition, PHI.
2. A Structured Approach Using C by Behrouz A. Forouzan, Richard F. Gilberg 3<sup>rd</sup> Edition

#### **References**

1. Yashwant Kantikar. 2012. Let Us C, 8th Ed.. PBP Publications.
2. E. Balagurusamy. 2011. C Programming. Tata Mc Graw Hills, New Delhi, India.
3. <https://www.tutorialspoint.com> › Cprogramming › C – Home
4. <https://www.programiz.com/c-programming>



**Language Proficiency Lab**  
(Common to all branches)**Subject Code: 18HSL101**  
**Credits : 1.5****External Marks: 60**  
**Internal Marks: 40****Course Objectives**

- To enable students develop neutralized accent
- To assist students utter words intelligibly
- To help students converse aptly as the context demands
- To get students acquire perceptive abilities in professional conversations
- To aid students grasp and interpret information provided in graphs and tables

**Course Outcomes**

- Students will be able to recognize differences among various accents and speak with neutralized accent.
- Students will be able to pronounce words accurately with the knowledge of speech sounds and use appropriate rhythm and intonation patterns in speech.
- Students will be able to generate dialogues for various situations.
- Students will be able to communicate perceptively and concisely.
- Students will be able to comprehend and interpret data provided in graphs and tables.

**Course Syllabus****Unit I:** Listening Comprehension of Audio and Video clips of different accents**Unit II:** Pronunciation—Intonation—Stress—Rhythm**Unit III:** Situational Dialogues**Unit IV:** Poster Presentation**Unit V:** Interpretation of Data in Graphs and Tables**Suggested Readings:**

Communication Skills. Sanjay Kumar and Pushpa Lata. OUP. 2011.  
Practical English Usage. Michael Swan. OUP. 1995.  
Speak Well. K. Nirupa Rani. Orient Blackswan, Hyderabad. 2012.  
Strengthen Your Communication Skills. M. Hari Prasad. Maruthi Publications, Hyd. 2014.  
Strengthen Your Steps. M. Hari Prasad. Maruthi Publications, Hyderabad. 2012.  
Technical Communication. Meenakshi and Sangeetha. OUP. New Delhi. 2013.

**AR-18 – B.Tech – Civil**

**I year II Sem**

**Constitution of India/Essence of Indian Traditional Knowledge**

**(Common to all branches)**

**Subject Code: 18MCT103**

**Credits : 0**

**External Marks: 0**

**Internal Marks: 0**

**Chemistry**  
(Common to all branches)

**Subject Code: 18BST108****Credits : 04****External Marks: 60****Internal Marks: 40****Course Objectives:**

The students will become familiar and understand about:

- Analyse microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces.
- Distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques
- Rationalise reference electrodes and science of corrosion.
- Rationalise organic reactions such as addition, substitution, elimination, rearrangement reactions and polymerization.
- Distinguish Renewable & Non-Renewable energy resources and rationalise about green chemistry, batteries.

**Course Outcomes:**

The course will enable the student to:

- Analyse microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces.
- Distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques
- Rationalise reference electrodes and science of corrosion.
- Rationalise organic reactions such as addition, substitution, elimination, rearrangement reactions and polymerization.
- Distinguish Renewable & Non-Renewable energy resources and rationalise about green chemistry, batteries.

**Unit-1: Atomic Structure and Chemical Bonding:**

Types of Hybridisation-valency shell electron pair repulsion theory (VSEPR) -Molecular orbital theory(MOT) –Energy Level diagrams of diatomic molecules (O<sub>2</sub>, CO) - Atomic and ionic sizes - ionization energies - electron affinity and electronegativity – variable oxidation states - coordination numbers and geometries.

**Unit-2: Spectroscopy:**

Spectroscopy - Electronic spectroscopy-types of Electronic transitions and selection rules – Definition of Chromophore – Definition of Auxochrome – Absorption and intensity shifts. Principle of Fluorescence and Phosphorescence. Introduction to I.R. Spectroscopy –Fingerprint region–I.R. Values for Functional groups (- Carbonyl, -alcohol, -nitryle, -amino)- Introduction to NMR – Principle - equivalent and non-equivalent protons - Chemical shift& Splitting – Coupling Constant

**Unit-3: Electrochemistry & Corrosion:**

Introduction to Electrochemistry - EMF of the cell or Cell potential-Electrochemical series and its importance–Reference electrodes (SHE and Calomel electrode).

Corrosion (chemical and electrochemical theory of corrosion) –Galvanic series. Factors effecting the rate of corrosion – Controlling of corrosion (Proper designing, Modifying the environment, Cathodic protections – Sacrificial Anodic and Impressed Current Cathodic Protection).

**Unit-4:Organic Reactions& Introduction to Polymers:**

Types of Organic reactions: Addition - electrophilic, nucleophilic and free radical - Substitution - electrophilic, nucleophilic ( $SN^1$  and  $SN^2$ ) and free radical – Elimination( $E_1$  and  $E_2$ ) ( $E_{CB}$ - Examples ) – Rearrangement Reactions (Claisen, Pinacol pinacolone rearrangement) – Diels-Alder reaction - Isomerism (Cis- Trans)

Definition of Polymer - Polymerisation(Addition and Condensation) – Functionality – Degree of Polymerisation–Classification of Polymers – Zeiglar Natta Catalysis.

**Unit-5: Green Chemistry & Energy:**

Introduction to green chemistry – Definition and 12 principles of green chemistry.

Types of energy sources – Renewable & Non-Renewable - Introduction to solar energy – harnessing of solar energy – photo voltaic cells – Concentrated Solar power plants.

Introduction of Energy storage devices: Principle& mechanism of Batteries&Supercapacitors, Types of Batteries (Alkaline & Lead-Acid) - Difference between Batteries and Supercapacitors.

**Suggested Text Books:**

- (i) University chemistry, by B. H. Mahan
- (ii) Elementary organic spectroscopy: principles and applications, by Y. R. Sharma
- (iii) Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane
- (iv) “Engineering Chemistry”, P. C. Jain and Monica Jain, Dhanpat Rai Publications, Co., New Delhi, 2004, 16<sup>th</sup> Edition

**Reference books:**

- (i) Fundamentals of Molecular Spectroscopy, by C. N. Banwell
- (ii) Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan
- (iii) Physical Chemistry, by P. W. Atkins
- (iv) Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore, 5th Edition.
- (v) Concise Inorganic Chemistry: Fifth Edition by J.D. Lee

**Differential Equations**  
(For Mech, CSE, Civil, & IT)

Subject Code: 18BST103

Credits : 04

External Marks: 60

Internal Marks: 40

**Course Objectives:**

- To solve the first order Ordinary Differential equations and apply to Orthogonal trajectories, Newton's Law of Cooling and Law of Growth (Decay).
- To solve second and higher order ordinary differential equations.
- To develop series solutions to Legendre's and Bessel's differential equations including properties.
- The effective mathematical tool for the solution of first order linear Partial differential equation and non-linear Partial differential equation (standard types).
- The effective mathematical tool for the solution of homogeneous and non-homogeneous Partial differential equations of higher order with constant coefficients.

**Course Outcomes:**

The student will be able to:

- Apply the mathematical tool for the solution of Ordinary Differential equations, Orthogonal trajectories, Newton's Law of Cooling and Law of Growth (Decay).
- Evaluate higher order homogenous and non-homogenous linear differential equations with constant coefficients.
- Estimate power series solutions for Legendre's and Bessel's differential equations including the recurrence relations.
- Frame Partial differential equation and evaluate first order linear and non-linear Partial differential equation (standard types).
- Apply mathematical tool for the solution of homogeneous and non-homogeneous Partial differential equation of higher order with constant coefficients.

**UNIT-I : Ordinary differential equations of first order:**

Linear - Bernoulli-Exact - Equations reducible to exact.- Orthogonal Trajectories-Newton's law of cooling - Law of Growth and Decay.

**UNIT-II: Ordinary differential equations of higher order :**

Higher order homogenous and non-homogenous linear differential equations with constant coefficients- Particular integrals for the functions of type  $\sin(ax+b)/\cos(ax+b)$ ,  $x^m$ ,  $e^{ax}$ ,  $e^{ax} V(x)$  - Method of variation of parameters.

**UNIT-III : Special Functions**

Legendre's and Bessel's Differential equations – Solutions in power series – Orthogonality property and recurrence relations.

**UNIT-IV : Partial Differential Equations of first order**

Partial differential Equations - Formation of partial differential equations – solutions of first order linear (Lagrange) equation and non-linear (standard type) equations.

**UNIT-V: Partial Differential Equations of higher Order**

Homogenous and non homogeneous partial differential equations of higher order with constant coefficients - Particular integrals for the functions of type  $e^{ax+by}$ ,  $\sin(ax+by)/\cos(ax+by)$ ,  $x^m y^n$ ,  $e^{ax+by} \cdot V(x,y)$ .

**Suggested Text Books**

1. B.V.Ramana, Higher Engineering Mathematics, 44<sup>th</sup> Edition, Tata McGraw Hill New Delhi, 2014.
2. Dr.B.S.Grewal, Higher Engineering Mathematics, 43<sup>rd</sup> Edition, Khanna Publishers, 2015.

**Reference Books**

3. Erwin Kreyszig, Advanced Engineering Mathematics, 9<sup>th</sup> Edition, John Wiley & Sons, 2006.
4. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.

**BUILDING MATERIALS****Subject Code: 18CET101****Credits : 02****External Marks: 60****Internal Marks: 40****Course objectives:**

- To learn about Mechanical and Non Mechanical properties of materials
- To learn about the classification, manufacturing process, test of Timber, Bricks and lime
- To learn about classification, manufacturing process, test of cement, ceramic products, mortar and concrete
- To know about ferrous metals, alloys, glass and corrosion
- To know about paints, varnishes, distempers, fibre and glass reinforced plastics

**Course Outcomes:**

- Explain Mechanical and Non Mechanical properties of materials
- Explain classification, manufacturing process, test of Timber, Bricks and lime
- Explain classification, manufacturing process, test of cement, ceramic products, mortar and concrete
- Discuss about ferrous metals, alloys, glass and corrosion

Discuss about paints, varnishes, distempers, fibre and glass reinforced plastics

**Unit I**

Materials Introduction-Material Selection, Mechanical and Non-Mechanical Properties, Rocks and Stones-Classification, Mechanical Properties, Tests, Quarrying, Dressing, Quality& Requirements of Stones, temperature transition approach; Background of fracture mechanics, concept of fatigue of materials

**Unit II**

Timber and Timber Products-Classification, Structure, Processing of Timber, Defects, Prevention, Qualities of Good Timber& Timber Products.Bricks- Composition, Classification, Manufacturing, Tests, Factors Affecting Quality of Bricks. Lime-Constituents, Sources, Classification, Manufacturing, Tests on Lime.

**Unit III**

Cement-Introduction, Properties, Composition, Manufacturing, Tests, Factors Affecting Quality of Cement. Ceramic Products-Introduction, Properties, Classification, Manufacturing, Factors Affecting Quality of Tiles.Mortar-sources, classification, properties, preparation, selection of mortar, tests. Concrete-classification, production, properties, tests on concrete,light-weight concrete.

**Unit IV**

ferrous Metals and Alloys-Mechanical Properties of Metals, Composition Manufacture, Market Forms Of steel, Heat Treatment and Alloying, Brittle fracture of steel.& non- ferrous materials. corrosion-causes, factors influencing corrosion, types, prevention. Glass-classification, composition, properties, manufacturing, industries. Behaviour of Concrete and Steel

**Unit V**

Paints, varnishes and distempers- characteristics, types, defects. Plastics-composition, classification, properties, fabrication, Fiber reinforced plastics application, properties. - Glass reinforced plastics-application, properties.

**Text Books:**

1. S.C.Rangwala, “ Building Materials”,Charotar Publishing House,.
- 2.P.C.Varghese, “Building Materials”, Prentice-Hall of India (P) Ltd.,
- 3.S.K.Duggal, “Building Materials”, New Age International (P) Ltd.
- 4.Kyriakos Komvopoulos (2011), Mechanical Testing of Engineering Materials, Cognella
5. E.N. Dowling (1993), Mechanical Behaviour of Materials,Prentice Hall International Edition

**Reference Books:**

1. Dr. B.C. Punmia, “Building Construction”, Laxmi publications (p)Ltd New Delhi.
2. Ashokkumar Jain, “Building Construction”, Laxmi publications (p)Ltd Chennai.
3. I S 2185 Part I & II PWD & CPWD Specifications



**Basic Electrical Engineering****Subject Code: 18EST101****Credits : 04****External Marks: 60****Internal Marks: 40****Course objectives:**

- To introduce the basic knowledge of electric circuits
- To illustrate knowledge with AC circuits.
- To become familiar with DC Machines.
- To understand the concept of transformers.
- To provide knowledge on three phase induction motors.

**Course outcomes:****CO1:** Able to summarize different electrical circuits.**CO2:** Able to outline the basics of AC circuits.**CO3:** Able to examine DC Machines.**CO4:** Able to demonstrate working of transformers.**CO5:** Able to generalize three phase induction motors.**UNIT –I Introduction to Electric Circuits**

Basic definitions, Electrical circuit elements (R, L and C), Ohm's Law, voltage and current sources, Series & Parallel circuits, Kirchoff's Laws, Star-delta and delta-star transformations, simple problems with dc excitation.

**UNIT-II AC Circuits**

Representation of sinusoidal waveforms, peak and rms values, phasor representation, Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series only), real power, reactive power, apparent power, power factor, sample problems.

**UNIT-III DC Machines**

Generator-Principle of Operation, construction, EMF equation, Classification, O.C.C, internal and external characteristics of shunt generator. Motor-principle of operation, Torque equation, Speed Control Methods, Operation of 3 point starter.

**UNIT-IV Transformers**

Operation of a Single Phase Transformer, EMF equation, losses, Regulation and Efficiency of a single phase transformer, O.C and S.C Tests. sample problems.

**UNIT-V Three Phase induction Motor**

Principle of Operation of 3- $\Phi$  induction motor, power and torque equations, Speed-Torque Characteristics of 3-  $\Phi$  induction Motor.

**TEXT BOOKS**

1. Principles of Electrical and Electronics Engineering by V.K.Mehta, S.Chand& Co.
2. Introduction to Electrical Engineering – M.S Naidu and S. Kamakshaiah, TMH Publ.

**REFERENCE BOOKS .**

1. Basic Electrical Engineering Dr.K.B.Madhu Sahu scitech publications (india) pvt.ltd.
2. D. C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill, 2009.
3. D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill,2010.

**Workshop and Manufacturing practice  
(Common all branches)**

**Subject Code: 18ESL103**  
**Credits : 1.5**

**External Marks: 60**  
**Internal Marks: 40**

**COURSE OBJECTIVES:**

- The Engineering Workshop Practice for engineers is a training lab course spread over entire semester. The modules include training on different trades like Fitting, Carpentry, Black smithy etc... which makes the students to learn how various joints are made using wood and other metal pieces.

**COURSE OUTCOMES:**

- Make half-lap, mortise & tenon, corner dovetail or bridle wooden joints.
- Develop sheet metal into objects like square tray, taper side tray, conical funnel or elbow pipe.
- Forge MS rod from round to square cross-section, or into L- or S- bend.
- Fabricate MS pieces into either a straight, square, dovetail or V-fit.
- Connect a staircase or a tube light house-wiring electrical circuit.

**I. Wood Working Technology** - Familiarity with different types of wood and tools used in wood Working technology.

Tasks to be performed:

- 1) Half – Lap joint
- 2) Mortise and Tenon joint
- 3) Corner Dovetail joint
- 4) Bridle joint.

**II. Sheet Metal Working** – Familiarity with different types of tools used in sheet metal working, developments of sheet metal jobs from GI sheets, knowledge of basic concepts of soldering.

Tasks to be performed:

- 1) Square Tray
- 2) Taper side Tray
- 3) Conical Funnel
- 4) Elbow Pipe.

**III. Forging Technology** – Familiarity with different types of tools used in forging technology. Knowledge of different types of furnaces like coal fired, electrical furnaces etc...

Tasks to be performed:

- 1) round M.S rod to square bar
- 2) L bend in given M.S. Rod.
- 3) S bend in given M.S. Rod.
- 4) heat treatment tests like annealing, normalizing etc...

**IV. Fitting Technology** – Familiarity with different types of tools used in fitting technology.

Tasks to be performed:

- 1) “V” – fitting
- 2) square fitting
- 3) Dovetail fitting
- 4) Straight fitting

**V.HOUSE WIRING**

- 1) Tube light connection
- 2) Staircase connection

Note: Any two jobs from each trade must be performed by the student.

**Chemistry Lab****Subject Code: 18BSL102****Credits : 1.5****External Marks: 60****Internal Marks: 40****Course Objectives:**

The students will become familiar and understand about:

- Measure molecular/system properties such as kinematic viscosity, acid number of lubricating oil, etc
- Measure molecular/system properties such as surface tension, viscosity, pH, conductance of solutions, redox potentials, etc
- Measure molecular/system properties such as chloride content, hardness of water, dissolved oxygen, iron by colorimeter etc.
- Synthesize a small polymer molecule and analyze a salt sample.
- Estimate iron (by colorimeter), partition coefficient, adsorption of acetic acid by charcoal etc.

**Course Outcomes:**

The students will learn to:

- Measure molecular/system properties such as kinematic viscosity, acid number of lubricating oil, etc.
- Measure molecular/system properties such as surface tension, viscosity, pH, conductance of solutions, redox potentials, etc
- Measure molecular/system properties such as chloride content, hardness of water, dissolved oxygen, iron by colorimeter etc.
- Synthesize a small polymer molecule and analyze a salt sample.
- Estimate iron (by colorimeter), partition coefficient, adsorption of acetic acid by charcoal etc.

**LIST OF EXPERIMENTS: Choice of 10-12 experiments from the following:**

1. Determination of surface tension and viscosity
2. Determination of Hardness of water sample by EDTA Method.
3. Conductometric estimation of Acid by Base.
4. Conductometric estimation of mixture of acids by base.
5. Potentiometric Titrations.
6. Synthesis of a polymer/drug.
7. Determination of acid value of an oil
8. Chemical analysis of a salt
9. Determination of Dissolved Oxygen present in the given water sample by Modern Winkler's Method
10. Colorimetric estimation of iron
11. pH metric titrations
12. Determination of the partition coefficient of a substance between two immiscible liquids
13. Adsorption of acetic acid by charcoal Use of the capillary viscosimeters to demonstrate the isoelectric point as the pH of minimum viscosity for gelatin sols and/or coagulation of the white part of egg
14. Thin layer chromatography.
15. Determination of Chloride content present in given water sample.
16. Determination of kinematic viscosity of given lubricating oil.

**TEXT BOOKS:**

1. "Practical Engineering Chemistry" by K.Mukkanti, etal. B.S.Publications, Hyderabad (2011).
2. "Lab Manual on Engineering Chemistry" by Sudharani, Dhanpat Rai Publications, Co., New Delhi., (2009).

**REFERENCE BOOKS:**

1. “Engineering Chemistry Lab Manual” by Shuchi Tiwari (2010), SCITECH Publications.
2. “Vogel’s Text Book of Quantitative Chemical Analysis”, 6th Edition by G. J. Jeffery, J. Bassett, J. Mendham, R.C. Denney, Longman Scientific & Technical Publications, New York.
3. “A Text Book of Engineering Chemistry” by R. N. Goyal and H. Goel, Ane Books (P) Ltd.(2009).
4. “A Text Book on experiments and calculations Engineering” by S.S. Dara, S.Chand & Company Ltd. (2003).
5. “Instrumental methods of Chemical Analysis”, Gurudeep R, Chatwal Sham, K. Anand, Latest Edition (2015), Himalaya Publications.

**Basic Electrical Engineering Lab**

**Subject Code: 18ESL101**

**Credits : 1.5**

**External Marks: 60**

**Internal Marks: 40**

**Course Objective:**

To introduce the student to study different electrical components and to verify the basic laws related to electrical engineering, Speed control of D.C. motor, testing of transformer, electrical wiring system through study, practice, and experiments.

**Course Outcomes:**

Students will be able to

**CO1:** Label various types of electrical components.

**CO2:** Demonstrate various basic electrical laws.

**CO3:** Demonstrate speed control DC motor & testing of transformer.

**CO4:** Experiment with lamps.

**CO5:** Examine electrical wiring system

**List of Experiments:**

1. Study of electrical components.
2. To verify Ohm's law.
3. To verify (a) Kirchhoff's current law (b) Kirchhoff's voltage law.
4. To verify the total resistance of the series and parallel connected circuits.
5. Find armature resistance, field resistance and filament Lamp Resistance using V-I method.
6. Speed control of D.C. Shunt motor by a) Armature Voltage control b) Field flux control method
7. OC and SC tests on single phase transformer.
8. Fluorescent tube connection.
9. (a) One way control of lamp  
(b) Two way control of lamp
10. Fan wiring.

**Additional Experiments:**

11. Soldering and bread board precautions.
12. To find voltage current relationship for series RL circuit and determine power factor.