Study Scheme & Syllabus of

Bachelor of Technology
Civil Engineering
(IKG PTU Main & Constituent Campuses)

1st to 8th Semesters

Batch 2018 onwards

IK Gujral Punjab Technical University

1st Year

Study scheme

Bachelors of Technology 1st and 2nd semester
It is an Under Graduate (UG) Programme of 4 years duration (8 semesters)
Eligibility for Admission:*As per AICTE norms.*

First Semester **Group-A** **Contact Hrs. : 26**

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L	T	P	Internal	External		
BTPH**101-18**	Basic Science Course	Mechanics of Solids	3	1	0	40	60	100	4
BTPH**111-18**	Basic Science Course	Mechanics of Solids (Lab)	0	0	3	30	20	50	1.5
BTAMXX-18	Basic Science Course	Maths-I	3*	1	0	40	60	100	4
BTEE101-18	Engineering Science Course	Basic Electrical Engineering	3	1	0	40	60	100	4
BTEE102-18	Engineering Science Course	Basic Electrical Engineering (Lab)	0	0	2	30	20	50	1
BTME101-19	Engineering Science Courses	Engineering Graphics & Design	1	0	**6**	60	40	100	**4**
BMPD101-18		Mentoring and Professional Development	0	0	2	Satisfactory / Un-Satisfactory			Non-Credit
TOTAL			**10**	**3**	**13**	**220**	**280**	**500**	**18.5**

***These are the minimum contact hrs. allocated. The contact hrs. may be increased by institute as per the need based on the content of subject.**

First Semester **Group-B** **Contact Hrs. :31**

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L	T	P	Internal	External		
BTCH101-18	Basic Science Course	Chemistry-I	3	1	0	40	60	100	4
BTCH102-18	Basic Science Course	Chemistry-I (Lab)	0	0	3	30	20	50	1.5
BTAMXX-18	Basic Science Course	Maths-I	3*	1	0	40	60	100	4
BTPS101-18	Engineering Science Course	Programming for Problem Solving	3	0	0	40	60	100	3
BTPS102-18	Engineering Science Course	Programming for Problem Solving (Lab)	0	0	4	30	20	50	2
BTMP101-**19**	Engineering Science Courses	Workshop / Manufacturing Practices	1	0	**6**	60	40	100	**4**
BTHU101-18	Humanities and Social Sciences including Management courses	English	2	0	0	40	60	100	2
BTHU102-18	Humanities and Social Sciences including Management courses	English (Lab)	0	0	2	30	20	50	1
BMPD101-18		Mentoring and Professional Development	0	0	2	Satisfactory / Un-Satisfactory			Non-Credit
	TOTAL		**12**	**2**	**17**	**290**	**360**	**650**	**21.5**

***These are the minimum contact hrs. allocated. The contact hrs. may be increased by institute as per the need based**

on the content of subject.

Second Semester Group-A Contact Hrs. :31

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L	T	P	Internal	External		
BTCH101-18	Basic Science Course	Chemistry-I	3	1	0	40	60	100	4
BTCH102-18	Basic Science Course	Chemistry-I (Lab)	0	0	3	30	20	50	1.5
BTAMXX-18	Basic Science Course	Maths-II	3*	1	0	40	60	100	4
BTPS101-18	Engineering Science Course	Programming for Problem Solving	3	0	0	40	60	100	3
BTPS102-18	Engineering Science Course	Programming for Problem Solving (Lab)	0	0	4	30	20	50	2
BTMP101-**19**	Engineering Science Courses	Workshop / Manufacturing Practices	1	0	**6**	60	40	100	**4**
BTHU101-18	Humanities and Social Sciences including Management courses	English	2	0	0	40	60	100	2
BTHU102-18	Humanities and Social Sciences including Management courses	English (Lab)	0	0	2	30	20	50	1
BMPD201-18		Mentoring and Professional Development	0	0	2	Satisfactory / Un-Satisfactory			Non-Credit
	TOTAL		**12**	**2**	**17**	**290**	**360**	**650**	**21.5**

***These are the minimum contact hrs. allocated. The contact hrs. may be increased by institute as per the need based on the content of subject.**

Second Semester Group-B Contact Hrs.: 26

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L	T	P	Internal	External		
BTPHXX-**18**	Basic Science Course	Physics	3	1	0	40	60	100	4
BTPHXX-**18**	Basic Science Course	Physics (Lab)	0	0	3	30	20	50	1.5
BTAMXX-18	Basic Science Course	Maths-II	3*	1	0	40	60	100	4
BTEE101-18	Engineering Science Course	Basic Electrical Engineering	3	1	0	40	60	100	4
BTEE102-18	Engineering Science Course	Basic Electrical Engineering (Lab)	0	0	2	30	20	50	1
BTME101-**19**	Engineering Science Courses	Engineering Graphics & Design	1	0	**6**	60	40	100	**4**
BMPD201-18		Mentoring and Professional Development	0	0	2	Satisfactory / Un-Satisfactory			Non-Credit
	TOTAL		**10**	**3**	**13**	**220**	**280**	**500**	**18.5**

***These are the minimum contact hrs. allocated. The contact hrs. may be increased by institute as per the need based on the content of subject.**

Note : 1. Mentoring and Professional Development will be offered as mandatory Non-Credit course. Mentoring and Professional Development course will have internal evaluation only.

2. This study scheme & syllabus is not applicable for B. Tech Chemical Engineering and B. Tech Petrochem & Petroleum Refinery Engineering. The study scheme and syllabus of B. Tech Chemical Engineering and B. Tech Petrochem & Petroleum Refinery Engineering is separately uploaded on University website.
3. There will be no external theory exam for subject code BTME101-18 (Engineering Graphics & Design) For detail evaluation scheme refer detailed syllabus (page no. 84)
4. The Institutional Summer Vacation Training (4 Weeks) as per IKGPTU/DA/792 dated 21.05.2019.

A. Definition of Credit:

1 Hr. Lecture (L) per week	1 credit
1 Hr. Tutorial (T) per week	1 credit
1 Hr. Practical (P) per week	0.5 credits
2 Hours Practical(Lab)/week	1 credit

B. Range of credits –

A range of credits from 150 to 160 for a student to be eligible to get Under Graduate degree in Engineering. A student will be eligible to get Under Graduate degree with Honours or additional Minor Engineering, if he/she completes an additional 20 credits. These could be acquired through MOOCs.

C. Structure of Undergraduate Engineering program:

S. No.	Category	Suggested Breakup of Credits(Total 160)
1	Humanities and Social Sciences including Management courses	12
2	Basic Science courses	25
3	Engineering Science courses including workshop, drawing, basics ofelectrical/mechanical/computer etc	24
4	Professional core courses	48
5	Professional Elective courses relevant to chosen specialization/branch	18
6	Open subjects – Electives from other technical and /or emergingSubjects	18
7	Project work, seminar and internship in industry or elsewhere Mandatory Courses	15
	[Environmental Sciences, Induction training, Indian Constitution,Essence of Indian Traditional Knowledge]	(non-credit)
	Total	160

Guidelines regarding Mentoring and Professional Development

The objective of mentoring will be development of:

- Overall Personality
- Aptitude (Technical and General)
- General Awareness (Current Affairs and GK)
- Communication Skills
- Presentation Skills

The course shall be split in two sections i.e. outdoor activities and class activities.
For achieving the above, suggestive list of activities to be conducted are:

Part – A
(Class Activities)

1. Expert and video lectures
2. Aptitude Test
3. Group Discussion
4. Quiz (General/Technical)
5. Presentations by the students
6. Team building Exercises

Part – B
(Outdoor Activities)

1. Sports/NSS/NCC
2. Society Activities of various students chapter i.e. ISTE, SCIE, SAE, CSI, Cultural Club, etc.

Evaluation shall be based on rubrics for Part – A & B
Mentors/Faculty incharges shall maintain proper record student wise of each activity conducted and the same shall be submitted to the department.

Induction Programs

A Guide to Induction Program

Introduction

(Induction Program was discussed and approved for all colleges by AICTE in March 2017. It was discussed and accepted by the Council of IITs for all IITs in August 2016. It was originally proposed by a Committee of IIT Directors and accepted at the meeting of all IIT Directors in March 2016.[1] *This guide has been prepared based on the Report of the Committee of IIT Directors and the experience gained through its pilot implementation in July 2016 as accepted by the Council of IITs. Purpose of this document is to help insti-tutions in understanding the spirit of the accepted Induction Program and implementing it.)*

Engineering colleges were established to train graduates well in the branch/department of admission, have a holistic outlook, and have a desire to work for national needs and beyond.

The graduating student must have knowledge and skills in the area of his study. However, he must also have broad understanding of society and relationships. Character needs to be nurtured as an essential quality by which he would understand and fulfill his responsibility as an engineer, a citizen and a human being. Besides the above, several meta-skills and underlying values are needed.

There is a mad rush for engineering today, without the student determining for himself his interests and his goals. This is a major factor in the current state of demotivation towards studies that exists among UG students.

The success of gaining admission into a desired institution but failure in getting the desired branch, with peer pressure generating its own problems, leads to a peer envi-ronment that is demotivating and corrosive. Start of hostel life without close parental supervision at the same time, further worsens it with also a poor daily routine.

To come out of this situation, a multi-pronged approach is needed. One will have to work closely with the newly joined students in making them feel comfortable, allow them to explore their academic interests and activities, reduce competition and make them

[1] A Committee of IIT Directors was setup in the 152nd Meeting of IIT Directors on 6th September 2015 at IIT Patna, on how to motivate undergraduate students at IITs towards studies, and to develop verbal ability. The Committee submitted its report on 19th January 2016. It was considered at the 153rd Meeting of all IIT Directors at IIT Mandi on 26 March 2016, and the accepted report came out on 31 March 2016. The Induction Program was an important recommendation, and its pilot was implemented by three IITs, namely, IIT(BHU), IIT Mandi and IIT Patna in July 2016. At the 50th meeting of the Council of IITs on 23 August 2016, recommendation on the Induction Program and the report of its pilot implementation were discussed and the program was accepted for all IITs.

work for excellence, promote bonding within them, build relations between teachers and students, give a broader view of life, and build character.

Induction Program

When new students enter an institution, they come with diverse thoughts, backgrounds and preparations. It is important to help them adjust to the new environment and inculcate in them the ethos of the institution with a sense of larger purpose. Precious little is done by most of the institutions, except for an orientation program lasting a couple of days.

We propose a 3-week long induction program for the UG students entering the insti-tution, right at the start. Normal classes start only after the induction program is over. Its purpose is to make the students feel comfortable in their new environment, open them up, set a healthy daily routine, create bonding in the batch as well as between faculty and students, develop awarness, sensitivity and understanding of the self, people around them, society at large, and nature.[2]

The time during the Induction Program is also used to rectify some critical lacunas, for example, English background, for those students who have deficiency in it.

The following are the activities under the induction program in which the student would be fully engaged throughout the day for the entire duration of the program.

Induction Program as described here borrows from three programs running earlier at different insti-tutions: (1) Foundation Program running at IIT Gadhinagar since July 2011, (2) Human Values course running at IIIT Hyderabad since July 2005, and (3) Counselling Service or mentorship running at several IITs for many decades. Contribution of each one is described next.

(1) IIT Gandhinagar was the first IIT to recognize and implement a special 5-week Foundation Program for the incoming 1st year UG students. It took a bold step that the normal classes would start only after the five week period. It involved activities such as games, art, etc., and also science and other creative workshops and lectures by resource persons from outside.

(2) IIIT Hyderabad was the first one to implement a compulsary course on Human Values. Under it, classes were held by faculty through discussions in small groups of students, rather than in lecture mode. Moreover, faculty from all departments got involved in conducting the group discussions under the course. The content is non-sectarian, and the mode is dialogical rather than sermonising or lecturing. Faculty were trained beforehand, to conduct these discussions and to guide students on issues of life.

(3) Counselling at some of the IITs involves setting up mentor-mentee network under which 1st year students would be divided into small groups, each assigned a senior student as a student guide, and a faculty member as a mentor. Thus, a new student gets connected to a faculty member as well as a senior student, to whom he/she could go to in case of any difficulty whether psychological, financial, academic, or otherwise.

The Induction Program defined here amalgamates all the three into an integrated whole, which leads to its high effectiveness in terms of building physical activity, creativity, bonding, and character. It develops sensitivity towards self and one's relationships, builds awareness about others and society beyond the individual, and also in bonding with their own batch-mates and a senior student besides a faculty member.

Scaling up the above amalgamation to an intake batch of 1000 plus students was done at IIT(BHU), Varanasi starting from July 2016.

2.1 Physical Activity

This would involve a daily routine of physical activity with games and sports. It would start with all students coming to the field at 6 am for light physical exercise or yoga. There would also be games in the evening or at other suitable times according to the local climate. These would help develop team work. Each student should pick one game and learn it for three weeks. There could also be gardening or other suitably designed activity where labour yields fruits from nature.

2.2 Creative Arts

Every student would chose one skill related to the arts whether visual arts or performing arts. Examples are painting, sculpture, pottery, music, dance etc. The student would pursue it everyday for the duration of the program.

These would allow for creative expression. It would develop a sense of aesthetics and also enhance creativity which would, hopefully, flow into engineering design later.

2.3 Universal Human Values

It gets the student to explore oneself and allows one to experience the joy of learning, stand up to peer pressure, take decisions with courage, be aware of relationships with colleagues and supporting staff in the hostel and department, be sensitive to others, etc. Need for character building has been underlined earlier. A module in Universal Human Values provides the base.

Methodology of teaching this content is extremely important. It must not be through do's and dont's, but get students to explore and think by engaging them in a dialogue. It is best taught through group discussions and real life activities rather than lecturing. The role of group discussions, however, with clarity of thought of the teachers cannot be over emphasized. It is essential for giving exposure, guiding thoughts, and realizing values.

The teachers must come from all the departments rather than only one department like HSS or from outside of the Institute. Experiments in this direction at IIT(BHU) are noteworthy and one can learn from them.[3]

Discussions would be conducted in small groups of about 20 students with a faculty mentor each. It is to open thinking towards the self. Universal Human Values discussions could even continue for rest of the semester as a normal course, and not stop with the induction program.

Besides drawing the attention of the student to larger issues of life, it would build relationships between teachers and students which last for their entire 4-year stay and possibly beyond.

[3]The Universal Human Values Course is a result of a long series of experiments at educational institutes starting from IIT-Delhi and IIT Kanpur in the 1980s and 1990s as an elective course, NIT Raipur in late 1990s as a compulsory one-week off campus program. The courses at IIT(BHU) which started from July 2014, are taken and developed from two compulsory courses at IIIT Hyderabad first introduced in July 2005.

2.4 Literary

Literary activity would encompass reading, writing and possibly, debating, enacting a play etc.

2.5 Proficiency Modules

This period can be used to overcome some critical lacunas that students might have, for example, English, computer familiarity etc. These should run like crash courses, so that when normal courses start after the induction program, the student has overcome the lacunas substantially. We hope that problems arising due to lack of English skills, wherein students start lagging behind or failing in several subjects, for no fault of theirs, would, hopefully, become a thing of the past.

2.6 Lectures by Eminent People

This period can be utilized for lectures by eminent people, say, once a week. It would give the students exposure to people who are socially active or in public life.

2.7 Visits to Local Area

A couple of visits to the landmarks of the city, or a hospital or orphanage could be organized. This would familiarize them with the area as well as expose them to the under privileged.

2.8 Familiarization to Dept./Branch & Innovations

The students should be told about different method of study compared to coaching that is needed at IITs. They should be told about what getting into a branch or department means what role it plays in society, through its technology. They should also be shown the laboratories, workshops & other facilties.

3.Schedule

The activities during the Induction Program would have an Initial Phase, a Regular Phase and a Closing Phase. The Initial and Closing Phases would be two days each.

Time	Activity
Day 0 Whole Day	Student arrive – Hostel allotment. (Preferably do pre-allotment)
Day-1 09:00 am- 03:00 pm 04:30 pm - 06:00 pm	 Academic Registration Orientation
Day-2 09:00 am - 10:00 am	 Diagnostic Test (for English etc.)
10:15am - 12:25 pm	Visit to respective depts..
12:30 pm - 01:55 pm	Lunch
02:00 pm -02:55 pm	Director's address
03:00 pm – 05:00 pm	Interaction with parents
03:30 pm – 05:00 pm	Mentor-mentee groups – introduction within group (Same as Universal Human Values groups)

3.2 Regular Phase

After two days is the start of the Regular Phase of induction. With this phase there would be regular program to be followed every day.

3.2.1 Daily Schedule

Some of the activities are on a daily basis, while some others are at specified periods within the Induction Program. We first show a typical daily timetable.

Sessn.	*Time*	*Activity*	*Remarks*
	Day 3 onwards		
	06:00 am	*Wake up call*	
I	06:30 am - 07:10 am	Physical activity (mild exercise/yoga)	
	07:15 am - 08:55 am	*Bath, Breakfast, etc.*	
II	09:00 am - 10:55 am	Creative Arts / Universal Human Values	Half the groups do Creative Arts
III	11:00 am - 12:55 pm	Universal Human Values / Creative Arts	Complementary alternate
	01:00 pm - 02:25 pm	*Lunch*	
IV	02:30 pm - 03:55 pm	Afternoon Session	See below.
V	04:00 pm - 05:00 pm	Afternoon Session	See below.
	05:00 pm - 05:25 pm	*Break / light tea*	
VI	05:30 pm - 06:45 pm	Games / Special Lectures	
	06:50 pm - 08:25 pm	*Rest and Dinner*	
VII	08:30 pm - 09:25 pm	Informal interactions (in hostels)	

Sundays are off. Saturdays have the same schedule as above or have outings.

3.2.2 Afternoon Activities (Non-Daily)

The following five activities are scheduled at different times of the Induction Program, and are not held daily for everyone:

1. Familiarization to Dept. / Branch & Innovations
2. Visits to Local Area
3. Lectures by Eminent People
4. Literary
5. Proficiency Modules

Here is the approximate activity schedule for the afternoons (may be changed to suit local needs):

Activity	*Session*	*Remarks*
Familiarization with Dept/Branch & Innovations	IV	For 3 days (Day 3 to 5)
Visits to Local Area	IV, V and VI	For 3 days - interspersed (e.g., 3 Saturdays)
Lectures by Eminent People	IV	As scheduled - 3-5 lectures
Literary (Play / Book Reading / Lecture)	IV	For 3-5 days
Proficiency Modules	V	Daily, but only for those who need it

3.3 Closing Phase

Time	*Activity*
Last But One Day	
08:30 am - 12 noon	Discussions and finalization of presentation within each group
02:00 am - 05:00 pm	Presentation by each group in front of 4 other groups besides their own (about 100 students)
Last Day	
Whole day	Examinations (if any). May be expanded to last 2 days, in case needed.

3.4 Follow Up after Closure

A question comes up as to what would be the follow up program after the formal 3-week Induction Program is over? The groups which are formed should function as mentor-mentee network. A student should feel free to approach his faculty mentor or the student guide, when facing any kind of problem, whether academic or financial or psychological etc. (For every 10 undergraduate first year students, there would be a senior student as a *student guide*, and for every 20 students, there would be a *faculty mentor*.) Such a groupshould remain for the entire 4-5 year duration of the stay of the student. Therefore, it would be good to have groups with the students as well as teachers from the same department/discipline[4].

Here we list some important suggestions which have come up and which have been experimented with.

3.4.1 Follow Up after Closure – Same Semester

It is suggested that the groups meet with their faculty mentors once a month, within the semester after the 3-week Induction Program is over. This should be a scheduled meeting shown in the timetable. (The groups are of course free to meet together on their own more often, for the student groups to be invited to their faculty mentor's home for dinner or tea, nature walk, etc.)

3.4.2 Follow Up – Subsequent Semesters

It is extremely important that continuity be maintained in subsequent semesters.

It is suggested that at the start of the subsequent semesters (upto fourth semester), three days be set aside for three full days of activities related to follow up to Induc-tion Program. The students be shown inspiring films, do collective art work, and group discussions be conducted. Subsequently, the groups should meet at least once a month.

Summary

Engineering institutions were set up to generate well trained manpower in engineering with a feeling of responsibility towards oneself, one's family, and society. The incoming undergraduate students are driven by their parents and society to join engineering without understanding their own interests and talents. As a result, most students fail to link up with the goals of their own institution.

The graduating student must have values as a human being, and knowledge and meta-skills related to his/her profession as an engineer and as a citizen. Most students who get demotivated to study engineering or their branch, also lose interest in learning.

The *Induction Program* is designed to make the newly joined students feel comfortable, sensitize them towards exploring their academic interests and activities, reducing compe-tition and making them work for excellence, promote bonding within them, build relations between teachers and students, give a broader view of life, and building of character.

The *Universal Human Values* component, which acts as an anchor, develops awareness and sensitivity, feeling of equality, compassion and oneness, draw attention to society and nature, and character to follow through. It also makes them reflect on their relationship with their families and extended family in the college (with hostel staff and others). It also connects students with each other and with teachers, so that they can share any difficulty they might be facing and seek help.

[4]We are aware that there are advantages in mixing the students from different depts. However, in mixing, it is our experience that the continuity of the group together with the faculty mentor breaks down soon after. Therefore, the groups be from the same dept. but hostel wings have the mixed students from different depts. For example, the hostel room allotment should be in alphabetical order irrespective of dept.

References:

Motivating UG Students Towards Studies,
Rajeev Sangal, IITBHU Varanasi, Gautam Biswas, IIT Guwahati, Timothy Gonsalves, IIT Mandi, Pushpak Bhattacharya, IIT Patna, (Committee of IIT Directors), 31 March 2016, IIT Directors' Secretariat, IIT Delhi.

Contact: *Prof. Rajeev Sangal*Director, IIT(BHU), Varanasi, (director@iitbhu.ac.in)

Third Semester										
S. No.	**Category**	**Subject Code**	**Course Title**	**Hours per week**			**Marks**			**Credits**
				L	**T**	**P**	**Int**	**Ext**	**Total**	
1	Professional Core courses	BTCE-301-18	Surveying & Geomatics	3	1	0	40	60	100	4
2	Professional Core courses#	BTCE-302-18	Solid Mechanics#	3	1	0	40	60	100	4
3	Professional Core courses #	BTCE-303-18	Fluid Mechanics#	3	1	0	40	60	100	4
4	Basic Science Course	BTAM-301-18	MathematicsIII (Transform & Discrete	4	1	0	40	60	100	4
5	Engineering Science Course	BTEC-305-18	Basic Electronics & applications in Civil Engineering	3	0	0	40	60	100	3
6	Humanities and Social Sciences including Management	HSMC-132-18	Civil Engineering-Introduction, Societal & Global Impact	3	0	0	40	60	100	3
7	Professional Core courses	BTCE-306-18	Surveying & Geomatics Lab	0	0	2	30	20	50	1
8	Professional Core courses	BTCE-307-18	Fluid Mechanics Lab	0	0	2	30	20	50	1
9	Professional Core courses	BTCE-308-18	Solid Mechanics Lab	0	0	2	30	20	50	1
10		BMPD-301-18	Mentoring and Professional Development	0	0	2	Satisfactory/ Unsatisfactory			-
11	Pofessional Skill Enhancement	BTCE-332-18	Training – I*	-	-	-	60	40	100	s/us
			31	**19**		**8**	**390**	**460**	**850**	**26**
*** Students have already completed 3 weeks institutional training and field and market survey in Summer vacation which is to be evaluated by viva-voce condcuted along End semester exam of Third semester.**										

Note : # These are the minimum contact hrs. allocated. The contact hrs. may be increased by institute as per the need based on the content of subject.

Fourth Semester										
S No	**Category**	**Subject Code**	**Course Title**	**Hours Per Week**			**Marks**			**Credits**
				L	**T**	**P**	**Int**	**Ext**	**Total**	
1	Professional Core courses	BTCE-401	Concrete Technology	3	0	0	40	60	100	3
2	Professional Core courses	BTCE-402	Material, Testing & Evaluation	4	0	0	40	60	100	4
3	Professional Core courses	BTCE-403	Hydrology & Water Resources	3	1	0	40	60	100	4
4	Professional Core courses	BTCE-404	Transportation Engineering	3	1	0	40	60	100	4
5	Professional Core courses	BTCE-405	Disaster Preparedness &	3	0	0	40	60	100	3
6	Basic Sciences (Mandatory Courses)	EVS-101-18	Environment Science (Non- credit)	3	0	0	50	-	100	0
7	Professional Core courses	BTCE-406-18	Concrete Testing Lab	0	0	2	30	20	50	1
8	Professional Core courses	BTCE-407-18	Transportation Lab	0	0	2	30	20	50	1
9	Professional Skill Enhancement		Training –II*	0	0	0	-	-	-	-
10		BMPD-401-18	Mentoring and Professional Development	0	0	2	Satisfactory/ Unsatisfactory			-
			26	**18**	**2**	**6**	**310**	**340**	**650**	**20**

* 2 weeks survey camp and 4 weeks industrial/institutional training for which viva will be condcuted along End semester examination of Fifth semester.

Fifth Semester										
S No	**Category**	**Subject Code**	**Course Title**	**Hours Per Week**			**Marks**			**Credits**
				L	**T**	**P**	**Int**	**Ext**	**Total**	
1	Professional Core courses	BTCE-501-18	Engineering Geology	3	0	0	40	60	100	3
2	Professional Core courses	BTCE-502-18	Elements of Earthquake Engineering	3	0	0	40	60	100	3
3	Professional Core courses	BTCE-503-18	Construction Engineering & Management	3	0	0	40	60	100	3
4	Professional Core courses	BTCE-504-18	Environmental Engineering	4	0	0	40	60	100	4
5	Professional Core courses	BTCE-505-18	Structural Engineering#	3	1	0	40	60	100	4
6	Professional Core courses #	BTCE-506-18	Geotechnical Engineering#	3	1	0	40	60	100	4
7	Professional Core courses	BTCE-507-18	Geotechnical Lab	0	0	2	30	20	50	1
8	Professional Core courses	BTCE-508-18	Environmental Engineering Lab	0	0	2	30	20	50	1
9	Professional Core courses	BTCE-509-18	Structural Lab	0	0	2	30	20	50	1
10		BMPD-501-18	Mentoring and Professional	0	0	2	Satisfactory/ Unsatisfactory			-
11	Professional Skill Enhancement	BTCE-532-18	Training – II*	-	-	-	60	40	100	Satisfactory /Unsatisfactory
			28	**19**	**1**	**8**	**390**	**460**	**850**	**24**
* Students have already completed 2 weeks survey camp and 4 weeks summer internship in Summer vacation which is to be evaluated by viva-voce conducted along End semester exam of Fifth semester.										

Note : # These are the minimum contact hrs. allocated. Thecontacthrs.maybeincreasedbyinstituteasperthenee dbasedonthecontentof subject.

Sixth Semester										
S. No	**Category**	Subject Code	**Course Title**	**Hours Per Week**			**Marks**			**Credits**
				L	**T**	**P**	**Int**	**Ext**	**Total**	
1	Professional Core course	BTCE- 601-18	Engineering Economics, Estimation & Costing	3	1	0	40	60	100	4
2	Professional Elective courses	PECE-602X-18	Elective –I	3	1	0	40	60	100	4
3	Professional Elective courses	PECE- 603Y-18	Elective –II	3	1	0	40	60	100	4
4	Professional Elective courses	PECE- 604Z-18	Elective – III	3	1	0	40	60	100	4
5	Open Elective Courses	OEZZ-XXX1	Open Elective-I	3	0	0	40	60	100	3
6	Mandatory Courses (Non-credit)	BTMC-101-18	Constitution of India	3	0	0	50	-	50	0
7		BMPD-601-18	Mentoring and Professional Development	0	0	2	Satisfactory/ Unsatisfactory	S/US		S/US
			Total 24	**18**	**4**	**2**	**290**	**360**	**650**	**19**

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Institute/Department to decide regarding sending students for One Semester Training in 7th or 8th Semester.

Seventh Semester/Eighth Semester										
S No	**Category**	**Subject Code**	**Course Title**	**Hours Per Week**			**Marks**			**Credits**
				L	**T**	**P**	**Int**	**Ext**	**Total**	
1	Professional Elective courses	PECE-701X-18	Elective – IV	3	1	0	40	60	100	4
2	Professional Elective courses	PECE-702Y-18	Elective – V	3	1	0	40	60	100	4
3	Open Elective courses	OECE-701-18	Open Elective – II (Metro system and Engg)	3	0	0	40	60	100	3
4	Open elective courses	OECE-702-18	Open elective-III	3	0	0	40	60	100	3
4	Professional Elective courses	PECE-703Z-18	Elective – VI	3	1	0	40	60	100	4
5	Professional core course		Project	0	0	8	40	60	100	7
6	Humanities and Social Sciences including Management courses HSMC255	HSMC-255	Professional Practice, Law & Ethics	2	0	0	40	60	100	2
7	Mandatory Courses (Non-credit)	BTMC-701-18	Management- I (Organizational Behavior)	2	0	0	50	-	50	0
			Total 30	**19**	**3**	**8**	**330**	**420**	**750**	**27**

Institute/Department/Student may decide for Industry oriented courses in lieu of One Semester Training in 7th or 8th Semester (Subject to approval from Competent Authority).

Seventh/ Eighth Semester

S No	Category	Subject Code	Course Title	Evaluation Internal		External			Credits
				Institute	Industry		Ext	Total	
1	Training (one semester)	BTCE-801-18	Software Training And Project	100	50		100	250	16
			Industrial training and Project	100	50		100	250	
			Total	**200**	**100**		**200**	**500**	**16**

Or
Students may obtain relevant credits from MOOC/SWAYAM
Or

Seventh/ Eighth semester

S No	Category	Subject Code	Course Title	Hours Per Week			Marks			Credits
				L	T	P	Int	Ext	Total	
1	Professional Core courses	BTCE-802-18	Smart City	3	1	0	40	60	100	4
2	Project		Project	0	0	24	60	40	100	12
3	Mandatory course	BMPD -803-18	Mentoring and Professional Development	0	0	2	Satisfactory/ Unsatisfactory			S/US

			Total 30	**3**	**1**	**26**		**16**

PROFESSIONAL (or PROGRAM) ELECTIVE (PE) COURSES [CIVIL ENGINEERING]

The Professional Electives are categorized into six different tracks viz.: Geotechnical engineering (PE1), Structural Engineering (PE2) and construction Engg and Management (PE3) to offer in 6th semester and the remaining three tracks i.e Transportation Engineering (PE4), Environmental Engg (PE5) & water Resources (PE6) to offer in 7th semester

The Program Elective Groups/courses have been categorized/developed keeping in mind the employment prospects of the students. The Program design in B.Tech. CE aims at providing domain specific knowledge to a student at UG level in progression. The Program/course design has been carried out jointly by the Academia in close coordination with Industry to provide a leading edge to the students and to prepare them as per the Industry needs

Professional Elective Course Tracks –Civil Engineering [PEC-CE]

Track	Code Number	Professional Core Course	Semester	Credits
Track-I	PECE-602X-18	Geotechnical engineering	6	4
Track-II	PECE-603Y-18	Structural Engineering	6	4
Track-III	PECE-604Z-18	Construction Engg and Management	6	4
Track-IV	PECE-701X-18	Transportation Engineering	7	4
Track-V	PECE-702Y-18	Environmental Engg	7	4
Track-VI	PECE-703Z-18	Water Resources	7	4
Total Credits				24

Basket of Professional Elective for different Tracks

Tra - I	Foundation Engg PECE-602A-18	Ground ImprovementTechniques PECE-602B-18	AdvancedSoil Mechanics PECE -602C-18	Geosynthetic Engineering PECE -602D-18	Geo-Environment Engineering PECE-602E-18	Rock Mechanics PECE-602F-18
Tra -II	Design ofconcrete structures PECE -603A-18	Design ofsteel Structures PECE -603B-18	AdvancedStructural Analysis PECE -603C-18	Structure Analysis and Design PECE -603D-18	Prestressed structures PECE-603E-18	Bridge Engg PECE -603F-18
Tra -III	Construction Equipment and Automation PECE -604A-18	Sustainable Construction methods PECE -604B-18	Repairandrehabilitation of structures PECE -604C-18	ConstructionCostAnalysis PECE -604D-18	Contracts Management PECE-604E-18	Construction EngineeringMaterials PECE -604F-18
Tra -IV	Pavement Andgeometric designof Highways PECE -701A-18	AirportplanningandDesign PECE -701B-18	Intelligent TransportationOnsystems PECE -701C-18	Highway ConstructionandManagement PECE -701D-18	HighSpeed Rail Engg PECE -701E-18	Traffic EnggAndManagement PECE -701F-18
Tra -V	Environment Law and Policy PECE-702A-18	Rural waterSupply AndonsiteSanitation Systems PECE-702B-18	Water and air QualityModelling PECE-702C-18	SolidandHazardousWaste Management PECE-702D-18	EIA and LCA PECE-702E-18	SustainableEnggandTechnology PECE-702F-18
Tra –VI	Design ofHydraulic structures	River Engg. PECE-703B-18	GroundWater PECE-703C-18	HydraulicModelling PECE-703D-18	Transientsin Closed conduits	Urban Hydrology and hydraulics PECE-703F-18

	PECE-703A-18				PECE-703E-18	

LIST OF OPEN ELECTIVE COURSES FOR STUDENTS OF OTHER PROGRAMMS
Offered by Civil Engg Department

S.No.	Course Title	Subject Code	Semester	Hours Per Week			Credits
				L	T	P	
1	Civil Engineering- Introduction, Societal & Global Impact	HSMC- 132-18	Even	3	0	0	3
2	Disaster Preparedness & Planning	BTCE- 405-18	Even	3	0	0	3
3	Remote Sensing & GIS	OECE-609-18	Even	3	0	0	3
4	Construction Engineering & Management	BTCE- 503-18	Even	3	0	0	3
5	Concrete Technology	BTCE-401-18	Even	3	0	0	3

Odd semester List

S.No.	Course Title	Subject Code	Semester	Hours Per Week			Credits
				L	T	P	
1	Metro system and Engg	OECE-701-18	ODD	3	0	0	3
2	Traffic Management	OECE- 702-18	ODD	3	0	0	3
3	Road Safety	OECE-703-18	ODD	3	0	0	3
4	Environmental Impact Assessment	OECE-704-18	ODD	3	0	0	3
5	Construction Materials	OECE-705-18	ODD	3	0	0	3

Semester 1st

Sr. No.	Branch	Related Branches	Course codes	Course title	Credits
1	Civil Engineering	1. Civil Engineering	BTPH101-18	Mechanics of solids	4
		2.Construction Engineering & Management	BTPH111-18	Mechanics of solids Lab	1.5
2	Electrical Engineering	1.Electrical Engineering	BTPH102-18	Optics and Modern Physics	4
		2.Automation & Robotics			
		3.Electrical & Electronics Engineering	BTPH112-18	Optics and Modern Physics Lab	1.5
		4.Electronics & Electrical Engineering			
		5.Electrical Engineering & Industrial Control			
		6.Instrumentation & Control Engineering			
3	Mechanical Engineering	1.Mechanical Engineering	BTPH101-19	Mechanics of solids	4
		2.Marine Engineering			
		3.Production Engineering	BTPH111-19	Mechanics of solids Lab	1.5
		4.Industrial Engineering			
		5.Tool Engineering			
		6.Automobile Engineering			
		7.Aerospace Engineering			
		8.Aeronautical Engineering			
4	Computer Science Engineering	1.Computer Engineering	BTPH104-18	Semiconductor Physics	4
		2.Computer Science Engineering			
		3.Information Technology	BTPH114-18	Semiconductor Physics Lab	1.5
		4.3D Animation Engineering			
5	Electronics and communication Engineering	1.Electronics & Communication Engineering	BTPH105-18	Semiconductor and Optoelectronics Physics	4
		2.Electronics & Computer Engineering			
		3.Electronics & Instrumentation Engineering	BTPH115-18	Semiconductor and Optoelectronics Physics Lab	1.5
		4.Electronics & Telecomm Engineering			
		5.Electronics Engineering			
6	Chemical Sciences	1.Chemical Engineering	BTPH106-18	Optics and Electromagnetism	4
		2.Petrochem & Petroleum Refinery Engineering			
		3.Textile Engineering	BTPH116-18	Optics and Electromagnetism Lab	1.5
		4.Food Technology			

7	Bio-Technology	Bio-Technology	BTPH107-18 BTPH117-18	Introduction to Physics: Biotechnology Physics Lab	4 1.5

BTPH101-18	**Mechanics of Solids**	**L-3, T-1, P-0**	**4 Credits**

Pre-requisites (if any): High-school education with Physics as one of the subject.

Course Objectives: The aim and objective of the course on **Mechanics of Solids** is to introduce the students of B. Tech. to the formal structure of vector mechanics, harmonic oscillators, and mechanics of solids so that they can use these in Engineering as per their requirement.

Course Outcomes: At the end of the course, the student will be able to

CO1	Understand the vector mechanics for a classical system.
CO2	Identify various types of forces in nature, frames of references, and conservation laws.
CO3	Know the simple harmonic, damped, and forced simple harmonic oscillator for a mechanical system.
CO4	Analyze the planar rigid body dynamics for a mechanical system.
CO5	Apply the knowledge obtained in this course to the related problems.

Detailed Syllabus:

PART-A

UNIT I: Vector mechanics *(10 lectures)*

Physical significance of gradient, Divergence and curl. Potential energy function, F = - Grad V, equipotential surfaces, Forces in Nature, Newton's laws and its completeness in describing particle motion, Conservative and non-conservative forces, curl of a force field; Central forces; Conservation of Angular Momentum and Energy, Introduction to Cartesian, spherical and cylindrical coordinate system, Inertial and Non-inertial frames of reference; Rotating coordinate system :- Centripetal and Coriolis accelerations.

UNIT II: Simple harmonic motion, damped and forced simple harmonic oscillator *(10 lectures)*

Mechanical simple harmonic oscillators, damped oscillations, damped harmonic oscillator – heavy, critical and light damping, energy decay in a damped harmonic oscillator, quality factor, forced mechanical oscillators, resonance.

PART-B

UNIT III: Planar rigid body mechanics *(10 lectures)*

Definition and motion of a rigid body in plane; Rotation in the plane, Angular momentum about a point of a rigid body in planar motion; center of mass, moment of inertia, theorems of moment of inertia, inertia of plane lamina, circular ring, moment of force, couple, Euler's laws of motion.

UNIT IV: Mechanics of solids *(10 lectures)*

Friction: Definitions: Types of friction, Laws of static friction, Limiting friction, Angle of friction, angle of repose; motion on horizontal and inclined planes. Methods of reducing friction, Concept of stress and strain at a point; Concepts of elasticity, plasticity, strain hardening, failure (fracture/yielding), one dimensional stress-strain curve; Generalized Hooke's law. Force analysis — axial force, shear force, bending moment and twisting moment. Bending stress; Shear stress; Concept of strain energy; Yield criteria.

Reference books and suggested reading:

1. Engineering Mechanics, 2nd ed. - MK Harbola, Cengage Learning India, 2013.
2. Introduction to Mechanics - MK Verma, CRC Press Book, 2009.
3. Mechanics- DS Mathur, S Chand Publishing, 1981.
4. An Introduction to Mechanics - D Kleppner& R Kolenkow, Tata McGraw Hill 2009.
5. Principles of Mechanics - JL Synge & BA Griffiths, Nabu Press, 2011.
6. Mechanics - JP Den Hartog, DoverPublications Inc, 1961.

7. Engineering Mechanics- Dynamics, 7th ed. - JL Meriam, Wiley.
8. Theory of Vibrations with Applications -WT Thomson, Pearson.
9. An Introduction to the Mechanics of Solids, 2nd ed. with SI Units-SH Crandall, NC Dahl & TJ Lardner
10. Classical Mechanics- H. Goldstein, Pearson Education, Asia.
11. Classical mechanics of particles and rigid bodies-K.C Gupta, Wiley eastern, New Delhi.
12. Engineering Physics-Malik and Singh, Tata McGraw Hill.
13. Engineering Mechanics: Statics- 7th ed.-JL Meriam, Wiley, 2011.
14. Analytical Mechanics-Satish K Gupta, Modern Publishers.
15. https://nptel.ac.in/courses/122102004/

BTPH111-18	**Mechanics of Solids Lab**	**L-0, T-0, P-3**	**1.5 Credits**

Pre-requisites (if any): High-school education with Physics lab as one of the subject.

Course Objectives: The aim and objective of the Lab course on **Mechanics of Solids** is to introduce the students of B. Tech to the formal structure of Mechanics of solids so that they can use these in Engineering as per their requirement.

Course Outcomes: At the end of the course, the student will be

CO1	Able to understand the concepts learned in the mechanics of solids.
CO2	Learning the skills needed to verify some of the concepts of theory courses.
CO3	Trained in carrying out precise measurements and handling sensitive equipment.
CO4	Able to understand the principles of error analysis and develop skills in experimental design.
CO5	Able to document a technical report which communicates scientific information in a clear and concise manner.

Detailed syllabus:

Note: Students are expected to perform about 10-12 experiments from the following list, selecting minimum of 7-8 from the Section-A and 3-4 from the Section-B.

Section -A

1. Measurements of length (or diameter) using Vernier caliper, screw gauge, and travelling microscope. Use of Plumb line and Spirit level.
2. To determine the horizontal distance between two points using a Sextant.
3. To determine the vertical distance between two points using a Sextant.
4. To determine the height of an inaccessible object using a Sextant.
5. To determine the angular diameter of the sun using the sextant.
6. To determine the angular acceleration α, torque τ, and Moment of Inertia of flywheel.
7. To study the Motion of a Spring and calculate (a) Spring Constant (b) Value of **g** and (c) Modulus of rigidity.
8. To determine the time period of a simple pendulum for different length and acceleration due to gravity.
9. To study the variation of time period with distance between centre of suspension and centre of gravity for a compound pendulum and to determine: (i) Radius of gyration of the bar about an axis through its C.G. and perpendicular to its length. (ii) The value of g in the laboratory.
10. To determine the Young's Modulus of a Wire by Optical Lever Method.
11. To determine the Elastic Constants/Young's Modulus of a Wire by Searle's method.
12. To determine the Modulus of Rigidity of a Wire by Maxwell's needle.
13. To determine the Modulus of Rigidity of brass using Searle's method.
14. To find the moment of inertia of an irregular body about an axis through its C.G with the torsional pendulum.
15. To determine **g** by Kater's Pendulum.
16. To determine **g** and velocity for a freely falling body using Digital Timing Technique.
17. To find out the frequency of AC mains using electric-vibrator.

Section-B

Virtual lab:

1. To determine the angular acceleration α and torque τ of flywheel.
2. To determine the moment of inertia of a flywheel.

3. To find the acceleration of the cart in the simulator.
4. To find the distance covered by the cart in the simulator in the given time interval.
5. To verify that energy conservation and momentum conservation can be used with a ballistic pendulum to determine the initial velocity of a projectile, its momentum and kinetic energy.
6. To verify the momentum and kinetic energy conservation using collision balls.
7. To understand the torsional oscillation of pendulum in different liquid. and determine the rigidity modulus of the suspension wire using torsion pendulum.
8. To find the Time of flight, Horizontal range and maximum height of a projectile for different velocity, angle of projection, cannon height and environment.
9. The Elastic and Inelastic collision simulation will help to analyse the collision variations for different situations.
10. Demonstration of collision behaviour for elastic and inelastic type.
11. Variation of collision behavior in elastic and inelastic type.
12. Study of variation of Momentum, Kinetic energy, Velocity of collision of the objects and the Center of Mass with different velocity and mass.
13. Calculation of the Momentum, Kinetic energy, and Velocity after collision.

Reference book and suggested readings:

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.
3. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11thEdn, 2011, Kitab Mahal.
4. Engineering Practical Physics, S. Panigrahi& B. Mallick, 2015, Cengage Learning India Pvt. Ltd.
5. Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge University Press.
6. Laboratory Experiments in College Physics, C.H. Bernard and C.D. Epp, John Wiley and Sons, Inc., New York, 1995.
7. Practical Physics, G.L. Squires, Cambridge University Press, Cambridge, 1985.
8. Experiments in Modern Physics, A.C. Melissinos, Academic Press, N.Y., 1966.
9. Practical Physics, C L Arora. S. Chand & Company Ltd.
10. http://www.vlab.co.in
11. http://vlab.amrita.edu/index.php?sub=1

BTPH102-18	**Optics and Modern Physics**	**L-3, T-1, P-0**	**4 Credits**

Pre-requisite (if any):

1. High-school education with physics as one of the subject.
2. Mathematical course on differential equations.

Course Objectives: The aim and objective of the course on **Optics andModern Physics** is to introduce the students of B.Tech. to the subjects of wave optics, Quantum Mechanics, Solids, and Semiconductors so that they can use these in Engineering as per their requirement.

Course Outcomes: At the end of the course, the student will be able to

CO1	Identify and illustrate physical concepts and terminology used in optics and other wave phenomena.
CO2	Understand optical phenomenon, such as, interference, diffraction etc. in terms of wave model.
CO3	Understand the importance of wave equation in nature and appreciate the mathematical formulation of the same.
CO4	Appreciate the need for quantum mechanics, wave particle duality, uncertainty principle etc. and their applications.
CO5	Understand some of the basic concepts in the physics of solids and semiconductors.

Detailed Syllabus:

PART-A

UNIT I: Waves and Oscillations ***(10 lectures)***

Mechanicalsimple harmonic oscillators, damped harmonic oscillator, forced mechanical oscillators, impedance, steady state motion of forced damped harmonic oscillator, Transverse wave on a string, wave equation on a string, reflection and transmission of waves at a boundary, impedance matching, standing waves, longitudinal waves and their wave equation, reflection and transmission of waves at a boundary.

UNIT II: Optics and LASERS ***(10 lectures)***

Optics: Light as an electromagnetic wave, reflectance and transmittance, Fresnel equations (Qualitative idea), Brewster's angle, total internal reflection: Interference: Huygens' principle, superposition of waves and interference of light by wavefront splitting and amplitude splitting; Young's double slit experiment, Michelson interferometer. Diffraction: Farunhofer diffraction from a single slit and a circular aperture, Diffraction gratings and their resolving power; LASERS:Spontaneous and stimulated emission, Einstein's theory of matter radiation interaction and A and B coefficients; population inversion, pumping, various modes, properties of laser beams, types of lasers: gas lasers (He-Ne), solid-state lasers (ruby), and its applications.

PART-B

UNIT III: Introduction to Quantum Mechanics ***(10 lectures)***

Wave nature of Particles, Free-particle wave function and wave-packets, probability densities, Expectation values, Uncertainty principle, Time-dependent and time-independent Schrodinger equation for wave function, Born interpretation, Solution of stationary-state Schrodinger equation for one dimensional problems: particle in a box,linear harmonic oscillator.

UNIT IV: Introduction to Solids and Semiconductors ***(10 lectures)***

Free electron theory of metals, Fermi level, density of states in 1, 2 and 3 dimensions, Bloch's theorem for particles in a periodic potential, Origin of energy bands (Qualitative idea); Types of electronic materials: metals, semiconductors, and insulators, Intrinsic and extrinsic semiconductors, Dependence of Fermi level

on carrier-concentration and temperature (equilibrium carrier statistics), Carrier generation and recombination, Carrier transport: diffusion and drift, p-n junction.

Reference books and suggested reading:

1. I. G. Main, "Vibrations and waves in physics", Cambridge University Press, 1993.
2. H. J. Pain, "The physics of vibrations and waves", Wiley, 2006.
3. E. Hecht, "Optics", Pearson Education, 2008.
4. A. Ghatak, "Optics", McGraw Hill Education, 2012.
5. O. Svelto, "Principles of Lasers", Springer Science & Business Media, 2010.
6. D. J. Griffiths, "Quantum mechanics", Pearson Education, 2014.
7. R. Robinett, "Quantum Mechanics", OUP Oxford, 2006.
8. D.A. Neamen, "Semiconductor Physics and Devices", Times Mirror High Education Group, Chicago, 1997.
9. E.S. Yang, "Microelectronic Devices", McGraw Hill, Singapore, 1988.
10. B.G. Streetman, "Solid State Electronic Devices", Prentice Hall of India, 1995.
11. HK Malik and AK Singh, Engineering Physics, 2nd ed., Tata McGraw Hill, 2018.
12. S. Sharma and J. Sharma, Engineering Physics, Pearson, 2018.
13. https://nptel.ac.in/courses/117108037/3
14. https://nptel.ac.in/courses/115102023/

BTPH112-18	**Optics and Modern Physics Lab**	**L-0, T-0, P-3**	**1.5 Credits**

Pre-requisite (If any): High-school education with physics as one of the subject.

Course Objectives: The aim and objective of the lab on **Optic andModern Physics** is to introduce the students of B.Tech. class to the formal structure of wave and optics, Quantum Mechanics and semiconductor physics so that they can use these in Engineering branch as per their requirement.

Course Outcomes: At the end of the course, the student will be able to

CO1	Verify some of the theoretical concepts learnt in the theory courses.
CO2	Trained in carrying out precise measurements and handling sensitive equipment.
CO3	Introduced to the methods used for estimating and dealing with experimental uncertainties and systematic errors.
CO4	Learn to draw conclusions from data and develop skills in experimental design.
CO5	Write a technical report which communicates scientific information in a clear and concise manner.

Detailed Syllabus:

Note: Students are expected to perform about 10-12 experiments from the following list, selecting minimum of 7-8 from the Section-A and 3-4 from the Section-B.

Section-A

1. To study the laser beam characteristics like; wave length using diffraction grating aperture & divergence.
2. Study of diffraction using laser beam and thus to determine the grating element.
3. To study laser interference using Michelson's Interferometer.
4. To determine the numerical aperture of a given optic fibre and hence to find its acceptance angle.
5. To determine attenuation & propagation losses in optical fibres.
6. To determine the grain size of a material using optical microscope.
7. To find the refractive index of a material/glass using spectrometer.
8. To find the refractive index of a liquid using spectrometer.
9. To find the velocity of ultrasound in liquid.
10. To determine the specific rotation of sugar using Laurent's half-shade polarimeter.
11. To study the characteristic of different p-n junction diode - Ge and Si.
12. To analyze the suitability of a given Zener diode as voltage regulator.
13. To find out the intensity response of a solar cell/Photo diode.
14. To find out the intensity response of a LED.
15. To find out the frequency of AC mains using electric-vibrator.

Section-B

Virtual lab:

1. To find the resolving power of the prism.
2. To determine the angle of the given prism.
3. To determine the refractive index of the material of a prism
4. To determine the numerical aperture of a given optic fibre and hence to find its acceptance angle.
5. To calculate the beam divergence and spot size of the given laser beam.
6. To determine the wavelength of a laser using the Michelson interferometer.
7. To revise the concept of interference of light waves in general and thin-film interference in particular.
8. To set up and observe Newton's rings.
9. To determine the wavelength of the given source.
10. To understand the phenomenon Photoelectric effect.
11. To draw kinetic energy of photoelectrons as a function of frequency of incident radiation.
12. To determine the Planck's constant from kinetic energy versus frequency graph.

13. To plot a graph connecting photocurrent and applied potential.
14. To determine the stopping potential from the photocurrent versus applied potential graph.

Reference books and suggested reading:

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.
3. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11thEdn, 2011, Kitab Mahal.
4. Engineering Practical Physics, S. Panigrahi& B. Mallick, 2015, Cengage Learning India Pvt. Ltd.
5. Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge University Press.
6. Laboratory Experiments in College Physics, C.H. Bernard and C.D. Epp, John Wiley and Sons, Inc., New York, 1995.
7. Practical Physics, G.L. Squires, Cambridge University Press, Cambridge, 1985.
8. Experiments in Modern Physics, A.C. Melissinos, Academic Press, N.Y., 1966.
9. Practical Physics, C L Arora. S. Chand & Company Ltd.
10. http://www.vlab.co.in
11. http://vlab.amrita.edu/index.php?sub=1

BTPH103-18	**Electromagnetism**	**L-3, T-1, P-0**	**4 Credits**

Pre-requisites (if any):

1. High-school education with physics as one of the subject.
2. Mathematical course on vector calculus.

Course Objectives: The aim and objective of the course is to expose the students to the formal structure of electromagnetism so that they can use these inEngineering as per their requirement.

Course Outcomes: At the end of the course, the student will be able to

CO1	Specify the constitutive relationships for fields and understand their important.
CO2	Describe the static and dynamic electric and magnetic fields for technologically important structures.
CO3	Measure the voltage induced by time varying magnetic flux.
CO4	acquire the knowledge of Maxwell equation and electromagnetic field theory and propagation and reception of electro-magnetic wave systems.
CO5	have a solid foundation in engineering fundamentals required to solve problems and also to pursue higher studies.

Detailed Syllabus:

PART-A

UNIT I: Electrostatics in vacuum and linear dielectric medium ***(10 lectures)***

Calculation of electric field and electrostatic potential for a charge distribution; Divergence and curl of electrostatic field; Laplace's and Poisson's equations for electrostatic potential; Uniqueness theorem (Definition); examples: Faraday's cage; Boundary conditions of electric field; Energy of a charge distribution and its expression in terms of electric field. Electrostatic field and potential of a dipole. Bound charges due to electric polarization in Dielectrics; Electric displacement; Solving simple electrostatics problems in presence of dielectrics – Point charge at the centre of a dielectric sphere, charge in front of a dielectric slab.

UNIT II: Magnetostatics in linear magnetic medium ***(10 lectures)***

Bio-Savart law, Divergence and curl of static magnetic field; Concept of vector potential, Magnetization and associated bound currents; auxiliary magnetic field $\vec{H}$; Boundary conditions on $\vec{B}$ and $\vec{H}$. Solving for magnetic field due to bar magnet; magnetic susceptibility and ferromagnetic, paramagnetic and diamagnetic materials; magnetic domains, hysteresis and B-H curve.

PART-B

UNIT III: Faraday's law and Maxwell's equations ***(10 lectures)***

Faraday's law; equivalence of Faraday's law and motional EMF; Lenz's law; Electromagnetic breaking and its applications; Differential form of Faraday's law; energy stored in a magnetic field. Continuity equation for current densities; Modifying equation for the curl of magnetic field to satisfy continuity

equation; displacement current and magnetic field arising from time-dependent electric field; Maxwell's equation in vacuum and non-conducting medium; Flow of energy and Poynting vector and Poynting theorem.

UNIT IV: Electromagnetic waves *(10 lectures)*

Wave equation for electromagnetic waves in free space and conducting medium, Uniform plane waves and general solution of uniform plane waves, relation between electric and magnetic fields of an electromagnetic wave their transverse nature.; Linear, circular and elliptical polarization, Reflection and transmission of electromagnetic waves from a non-conducting medium-vacuum interface for normal incidence.

Text and Reference Books:

1. D. Griffiths, Introduction to Electrodynamics, Pearson Education India; 4th ed. (2015).
2. J D Jackson, Classical Electrodynamics, John Wiley and Sons (1999).
3. Halliday and Resnick, Fundamentals of Physics, Wiley (2011).
4. W. Saslow, Electricity, Magnetism and Light, Academic Press (2002).
5. HK Malik and AK Singh, Engineering Physics, 2nd ed., Tata McGraw Hill (2018).

BTPH113-18	**Electromagnetism Lab**	**L-0, T-0, P-3**	**1.5 Credits**

Pre-requisite (If any): High-school education

Course Objectives: The aim and objective of the lab course on **Electromagnetism** is to introduce the students of B. Tech. class to the formal structure of electromagnetism so that they can use these in various branches of engineering as per their requirement.

Course Outcomes: At the end of the course, the student will be able to

CO1	Able to verify some of the theoretical concepts learnt in the theory courses.
CO2	Trained in carrying out precise measurements and handling sensitive equipment.
CO3	understand the methods used for estimating and dealing with experimental uncertainties and systematic "errors."
CO4	Learn to draw conclusions from data and develop skills in experimental design.
CO5	Write a technical report which communicates scientific information in a clear and concise manner.

Detailed Syllabus:

Note: Students are expected to perform about 10-12 experiments from the following list, selecting minimum of 7-8 from the Section-A and 3-4 from the Section-B.

Section-A

1. Use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c) DC Current, (d) Capacitances, and (e) Checking electrical fuses.
2. To study the magnetic field of a circular coil carrying current.
3. To study B-H curve for a ferromagnetic material using CRO.
4. To find out the frequency of AC mains using electric-vibrator.
5. To find out polarizability of a dielectric substance.
6. Determine a high resistance by leakage method using Ballistic Galvanometer.
7. To study the characteristics of a Series RC Circuit.
8. To study the series LCR circuit and determine its (a) Resonant Frequency, (b) Quality.
9. To study a parallel LCR circuit and determine its (a) Anti-resonant frequency (b) Quality factor Q.
10. To determine the value of self-inductance by Maxwell Inductance Bridge.
11. To determine the value of self-inductance by Maxwell Inductance Capacitance Bridge.
12. To determine the mutual inductance of two coils by Absolute method.
13. To study the induced emf as a function of the velocity of magnet and to study the phenomenon of electromagnetic damping.
14. To determine unknown capacitance by flashing and quenching method.
15. To study the field pattern of various modes inside a rectangular waveguide.
16. To determine charge to mass ratio (e/m) of an electron by helical method.
17. To determine charge to mass ratio (e/m) of an electron by Thomson method.
18. To find out the horizontal component of earth's magnetic field (B_h).

Section-B

Virtual lab:

1. To find out the horizontal component of earth's magnetic field (B_h).
2. An experiment to study the variation of magnetic field with distance along the axis of a circular coil carrying current.
3. Aim is to find the horizontal intensity of earth's magnetic field at a place and moment of the bar magnet.
4. To determine the self-inductance of the coil (L) using Anderson's bridge.
5. To calculate the value of inductive reactance (X_L) of the coil at a particular frequency.
6. The temperature coefficient of resistor simulation will help the user to easily identify the change in resistivity of the resistor according to the change in temperature.

Reference books and suggested reading:

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.
3. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11thEdn, 2011, Kitab Mahal.
4. Engineering Practical Physics, S. Panigrahi& B. Mallick, 2015, Cengage Learning India Pvt. Ltd.
5. Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge University Press.
6. Laboratory Experiments in College Physics, C.H. Bernard and C.D. Epp, John Wiley and Sons, Inc., New York, 1995.
7. Practical Physics, G.L. Squires, Cambridge University Press, Cambridge, 1985.
8. Experiments in Modern Physics, A.C. Melissinos, Academic Press, N.Y., 1966.
9. Practical Physics, C L Arora, S. Chand & Company Ltd.
10. http://www.vlab.co.in
11. http://vlab.amrita.edu/index.php?sub=1

BTPH104-18	**Semiconductor Physics**	**L-3, T-1, P-0**	**4 redits**

Prerequisite (if any): Introduction to Quantum Mechanics desirable

Course Objectives: The aim and objective of the course on **Semiconductor Physics** is to introduce the students of B. Tech. class to the formal structure of semiconductor physics so that they can use these in Engineering as per their requirement.

Course Outcomes: At the end of the course, the student will be able to

CO1	Understand and explain the fundamental principles and properties of electronic materials and semiconductors
CO2	Understand and describe the interaction of light with semiconductors in terms of fermi golden rule.
CO3	Understand and describe the impact of solid-state device capabilities and limitations on electronic circuit performance.
CO4	Understand the design, fabrication, and characterization techniques ofEngineered semiconductor materials.
CO5	Develop the basic tools with which they can study and test the newly developed devices and other semiconductor applications.

Detailed Syllabus:

PART-A

UNIT 1: Electronic materials*(10 lectures)*

Free electron theory of metals, Density of states in 1D, 2D, and 3D, Bloch's theorem for particles in a periodic potential, Energy band diagrams, Kronig-Penny model (to introduce origin of band gap), Energy bands in solids, E-k diagram, Direct and indirect bandgaps, Types of electronic materials: metals, semiconductors, and insulators, Occupation probability, Fermi level, Effective mass.

UNIT II: Semiconductors*(10 lectures)*

Intrinsic and extrinsic semiconductors, Dependence of Fermi level on carrier-concentration and temperature (equilibrium carrier statistics), Carrier generation and recombination, Carrier transport: diffusion and drift, p-n junction, Metal-semiconductor junction (Ohmic and Schottky), Semiconductor materials of interest for optoelectronic devices.

PART-B

UNIT III: Light-semiconductor interaction*(10 lectures)*

Optical transitions in bulk semiconductors: absorption, spontaneous emission, and stimulated emission; Einstein coefficients, Population inversion, application in semiconductor Lasers; Joint density of states, Density of states for phonons, Transition rates (Fermi's golden rule), Optical loss and gain; Photovoltaic effect, Exciton, Drude model.

UNIT IV: Measurement Techniques*(10 lectures)*

Measurement for divergence and wavelength using a semiconductor laser, Measurements for carrier density, resistivity, hallmobility using Four-point probe and van der Pauwmethod, Hot-point probe measurement, capacitance-voltage measurements, parameterextraction from diode I-V characteristics.

Reference books and suggested reading:

1. J. Singh: Semiconductor Optoelectronics: Physics and Technology, McGraw-Hill Inc. (1995).
2. B. E. A. Saleh and M. C. Teich: Fundamentals of Photonics, John Wiley & Sons, Inc., (2007).
3. S. M. Sze: Semiconductor Devices: Physics and Technology, Wiley (2008).
4. A. Yariv and P. Yeh, Photonics: Optical Electronics in Modern Communications, Oxford University Press, New York (2007).
5. P. Bhattacharya: Semiconductor Optoelectronic Devices, Prentice Hall of India (1997).
6. Ben G. Streetman: Solid State Electronics Devices, Pearson Prentice Hall.
7. D.A. Neamen, "Semiconductor Physics and Devices", Times Mirror High Education Group, Chicago,

1997.
8. E.S. Yang, “Microelectronic Devices”, McGraw Hill, Singapore, 1988.
9. Online course: “Semiconductor Optoelectronics” by M R Shenoy on NPTEL.
10. Online course: "Optoelectronic Materials and Devices" by Monica Katiyar and Deepak Gupta on NPTEL.

BTPH114-18	**Semiconductor Physics Lab**	**L-0, T-0, P-3**	**1.5 Credits**

Pre-requisite (if any): (i) High-school education

Course Objectives: The aim and objective of the Lab course on **Semiconductor Physics** is to introduce the students of B.Tech. class to the formal structure of semiconductor physics so that they can use these in Engineering as per their requirement.

Course Outcomes: At the end of the course, the student will be able to

CO1	Able to verify some of the theoretical concepts learnt in the theory courses.
CO2	Trained in carrying out precise measurements and handling sensitive equipment.
CO3	Introduced to the methods used for estimating and dealing with experimental uncertainties and systematic "errors."
CO4	Learn to draw conclusions from data and develop skills in experimental design.
CO5	Write a technical report which communicates scientific information in a clear and concise manner.

Detailed Syllabus:

Note: Students are expected to perform about 10-12 experiments from the following list, selecting minimum of 7-8 from the Section-A and 3-4 from the Section-B.

Section-A

1. To study the characteristic of different PN junction diode-Ge and Si.
2. To analyze the suitability of a given Zener diode as a power regulator.
3. To find out the intensity response of a solar cell/Photo diode.
4. To find out the intensity response of a LED.
5. To determine the band gap of a semiconductor.
6. To determine the resistivity of a semiconductor by four probe method.
7. To confirm the de Broglie equation for electrons.
8. To study voltage regulation and ripple factor for a half-wave and a full-wave rectifier without and with different filters.
9. To study the magnetic field of a circular coil carrying current.
10. To find out polarizability of a dielectric substance.
11. To study B-H curve of a ferro-magnetic material using CRO.
12. To find out the frequency of AC mains using electric-vibrator.
13. To find the velocity of ultrasound in liquid.
14. To study the Hall effect for the determination of charge current densities.
15. Distinguish between Diamagnetic material, Paramagnetic and ferromagnetic material.
16. Measurement of susceptibility of a liquid or a solution by Quincke's method.
17. To study the sample with the nano-scale objects and measure surface topography with different scales, width and height of nano objects, and force-distance curves using AFM.
18. To study the temperature coefficient of Resistance of copper.
19. To determine the ratio k/e Using a transistor.
20. To compare various capacitance and verify the law of addition of capacitance.
21. To determine dipole moment of an organic molecule acetone.
22. To measure the temperature dependence of a ceramic capacitor.
23. Verification of the curie Weiss law for the electrical susceptibility of a ferromagnetic material.
24. To study the laser beam characteristics like; wave length using diffraction grating aperture & divergence.
25. To study laser interference using Michelson's Interferometer.
26. Study of diffraction using laser beam and thus to determine the grating element.

Section-B

Virtual lab:

1. To draw the static current-voltage (I-V) characteristics of a junction diode.
2. To plot the characteristics of thermistor and hence find the temperature coefficient of resistance.
3. To determine the resistivity of semiconductors by Four Probe Method.
4. To study Zener diode voltage as regulator and measure its line and load regulation.
5. To study the B-H Curve for a ferromagnetic material.
6. To study the Hall effect experiment to determine the charge carrier density.
7. To determine the magnetic susceptibilities of paramagnetic liquids by Quincke's Method.
8. To study the phenomena of magnetic hysteresis and calculate the retentivity, coercivity and saturation magnetization of a material using a hysteresis loop tracer.
9. Verification and design of combinational logic using AND, OR, NOT, NAND and XOR gates.

Reference books and suggested reading:

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.
3. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11thEdn, 2011, Kitab Mahal.
4. Engineering Practical Physics, S. Panigrahi& B. Mallick, 2015, Cengage Learning India Pvt. Ltd.
5. Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge University Press.
6. Laboratory Experiments in College Physics, C.H. Bernard and C.D. Epp, John Wiley and Sons, Inc., New York, 1995.
7. Practical Physics, G.L. Squires, Cambridge University Press, Cambridge, 1985.
8. Experiments in Modern Physics, A.C. Melissinos, Academic Press, N.Y., 1966.
9. Practical Physics, C L Arora, S. Chand & Company Ltd.
10. http://www.vlab.co.in
11. http://vlab.amrita.edu/index.php?sub=1

BTPH105-18	**Semiconductor and Optoelectronics Physics**	**L-3, T-1, P-0**	**4 Credits**

Prerequisite (if any): "Introduction to Quantum Mechanics" Desirable

Course Objectives: The aim and objective of the course on **Semiconductor and Optoelectronics Physics** is to introduce the students of B. Tech. class to the formal structure of semiconductor physics and Optoelectronics so that they can use these in Engineering as per their requirement.

Course Outcomes: At the end of the course, the student will be able to

CO1	Understand and explain the fundamental principles and properties of electronic materials and semiconductors.
CO2	Understand and describe the interaction of light with semiconductors in terms of fermi golden rule.
CO3	Understand and describe the impact of solid-state device capabilities and limitations on electronic circuit performance.
CO4	Understand the design, fabrication, characterization techniques, and measurements ofEngineered semiconductor materials.
CO5	Learn the basics of the optoelectronic devices, LEDs, semiconductor lasers, and photo detectors.

Detailed Syllabus:

PART-A

UNIT -I: Electronic materials *(10 lectures)*

Free electron theory of metals, Density of states in 1D, 2D, and 3D, Bloch's theorem for particles in a periodic potential, energy band diagrams, Kronig-Penny model (to introduce origin of band gap), Energy bands in solids, E-k diagram, Direct and indirect band gaps, Types of electronic materials: metals, semiconductors and insulators, Occupation probability, Fermi level, Effective mass of electron and hole.

UNIT -II: Semiconductors*(10 lectures)*

Intrinsic and extrinsic semiconductors, Dependence of Fermi level on carrier-concentration and temperature (equilibrium carrier statistics), Carrier generation and recombination, Carrier transport: diffusion and drift, p-n junction, Metal-semiconductor junction (Ohmic and Schottky).

PART-B

UNIT -III: Optoelectronic devices *(10 lectures)*

Radiative and non-radiative recombination mechanisms in semiconductors, Semiconductor materials of interest for optoelectronic devices; Semiconductor light emitting diodes (LEDs): light emitting materials, device structure, characteristics; Optical transitions in bulk semiconductors: absorption, spontaneous emission, and stimulated emission, Semiconductor laser: population inversion at a junction, structure, materials, device characteristics, Photovoltaics:Types of semiconductor photo detectors-p-n junction, PIN, and Avalanche-and their structure, materials, working principle, and characteristics, Noise limits on performance.

UNIT-IV: Measurement techniques *(10 lectures)*

Measurement for divergence and wavelength using a semiconductor laser, Measurements for carrier density, resistivity, and hallmobility using Four-point probe and van der Pauw method, Hot-point probe measurement, capacitance-voltage measurements, parameterextraction from diode I-V characteristics.

Reference books and suggested reading:

1. J. Singh, Semiconductor Optoelectronics: Physics and Technology, McGraw-Hill Inc. (1995).
2. B. E. A. Saleh and M. C. Teich, Fundamentals of Photonics, John Wiley & Sons, Inc. (2007).
3. S. M. Sze, Semiconductor Devices: Physics and Technology, Wiley (2008).
4. A. Yariv and P. Yeh, Photonics: Optical Electronics in Modern Communications, Oxford University Press, New York (2007).

5. P. Bhattacharya: Semiconductor Optoelectronic Devices, Prentice Hall of India (1997).
6. Solid state electronics devices: Ben. G. Streetman Pearson Prentice Hall.
7. D.A. Neamen: "Semiconductor Physics and Devices", Times Mirror High Education Group, Chicago, 1997.
8. E.S. Yang: "Microelectronic Devices", McGraw Hill, Singapore, 1988.
9. Online course: "Semiconductor Optoelectronics" by M R Shenoy on NPTEL.
10. Online course: "Optoelectronic Materials and Devices" by Monica Katiyar and Deepak Gupta on NPTEL.

BTPH115-18	**Semiconductor and Optoelectronics Physics Lab**	**L-0, T-0, P-3**	**1.5 Credits**

Pre-requisite (if any): High-school education

Course Objectives: The aim and objective of the Lab course on **Semiconductor and Optoelectronics Physics** is to introduce the students of B.Tech. class to the formal lab structure of semiconductor physics so that they can use these in Engineering as per their requirement.

Course Outcomes: At the end of the course, the student will be able to

CO1	Able to verify some of the theoretical concepts learnt in the theory courses.
CO2	Trained in carrying out precise measurements and handling sensitive equipment.
CO3	Introduced to the methods used for estimating and dealing with experimental uncertainties and systematic "errors."
CO4	Learn to draw conclusions from data and develop skills in experimental design.
CO5	Write a technical report which communicates scientific information in a clear and concise manner.

Detailed Syllabus:

Note: Students are expected to perform about 10-12 experiments from the following list, selecting minimum of 7-8 from the Section-A and 3-4 from the Section-B.

Section-A

1. To study the characteristic of different PN junction diode-Ge and Si.
2. To analyze the suitability of a given Zener diode as a power regulator.
3. To find out the intensity response of a solar cell/Photo diode.
4. To find out the intensity response of a LED.
5. To determine the band gap of a semiconductor.
6. To determine the resistivity of a semiconductor by four probe method.
7. To confirm the de Broglie equation for electrons.
8. To study voltage regulation and ripple factor for a half-wave and a full-wave rectifier without and with different filters.
9. To study the magnetic field of a circular coil carrying current.
10. To find out polarizability of a dielectric substance.
11. To study B-H curve of a ferro-magnetic material using CRO.
12. To find out the frequency of AC mains using electric-vibrator.
13. To find the velocity of ultrasound in liquid.
14. To study the Hall effect for the determination of charge current densities.
15. Distinguish between diamagnetic material, paramagnetic and ferromagnetic material.
16. Measurement of susceptibility of a liquid or a solution by Quincke's method.
17. To study the sample with the nano-scale objects and measure surface topography with different scales, width and height of nano objects, and force-distance curves using AFM.
18. To study the temperature coefficient of Resistance of copper.
19. To determine the ratio k/e using a transistor.
20. To compare various capacitance and verify the law of addition of capacitance.
21. To measure the temperature dependence of a ceramic capacitor.
22. Verification of the curie Weiss law for the electrical susceptibility of a ferromagnetic material.
23. To study the laser beam characteristics like; wave length using diffraction grating aperture & divergence.
24. To study laser interference using Michelson's Interferometer.
25. Study of diffraction using laser beam and thus to determine the grating element.

Section-B

Virtual lab:

1. To draw the static current-voltage (I-V) characteristics of a junction diode.
2. To plot the characteristics of thermistor and hence find the temperature coefficient of resistance.
3. To determine the resistivity of semiconductors by Four Probe Method.
4. To study Zener diode voltage as regulator and measure its line and load regulation.
5. To study the B-H Curve for a ferromagnetic material.
6. To study the Hall effect experiment to determine the charge carrier density.
7. To determine the magnetic susceptibilities of paramagnetic liquids by Quincke's Method.
8. To study the phenomena of magnetic hysteresis and calculate the retentivity, coercivity and saturation magnetization of a material using a hysteresis loop tracer.
9. Verification and design of combinational logic using AND, OR, NOT, NAND and XOR gates.

Reference books and suggested reading:

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.
3. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11thEdn, 2011, Kitab Mahal.
4. Engineering Practical Physics, S. Panigrahi& B. Mallick, 2015, Cengage Learning India Pvt. Ltd.
5. Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge University Press.
6. Laboratory Experiments in College Physics, C.H. Bernard and C.D. Epp, John Wiley and Sons, Inc., New York, 1995.
7. Practical Physics, G.L. Squires, Cambridge University Press, Cambridge, 1985.
8. Experiments in Modern Physics, A.C. Melissinos, Academic Press, N.Y., 1966.
9. Practical Physics, C L Arora, S. Chand & Company LTD.
10. http://www.vlab.co.in
11. http://vlab.amrita.edu/index.php?sub=1

BTPH106-18	**Optics and Electromagnetism**	**L-3, T-1, P-0**	**4 redits**

Prerequisite (if any): Introduction to Quantum Mechanics desirable

Course Objectives: The aim and objective of the course on **Optics and Electromagnetism** is to introduce the students of B.Tech. class to the basic concepts of optics and its applications, electricity and magnetism, and quantum physics, so that they can use these in Engineering as per their requirement.

Course Outcomes: At the end of the course, the student will be able to understand

CO1	Identify and illustrate physical concepts and terminology used in optics and other wave phenomena.
CO2	Understand optical phenomena such as polarization, birefringence, interference, and diffraction in terms of the wave model.
CO3	Understand the importance of wave equation in nature and appreciate the mathematical formulation of the same
CO4	Acquire knowledge about the Maxwell equation and magnetic properties of materials.
CO5	Appreciate the need for quantum mechanics, wave particle duality, uncertainty principle etc.

Detailed syllabus:

PART-A

Unit I: Wave Optics (*8 lectures*)

Diffraction: Introduction to interference and example; concept of diffraction, Fraunhoferand Fresnel diffraction, Fraunhofer diffraction at single slit, double slit, and multiple slits;diffraction grating, characteristics of diffraction grating and its applications; Polarization:Introduction to polarization, polarisation by reflection, polarisation by double refraction,scattering of light, circular and elliptical polarisation, optical activity.

UNIT-II: Fibre Optics and LASERS (*12 lectures*)

Fibre Optics: Introduction, optical fibre as a dielectric wave guide: total internal reflection, numerical aperture and various fibre parameters, losses associated with optical fibres, step and graded index fibres, application of optical fibres; LASERS: Spontaneous and stimulated emission, Einstein's theory of matter radiation interaction and A and B coefficients; population inversion, pumping, various modes, properties of laser beams, types of lasers: gas lasers (He-Ne), solid-state lasers (ruby), applications.

PART-B

UNIT-III: Electromagnetism and Magnetic Properties of Materials *(10 lectures)*

Laws of electrostatics: Coulomb and Gauss Law, electric current and the continuity equation, laws of magnetism: Ampere's and Faraday's laws. Maxwell's equations (derivation and physical significance), Dielectric polarisation, permeability and dielectric constant, polar and non-polar dielectrics, internal fields in a solid, Clausius-Mossotti equation, applications of dielectrics; Magnetisation, permeability and susceptibility, classification of magnetic materials, ferromagnetism, magnetic domains and hysteresis, applications.

Unit IV: Quantum Mechanics *(10 lectures)*

Introduction to quantum physics, black body radiation, explanation using the photon concept, photoelectric effect, Compton effect, de Broglie hypothesis, wave-particle duality, Born's interpretation of the wave function, Davisson and Germer experiment: verification of matter waves, uncertainty principle, Schrodinger wave equation: particle in 1-dimensional box.

Reference books and suggested reading:

1. "Fundamentals of Physics", 6th Ed., D. Halliday, R. Resnick and J. Walker, John Wiley and Sons,

Inc., New York, 2001.
2. "Physics", M. Alonso and E.J. Finn, Addison Wesley, .1992.
3. "Fundamentals of Optics", 4th Ed., F.A. Jenkins and H.E. White, McGraw-Hill Book Co., 1981.
4. "Optics", A Ghatak, Tata-McGraw Hill, New Delhi, 1992.
5. "Vibration and Waves", A.P. French, Arnold-Heinemann, New Delhi, 1972.
6. "Vibrations and waves in physics", I. G. Main, Cambridge University Press, 1993.
7. "The physics of vibrations and waves", H. J. Pain, Wiley, 2006.
8. "Optics", E. Hecht, Pearson Education, 2008.
9. "Optics", A. Ghatak, McGraw Hill Education, 2012.
10. "Principles of Lasers", O. Svelto, Springer Science & Business Media, 2010.
11. "Quantum mechanics", D. J. Griffiths, Pearson Education, 2014.
12. "Quantum Mechanics", R. Robinett, OUP Oxford, 2006.
13. "Semiconductor Physics and Devices", D.A. Neamen, Times Mirror High Education Group, Chicago, 1997.
14. "Microelectronic Devices", E.S. Yang, McGraw Hill, Singapore, 1988.
15. "Solid State Electronic Devices", B.G. Streetman, Prentice Hall of India, 1995.
16. HK Malik and AK Singh, Engineering Physics, 2nd ed., Tata McGraw Hill (2018).
17. https://nptel.ac.in/courses/117108037/3
18. https://nptel.ac.in/courses/115102023/

BTPH116-18	**Optics and Electromagnetism Lab**	**L-0, T-0, P-3**	**1.5 redits**

Pre-requisite (if any): High-school education

Course Objectives: The aim and objective of the lab on Optics and Electromagnetism is to provide students the firsthand experience of verifying various theoretical concepts learnt in theory courses so that they can use these in their branch of Engineering as per their requirement.

Laboratory Outcomes: At the end of the course, students will be

CO1	Able to verify some of the theoretical concepts learnt in the theory courses.
CO2	Trained in carrying out precise measurements and handling sensitive equipment.
CO3	Introduced to the methods used for estimating and dealing with experimental uncertainties and systematic "errors."
CO4	Learn to draw conclusions from data and develop skills in experimental design.
CO5	Write a technical report which communicates scientific information in a clear and concise manner.

Detailed Syllabus:

Note: Students are expected to perform about 10-12 experiments from the following list, selecting minimum of 7-8 from the Section-A and 3-4 from the Section-B.

Section-A

1. To study the magnetic field of a circular coil carrying current.
2. To find out polarizability of a dielectric substance.
3. To study the laser beam characteristics like; wave length using diffraction grating aperture & divergence.
4. To study laser interference using Michelson's Interferometer.
5. Study of diffraction using laser beam and thus to determine the grating element.
6. To determine numerical aperture of an optical fibre.
7. To determine attenuation & propagation losses in optical fibres.

8. To find out the frequency of AC mains using electric-vibrator.
9. To find the refractive index of a material using spectrometer.
10. To find the refractive index of a liquid using spectrometer.
11. To study B-H curve for a ferromagnetic material using CRO.
12. To find the velocity of ultrasound in liquid.
13. To determine the grain size of a material using optical microscope.
14. To study the characteristics of solar cell.
15. To study the Characteristics of Light Emitting Diode (LED).
16. To determine the energy gap of a given semi-conductor.
17. To determine the specific rotation of sugar using Laurent's half-shade polarimeter.

Section-B

Virtual lab:

1. To find the resolving power of the prism.
2. To determine the angle of the given prism.
3. To determine the refractive index of the material of a prism.
4. To find the numerical aperture of a given optic fibre and hence to find its acceptance angle.
5. To calculate the beam divergence and spot size of the given laser beam.
6. To determine the wavelength of a laser using the Michelson interferometer.
7. To revise the concept of interference of light waves in general and thin-film interference in particular.
8. To set up and observe Newton's rings.
9. To determine the wavelength of the given source.
10. To understand the phenomenon Photoelectric effect as a whole.
11. To draw kinetic energy of photoelectrons as a function of frequency of incident radiation.
12. To determine the Planck's constant from kinetic energy versus frequency graph.
13. To plot a graph connecting photocurrent and applied potential
14. To determine the stopping potential from the photocurrent versus applied potential graph.

Reference books and suggested reading:

1. "Fundamentals of Physics", 6th Ed., D. Halliday, R. Resnick and J. Walker, John Wiley and Sons, Inc., New York, 2001.
2. "Physics", M. Alonso and E.J. Finn, Addison Wesley, .1992.
3. "Fundamentals of Optics", 4th Ed., F.A. Jenkins and H.E. White, McGraw-Hill Book Co., 1981.
4. "Optics", A Ghatak, Tata-McGraw Hill, New Delhi, 1992
5. "Vibration and Waves", A.P. French, Arnold-Heinemann, New Delhi, 1972.
6. "Students Reference Manual for Electronic Instrumentation Laboratories",
7. "Laboratory Experiments in College Physics", C.H. Bernard and C.D. Epp, John Wiley and Sons, Inc., New York, 1995.
8. "Practical Physics", G.L. Squires, Cambridge University Press, Cambridge, 1985.
9. "Experiments in Modern Physics", A.C. Melissinos, Academic Press, N.Y., 1966.
10. "Practical Physics", C L Arora. S. Chand & Company LTD.
11. http://www.vlab.co.in
12. http://vlab.amrita.edu/index.php?sub=1

BTPH107-18	**Introduction to Physics in Biotechnology**	**L-3, T-1, P-0**	**4 Credits**

Prerequisite (if any): High School knowledge

Course Objectives: The aim and objective of the course on Introduction to Physics in Biotechnology is to introduce the students of B. Tech. class to the basic concepts and applications of Lasers, fibre optics, X-rays, magnetic material, superconductivity and a brief introduction to quantum physics, so that they can use these in Engineering as per their requirement.

Course Outcomes: At the end of the course, the student will be able to

CO1	Identify and illustrate physical concepts and terminology used in Lasers, fibre optics and other wave phenomena.
CO2	Understand the X-Rays and their applications to the ultrasounds.
CO3	Understand the importance of wave equation in nature and appreciate the mathematical formulation of the same
CO4	Appreciate the need for quantum mechanics, wave particle duality, uncertainty principle etc.
CO5	Understand the properties of magnetic materials and superconductivity.

Detailed Syllabus:

PART-A

UNIT I: LASERS and Fibre Optics *(10 lectures)*

Principles and working oflaser: population inversion, pumping, threshold population inversion,types of laser: solid state (Ruby), gas (He-Ne); application of lasers (Medical/Industrial Applications); Fibre Optics:Introduction, optical fibre as a dielectric wave guide, total internal reflection, step and graded index fibres, numerical aperture and various fibre parameters, losses associated with optical fibres, application of optical fibres.

UNIT II: Magnetic Materials and Superconductivity *(10 lectures)*

Origin of magnetism, Basic idea of Diamagnetic, Paramagnetic, Ferromagnetic, Ferrimagnetic and Ferrite materials, Soft and Hard Magnetic materials, magnetostriction, magnetic anisotropy, applications of magnetic materials; Superconductivity, properties of superconducting state, Meissner Effect, Type-I and Type-II superconductors, Introduction to BCS theory (Qualitative idea), applications in medical industry.

PART-B

UNIT III: X-rays and Ultrasounds *(10 lectures)*

X-rays, Production of X-rays, Continuous and Characteristic X-Rays, Absorption of X-rays, Bragg's law, Adverse effects of X-rays, X-ray radiography; Ultrasounds:Ultra sound generators, properties of ultrasound-waves and its propagation in biological tissues, Pulse echo techniques, Doppler principle, involvement in design of medical instruments, Adverse effects of ultrasound waves.

UNIT IV: Quantum Theory and Nano-Materials (*(10 lectures)*

Photoelectric effect, Compton effect and de-Broglie waves; Wave-particle duality, concept of Electron microscopy; Nano-materials, surface to volume ratio, electron confinement (qualitative description), top-down and bottom-up method of synthesis, qualitative idea of quantum well, quantum wire and quantum dot. Carbon nanotubes: types, properties and applications.

Text and Reference Books:

1. Engineering Physics, Malik; HK, Singh; AK, Tata McGraw Hill.
2. Concepts of Modern Physics, Beiser; A., Tata McGraw Hill.
3. Introduction to Solids, Azaroff LV, Tata Mc Graw Hill.
4. Engineering Physics, D.K. Bhattacharya, Poonam Tondon, Oxford University Press.
5. Optical Fibre system, Technology, Design & Applications, Kao; CK, McGraw Hill.
6. Laser Theory & Applications, Thygrajan; K, Ghatak; AK, Mc Millan India Ltd.

BTPH117-18	**Physics lab**	**L-0, T-0, P-3**	**1.5 Credits**

Pre-requisite (if any): High-school education

Course Objectives: The aim and objective of the Physics lab is to provide students the firsthand experience of verifying various theoretical concepts learnt in theory courses so that they can use these in Engineering as per their requirement.

Laboratory Outcomes: At the end of the course, students will be

CO1	Able to verify some of the theoretical concepts learnt in the theory courses.
CO2	Trained in carrying out precise measurements and handling sensitive equipment.
CO3	Introduced to the methods used for estimating and dealing with experimental uncertainties and systematic errors.
CO4	Learn to draw conclusions from data and develop skills in experimental design.
CO5	Write a technical report which communicates scientific information in a clear and concise manner.

Detailed Syllabus:

Note: Students are expected to perform about 10-12 experiments from the following list, selecting minimum of 7-8 from the Section-A and 3-4 from the Section-B.

Section-A

1. To study the magnetic field of a circular coil carrying current.
2. To find out polarizability of a dielectric substance.
3. To study the laser beam characteristics like; wave length using diffraction grating aperture & divergence.
4. To study laser interference using Michelson's Interferometer.
5. Study of diffraction using laser beam and thus to determine the grating element.
6. To determine numerical aperture of an optical fibre.
7. To determine attenuation & propagation losses in optical fibres.
8. To find out the frequency of AC mains using electric-vibrator.
9. To determine the energy gap of a given semi-conductor.
10. To study B-H curve of a ferromagnetic material using CRO.
11. To find the velocity of ultrasound in liquid.
12. To determine the grain size of a material using optical microscope.
13. To study the characteristics of solar cell.
14. To study the Characteristics of Light Emitting Diode (LED).
15. To determine the specific rotation of sugar using Laurent's half-shade polarimeter.

Section-B

Virtual lab:

1. To find the numerical aperture of a given optic fibre and hence to find its acceptance angle.
2. To calculate the beam divergence and spot size of the given laser beam.
3. To determine the wavelength of a laser using the Michelson interferometer.
4. To revise the concept of interference of light waves in general and thin-film interference in particular.
5. To set up and observe Newton's rings.

6. To determine the wavelength of the given source.
7. To understand the phenomenon Photoelectric effect.
8. To draw kinetic energy of photoelectrons as a function of frequency of incident radiation.
9. To determine the Planck's constant from kinetic energy versus frequency graph.
10. To plot a graph connecting photocurrent and applied potential
11. To determine the stopping potential from the photocurrent versus applied potential graph.

Reference books and suggested reading:

1. "Fundamentals of Physics", 6th Ed., D. Halliday, R. Resnick and J. Walker, John Wiley and Sons, Inc., New York, 2001.
2. "Physics", M. Alonso and E.J. Finn, Addison Wesley, 1992.
3. "Fundamentals of Optics", 4th Ed., F.A. Jenkins and H.E. White, McGraw-Hill Book Co., 1981.
4. "Optics", A Ghatak, Tata-McGraw Hill, New Delhi, 1992
5. "Vibration and Waves", A.P. French, Arnold-Heinemann, New Delhi, 1972.
6. "Students Reference Manual for Electronic Instrumentation Laboratories",
7. "Laboratory Experiments in College Physics", C.H. Bernard and C.D. Epp, John Wiley and Sons, Inc., New York, 1995.
8. "Practical Physics", G.L. Squires, Cambridge University Press, Cambridge, 1985.
9. "Experiments in Modern Physics", A.C. Melissinos, Academic Press, N.Y., 1966.
10. "Practical Physics", C L Arora. S. Chand & Company LTD.
11. http://www.vlab.co.in
12. http://vlab.amrita.edu/index.php?sub=1

S.No.	Branch	Related Branches	Course codes	Course title	Credits
1	Civil Engineering-I Sem	1. Civil Engineering	BTAM101-18	Mathematics-I	5
		2.Construction Engineering & Management			
	Civil Engineering-II Sem	1. Civil Engineering	BTAM201-18	Mathematics-II	5
		2.Construction Engineering & Management			
2	Electrical Engineering-I Sem	1.Electrical Engineering	BTAM101-18	Mathematics-I	5
		2.Automation & Robotics			
		3.Electrical & Electronics Engineering			
		4.Electronics & Electrical Engineering			
		5.Electrical Engineering & Industrial Control			
		6.Instrumentation & Control Engineering			
	Electrical Engineering-II Sem	1.Electrical Engineering	BTAM202-18	Mathematics-II	5
		2.Automation & Robotics			
		3.Electrical & Electronics Engineering			
		4.Electronics & Electrical Engineering			
		5.Electrical Engineering & Industrial Control			
		6.Instrumentation & Control Engineering			
3	Mechanical Engineering-I Sem	1.Mechanical Engineering	BTAM101-18	Mathematics-I	5
		2.Marine Engineering			
		3.Production Engineering			
		4.Industrial Engineering			
		5.Tool Engineering			
		6.Automobile Engineering			
		7.Aerospace Engineering			
		8.Aeronautical Engineering			
	Mechanical Engineering-II Sem	1.Mechanical Engineering	BTAM203-18	Mathematics-II	5
		2.Marine Engineering			
		3.Production Engineering			
		4.Industrial Engineering			
		5.Tool Engineering			
		6.Automobile Engineering			
		7.Aerospace Engineering			

		8.Aeronautical Engineering			
4	Computer Science Engineering-I Sem	1.Computer Engineering	BTAM104-18	Mathematics Paper-I	5
		2.Computer Science Engineering			
		3.Information Technology			
		4.3D Animation Engineering			
	Computer Science Engineering-II Sem	1.Computer Engineering	BTAM204-18	Mathematics Paper-II	5
		2.Computer Science Engineering			
		3.Information Technology			
		4.3D Animation Engineering			
5	Electronics and communication Engineering-I Sem	1.Electronics & Communication Engineering	BTAM101-18	Mathematics-I	5
		2.Electronics & Computer Engineering			
		3.Electronics & Instrumentation Engineering			
		4.Electronics & Telecomm Engineering			
		5.Electronics Engineering			
	Electronics and communication Engineering-II Sem	1.Electronics & Communication Engineering	BTAM202-18	Mathematics-II	5
		2.Electronics & Computer Engineering			
		3.Electronics & Instrumentation Engineering			
		4.Electronics & Telecomm Engineering			
		5.Electronics Engineering			
6	Chemical Sciences-I Sem	1.Chemical Engineering	BTAM106-18	Mathematics-I	5
		2.Petrochem & Petroleum Refinery Engineering			
		3.Textile Engineering			
		4.Food Technology			
	Chemical Sciences-II Sem	1.Chemical Engineering	BTAM206-18	Mathematics-II	5
		2.Petrochem & Petroleum Refinery Engineering			
		3.Textile Engineering			
		4.Food Technology			
7	Bio-Technology-I Sem	Bio-Technology	BTAM107-18	Basic Mathematics-I	5
	Bio-Technology-II Sem	Bio-Technology	BTAM207-18	Basic Mathematics-II	5

Branch/Course: CIVIL ENGINEERING

BTAM101-18	**Mathematics-I (Calculus &LinearAlgebra)**	**4L:1T:0P**	**4 credits**

Course Objective:
The objective of this course is to familiarize the prospective engineers with techniques in calculus, multivariate analysis and linear algebra. It aims to equip 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 disciplines.

Detailed Contents:

Section-A

Unit-I: Calculus (10 hours)

Rolle's theorem, Mean value theorems, Taylor's and Maclaurin theorems with remainders; Indeterminate forms and L'Hôpital's rule; Maxima and minima; Evaluation of definite and Improper integrals; Applications of definite integrals to evaluate surface areas and volumes of revolutions.

Unit-II: Multivariable Calculus (15 hours)

Limit, continuity and partial derivatives, Total derivative; Tangent plane and normal line; Maxima, minima and saddle points; Method of Lagrange multipliers; Multiple Integration: double and triple integrals (Cartesian and polar), change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications: areas and volumes by (double integration), Center of mass and Gravity (constant and variable densities).

Section-B

Unit-III: Sequences and Series (12 hours)

Convergence of sequence and series, tests for convergence of positive term series: root test, ratio test, p-test, comparison test; Alternate series and Lebinitz's test; Power series, Taylor's series, series for exponential, trigonometric and logarithmic functions.

Unit-IV: Matrices (13 hours)

Algebra of matrices, Inverse and rank of a matrix, introduction of null space and kernel, statement of rank-nullity theorem; System of linear equations; Symmetric, skew-symmetric and orthogonal matrices; Determinants; Eigenvalues and eigenvectors; Similar matrices; Diagonalization of matrices; Cayley-Hamilton Theorem.

Suggested Text/Reference Books

G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
T. Veerarajan, Engineering Mathematics for first year, Tata McGraw-Hill, NewDelhi, 2008.
B.V. Ramana, Higher Engineering Mathematics, Tata McGraw Hill New Delhi,11th Reprint, 2010.
D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, LaxmiPublications, Reprint, 2008.
B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

Course Outcomes: The students will learn:

- The fallouts of Rolle's Theorem that is fundamental to application of analysis to Engineering problems.
- To apply differential and integral calculus to evaluate definite, improper integrals and its applications.
- The convergence of sequence and series and to apply different tests of convergence
- To deal with functions of several variables that are essential in most branches of engineering.

- The essential tool of matrices and linear algebra in a comprehensive manner.

BTAM201-18	**Mathematics-II** **(Differential equations)**	**4L:1T:0P**	**4 credits**

Course Objectives:
The objective of this course is to familiarize the prospective engineers with techniques in multivariate integration, ordinary and partial differential equations. It aims to equip the students to deal with advanced level of mathematics and applications that would be essential for their disciplines.

Detailed Contents:

Section A

Unit-I: Ordinary differential equations: First and Higher order (15 hours)
Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

Second order linear differential equations with variable coefficients, method of variation of parameters, Cauchy-Euler equation; Power series solutions.

Unit-II: Partial Differential Equations: First order (10 hours)
First order partial differential equations, solutions of first order linear and non-linear PDEs. Solution to homogenous and non-homogenous linear partial differential equations second and higher order by complimentary function and particular integral method.

Section B

Unit-III: Partial Differential Equations: higher order (12 hours)
Second-order linear equations and their classification, Initial and boundary conditions (with an informal description of well-posed problems), D'Alembert's solution of the wave equation. Separation of variables method to simple problems in Cartesian coordinates.

Unit-IV: Partial Differential Equations: higher order (contd.) (13 hours)
The Laplacian in plane, cylindrical and spherical polar coordinates. One dimensional diffusion equation and its solution by separation of variables. Boundary-value problems: Solution of boundary-value problems for various linear PDEs.

Textbooks/References:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. W. E. Boyce and R. C. DiPrima, Elementary Differential Equations and Boundary Value Problems, 9th Edition, Wiley India, 2009.
3. S. L. Ross, Differential Equations, 3rd Ed., Wiley India, 1984.
4. E. A. Coddington, An Introduction to Ordinary Differential Equations, Prentice Hall India, 1995.
5. E. L. Ince, Ordinary Differential Equations, Dover Publications, 1958.
6. G.F. Simmons and S.G. Krantz, Differential Equations, Tata McGraw Hill, 2007.
7. S. J. Farlow, Partial Differential Equations for Scientists and Engineers, Dover Publications, 1993.
8. R. Haberman, Elementary Applied Partial Differential equations with Fourier Series and Boundary Value Problem, 4th Ed., Prentice Hall, 1998.
9. Ian Sneddon, Elements of Partial Differential Equations, McGraw Hill, 1964.
10. Manish Goyal and N.P. Bali, Transforms and Partial Differential Equations, University Science Press, Second Edition, 2010.

Course Outcomes: The students will learn:

- The mathematical tools needed in evaluating multiple integrals and their usage.
- The effective mathematical tools for the solutions of differential equations that model physical processes.

- The tools of differentiation and integration of functions that are used in various techniques dealing engineering problems.

Branch/Course: ELECTRICAL ENGINEERING

BTAM101-18	**Mathematics-I (Calculus & Linear Algebra)**	**4L:1T:0P**	**4 credits**

Course Objective:

The objective of this course is to familiarize the prospective engineers with techniques in calculus, multivariate analysis and differential equations. It aims to equip 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 disciplines.

Detailed Contents:

Section-A

Unit-I: Calculus (10 hours)

Rolle's theorem, Mean value theorems, Taylor's and Maclaurin theorems with remainders; Indeterminate forms and L'Hôpital's rule; Maxima and minima; Evaluation of definite and Improper integrals; Applications of definite integrals to evaluate surface areas and volumes of revolutions.

Unit-II: Multivariable Calculus (15 hours)

Limit, continuity and partial derivatives, Total derivative; Tangent plane and normal line; Maxima, minima and saddle points; Method of Lagrange multipliers; Multiple Integration: double and triple integrals (Cartesian and polar), change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications: areas and volumes by (double integration), Center of mass and Gravity (constant and variable densities).

Section-B

Unit-III: Sequences and Series (12 hours)

Convergence of sequence and series, tests for convergence of positive term series: root test, ratio test, p-test, comparison test; Alternate series and Lebinitz's test; Power series, Taylor's series, series for exponential, trigonometric and logarithmic functions.

Unit-IV: Matrices (13 hours)

Algebra of matrices, Inverse and rank of a matrix, introduction of null space and kernel, statement of rank-nullity theorem; System of linear equations; Symmetric, skew-symmetric and orthogonal matrices; Determinants; Eigenvalues and eigenvectors; Similar matrices; Diagonalization of matrices; Cayley-Hamilton Theorem.

Text / References:

G.B. Thomas and R.L. Finney, "Calculus and Analytic geometry", Pearson, 2002.

T. Veerarajan, "Engineering Mathematics", McGraw-Hill, New Delhi, 2008.

B. V. Ramana, "Higher Engineering Mathematics", McGraw Hill, New Delhi, 2010.

N.P. Bali and M. Goyal, "A text book of Engineering Mathematics", Laxmi Publications, 2010.

B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 2010.

E. Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, 2006.

D. Poole, "Linear Algebra: A Modern Introduction", Brooks/Cole, 2005.

V. Krishnamurthy, V. P. Mainra and J. L. Arora, "An introduction to Linear Algebra", Affiliated East-West press, 2005.

Course Outcomes: The students will learn:

- The differential and integral calculus for applications of definite integrals to evaluate surface areas and volumes of revolutions.
- The fallouts of Rolle's Theorem that is fundamental to application of analysis to Engineering problems.
- The tool of matrices and convergence of sequence and series for learning advanced Engineering Mathematics.
- The tools of differentiation and integration of functions of multiple variables which are used in various techniques dealing engineering problems.

BTAM202-18	**Mathematics-II (Differential Equations & Numerical Methods)**	**4L:1T:0P**	**4 credits**

Course Objective:

The objective of this course is to familiarize the prospective engineers with techniques in linear algebra, transform calculus and numerical methods. It aims to equip the students with standard concepts and tools of integral transforms, matrices and numerical techniques that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.

Detailed Contents:

Section-A

Unit-I: Ordinary Differential Equations: First and higher order (13 hours)

Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type. Second order linear differential equations with variable coefficients, method of variation of parameters, Cauchy-Euler equation, Power series solutions.

Unit-II: Partial Differential Equations: First order (12 hours)

First order partial differential equations, solutions of first order linear and non-linear PDEs; Solution to homogenous and non-homogenous linear partial differential equations of second order by complimentary function and particular integral method. Second-order linear equations and their classification, Separation of variables method to simple problems.

Section-B

Unit-III: Numerical Methods-I (12 hours)

Solution of polynomial and transcendental equations – Bisection method, Regula-Falsi method, Newton-Raphson method. Finite differences, Interpolation using Newton's forward and backward difference formulae. Central difference interpolation: Gauss's forward and backward formulae. Numerical integration: Trapezoidal rule and Simpson's 1/3rd and 3/8 rules.

Unit-IV: Numerical Methods-II (13 hours)

Ordinary differential equations: Taylor's series, Euler and modified Euler's methods; Runge-Kutta method of fourth order for solving first and second order equations. Milne's and Adam's predicator-corrector methods. Partial differential equations: Finite difference solution of two-dimensional Laplace equation and Poisson equation, Implicit and explicit methods for one dimensional heat equation (Bender-Schmidt and Crank-Nicholson methods), Finite difference explicit method for wave equation.

Text / References:

W. E. Boyce and R. C. DiPrima, "Elementary Differential Equations and Boundary Value Problems", Wiley India, 2009.

S. L. Ross, "Differential Equations", Wiley India, 1984.
E. A. Coddington, "An Introduction to Ordinary Differential Equations", Prentice Hall India, 1995.
E. L. Ince, "Ordinary Differential Equations", Dover Publications, 1958.
G.F. Simmons and S.G. Krantz, "Differential Equations", McGraw Hill, 2007.
N.P. Bali and M. Goyal, "A text book of Engineering Mathematics", Laxmi Publications, 2008.
B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 2010.

Course Outcomes: Students will be able to:

- understand the methods which can be used to solve a variety of ordinary and partial differential equations
- demonstrate knowledge of a range of applications of analytical and numerical methods
- develop their attitude towards problem solving.
- Understand how to apply numerical methods to solve the mathematical models.

Branch/Course: MECHANICAL ENGINEERING

BTAM101-18	**Mathematics-I (Calculus & Linear Algebra)**	**4L:1T:0P**	**4 credits**

Course Objective:
The objective of this course is to familiarize the prospective engineers with techniques in calculus, multivariate analysis and linear algebra. It aims to equip 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 disciplines.

Detailed Contents:

Section-A

Unit-I: Calculus (10 hours)

Rolle's theorem, Mean value theorems, Taylor's and Maclaurin theorems with remainders; Indeterminate forms and L'Hôpital's rule; Maxima and minima; Evaluation of definite and Improper integrals; Applications of definite integrals to evaluate surface areas and volumes of revolutions.

Unit-II: Multivariable Calculus (15 hours)

Limit, continuity and partial derivatives, Total derivative; Tangent plane and normal line; Maxima, minima and saddle points; Method of Lagrange multipliers; Multiple Integration: double and triple integrals (Cartesian and polar), change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications: areas and volumes by (double integration), Center of mass and Gravity (constant and variable densities).

Section-B

Unit-III: Sequences and Series (12 hours)

Convergence of sequence and series, tests for convergence of positive term series: root test, ratio test, p-test, comparison test; Alternate series and Lebinitz's test; Power series, Taylor's series, series for exponential, trigonometric and logarithmic functions.

Unit-IV: Matrices (13 hours)

Algebra of matrices, Inverse and rank of a matrix, introduction of null space and kernel, statement of rank-nullity theorem; System of linear equations; Symmetric, skew-symmetric and orthogonal matrices; Determinants; Eigenvalues and eigenvectors; Similar matrices; Diagonalization of matrices; Cayley-Hamilton Theorem.

Suggested Text/Reference Books

G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.

Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
T. Veerarajan, Engineering Mathematics for first year, Tata McGraw-Hill, NewDelhi, 2008.
B.V. Ramana, Higher Engineering Mathematics, Tata McGraw Hill New Delhi,11th Reprint, 2010.
D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, LaxmiPublications, Reprint, 2008.
B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

Course Outcomes: The students will learn:

- The fallouts of Rolle's Theorem that is fundamental to application of analysis to Engineering problems.
- To apply differential and integral calculus to evaluate definite, improper integrals and its applications.
- The convergence of sequence and series and to apply different tests of convergence
- To deal with functions of several variables that are essential in most branches of engineering.
- The essential tool of matrices and linear algebra in a comprehensive manner.

BTAM203-18	**MATHEMATICS II (Ordinary Differential Equations and Complex Variable)**	**4L:1T:0P**	**5 credits**

Course Objective:
The objective of this course is to familiarize the prospective engineers with techniques in calculus, Ordinary differential equations and Complex analysis. It aims to equip 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 disciplines.

Detailed Contents:

Section-A

Unit-I: Ordinary differential equations: First Order (12 lectures)

Exact, linear and Bernoulli's equations, Euler's equation, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

Unit-II: Ordinary differential equations: Higher orders (13 lectures)

Second order linear differential equations with variable coefficients, method of variation of parameters, Cauchy-Euler equation; Power series solutions.

Section-B

Unit-III: Complex Variable – Differentiation (10 lectures)

Elementary functions of complex variables, limit, continuity and differentiability; Cauchy-Riemann equations, analytic functions, harmonic functions, finding harmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithm) and their properties; Conformal mappings, Mobius transformation and its properties.

Unit-IV: Complex Variable – Integration (15 lectures)

Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy Integral formula (without proof), Liouville's theorem and Maximum-Modulus theorem (without proof); Taylor's series, zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem (without proof), Evaluation of definite integral involving sine and cosine,

Suggested Text/Reference Books

G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition,Pearson, Reprint, 2002.
Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
W. E. Boyce and R. C. DiPrima, Elementary Differential Equations and Boundary Value Problems, 9th Edn., Wiley India, 2009.
S. L. Ross, Differential Equations, 3rd Ed., Wiley India, 1984.
E. A. Coddington, An Introduction to Ordinary Differential Equations, Prentice Hall India, 1995.
E. L. Ince, Ordinary Differential Equations, Dover Publications, 1958.
J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7thEd., Mc-Graw Hill, 2004.
N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, LaxmiPublications, Reprint, 2008.
B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36thEdition, 2010.

Course Outcomes: The students will learn:

- The effective mathematical tools for the solutions of differential equations that model physical processes.
- The tools of differentiation and integration of functions of a complex variable that are used in various techniques dealing engineering problems.

Branch/Course: COMPUTER SCIENCE AND ENGINEERING

BTAM104-18	**Mathematics Paper-I (Calculus & Linear Algebra)**	**4L:1T:0P**	**4 credits**

Course Objective:
The objective of this course is to familiarize the prospective engineers with techniques in basic calculus and linear algebra. It aims to equip 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 disciplines.

Detailed Contents:

Section-A

Unit-I: Calculus(13 hours)
Rolle's theorem, Mean value theorems, Statements of Taylor's and Maclaurin theorems with remainders; Indeterminate forms and L'Hôpital'srule; Maxima and minima.
Evaluation of definite and improper integrals; Applications of definite integrals to evaluate surface areas and volumes of revolutions; Beta and Gamma functions and their properties.

Unit-II: Matrix Algebra (12 hours)
Matrices, vectors addition and scalar multiplication, matrix multiplication; Linear systems of equations, linear Independence, rank of a matrix, determinants, Cramer's Rule, inverse of a matrix, Gauss elimination and Gauss-Jordan elimination.

Section-B

Unit-III: Linear Algebra (13 hours)
Vector Space, linear dependence of vectors, basis, dimension; Linear transformations (maps), range and kernel of a linear map, rank and nullity, statement of rank-nullity theorem, Matrix associated with a linear map.

Unit-IV: Linear Algebra (Contd.) (12 hours)
Eigenvalues, eigenvectors, symmetric, skew-symmetric, and orthogonal Matrices, eigen bases; Similar matrices, diagonalization.

Suggested Text/Reference Books

G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
B.V. Ramana, Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.
V. Krishnamurthy, V.P. Mainra and J.L. Arora, An introduction to Linear Algebra, Affiliated East–West press, Reprint 2005.

Course Outcomes: The students will be able

- To apply differential and integral calculus to notions of curvature and to improper integrals. Apart from various applications, they will have a basic understanding of Beta and Gamma functions. The essential tools of matrices and linear algebra including linear transformations, eigenvalues, diagonalization and orthogonalization.

BTA204-18	**Mathematics Paper-II (Probability & Statistics)**	**4L:1T:0P**	**4 credits**

Course Objective:

The objective of this course is to familiarize the students with statistical techniques. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling various problems in the discipline.

Detailed Content:

Section-A

Unit I: (10 hours)

Measures of Central tendency: Moments, skewness and kurtosis, Variance, Correlation coefficient, Probability, conditional probability, independence; Discrete random variables, Independent random variables, expectation of Discrete random variables.

Unit II: (15 hours)

Probability distributions: Binomial, Poisson and Normal, Poisson approximation to the binomial distribution, evaluation of statistical parameters for these three distributions, Correlation and regression – Rank correlation.

Section-B

Unit III: (10 hours)

Continuous random variables and their properties, distribution functions and densities, normal and exponential densities. Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas.

Unit IV; (15 hours)

Test of significance: Large sample test for single proportion, difference of proportions, single mean, difference of means, and difference of standard deviations.

Test for single mean, difference of means and correlation coefficients, test for ratio of variances - Chi-square test for goodness of fit and independence of attributes.

Suggested Text/Reference Books

Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.

P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory, Universal Book Stall, 2003 (Reprint).
S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.
W. Feller, An Introduction to Probability Theory and its Applications, Vol. 1, 3rd Ed., Wiley, 1968.
N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.
T. Veerarajan, Engineering Mathematics (for semester III), Tata McGraw-Hill, New Delhi, 2010.

Course Outcomes: The students will learn:

- The ideas of probability and random variables and various discrete and continuous probability distributions and their properties. The basic ideas of statistics including measures of central tendency, correlation and regression and the statistical methods of studying data samples.

Branch/Course: ELECTRONICS & COMMUNICATION ENGINEERING

BTAM101-18	**Mathematics-I (Calculus & Linear Algebra)**	**4L:1T:0P**	**4 credits**

Course Objective:
The objective of this course is to familiarize the prospective engineers with techniques in calculus, multivariate analysis and linear algebra. It aims to equip 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 disciplines.

Detailed Contents:

Section-A

Unit-I: Calculus (10 hours)

Rolle's theorem, Mean value theorems, Taylor's and Maclaurin theorems with remainders; Indeterminate forms and L'Hôpital's rule; Maxima and minima; Evaluation of definite and Improper integrals; Applications of definite integrals to evaluate surface areas and volumes of revolutions.

Unit-II: Multivariable Calculus (15 hours)

Limit, continuity and partial derivatives, Total derivative; Tangent plane and normal line; Maxima, minima and saddle points; Method of Lagrange multipliers; Multiple Integration: double and triple integrals (Cartesian and polar), change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications: areas and volumes by (double integration), Center of mass and Gravity (constant and variable densities).

Section-B

Unit-III: Sequences and Series (12 hours)

Convergence of sequence and series, tests for convergence of positive term series: root test, ratio test, p-test, comparison test; Alternate series and Lebinitz's test; Power series, Taylor's series, series for exponential, trigonometric and logarithmic functions.

Unit-IV: Matrices (13 hours)

Algebra of matrices, Inverse and rank of a matrix, introduction of null space and kernel, statement of rank-nullity theorem; System of linear equations; Symmetric, skew-symmetric and orthogonal matrices; Determinants; Eigenvalues and eigenvectors; Similar matrices; Diagonalization of matrices; Cayley-Hamilton Theorem.

Suggested Text/Reference Books

G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
T. Veerarajan, Engineering Mathematics for first year, Tata McGraw-Hill, NewDelhi, 2008.
B.V. Ramana, Higher Engineering Mathematics, Tata McGraw Hill New Delhi,11th Reprint, 2010.
D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, LaxmiPublications, Reprint, 2008.
B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

Course Outcomes: The students will learn:

- The fallouts of Rolle's Theorem that is fundamental to application of analysis to Engineering problems.
- To apply differential and integral calculus to evaluate definite, improper integrals and its applications.
- The convergence of sequence and series and to apply different tests of convergence
- To deal with functions of several variables that are essential in most branches of engineering.
- The essential tool of matrices and linear algebra in a comprehensive manner.

BTAM202-18	**Mathematics-II (Differential Equations & Numerical Methods)**	**4L:1T:0P**	**4 credits**

Course Objective:
The objective of this course is to familiarize the prospective engineers with techniques in linear algebra, transform calculus and numerical methods. It aims to equip the students with standard concepts and tools of integral transforms, matrices and numerical techniques that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.

Detailed Contents:

Section-A

Unit-I: Ordinary Differential Equations: First and higher order (13 hours)

Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type. Second order linear differential equations with variable coefficients, method of variation of parameters, Cauchy-Euler equation, Power series solutions.

Unit-II: Partial Differential Equations: First Order (12 hours)

First order partial differential equations, solutions of first order linear and non-linear PDEs; Solution to homogenous and non-homogenous linear partial differential equations of second order by complimentary function and particular integral method. Second-order linear equations and their classification, Separation of variables method to simple problems.

Section-B

Unit-III: Numerical Methods-I (12 hours)

Solution of polynomial and transcendental equations – Bisection method, Regula-Falsi method, Newton-Raphson method. Finite differences, Interpolation using Newton's forward and backward difference formulae. Central difference interpolation: Gauss's forward and backward formulae. Numerical integration: Trapezoidal rule and Simpson's 1/3rd and 3/8 rules.

Unit-IV: Numerical Methods-II (13 hours)

Ordinary differential equations: Taylor's series, Euler and modified Euler's methods; Runge-Kutta method of fourth order for solving first and second order equations. Milne's and Adam's predicator-corrector methods. Partial differential equations: Finite difference solution two-dimensional Laplace equation and Poisson equation, Implicit and explicit methods for one dimensional heat equation (Bender-Schmidt and Crank-Nicholson methods), Finite difference explicit method for wave equation.

Text / References:

W. E. Boyce and R. C. DiPrima, "Elementary Differential Equations and Boundary Value Problems", Wiley India, 2009.
S. L. Ross, "Differential Equations", Wiley India, 1984.
E. A. Coddington, "An Introduction to Ordinary Differential Equations", Prentice Hall India, 1995.
E. L. Ince, "Ordinary Differential Equations", Dover Publications, 1958.
G.F. Simmons and S.G. Krantz, "Differential Equations", McGraw Hill, 2007.
N.P. Bali and M. Goyal, "A text book of Engineering Mathematics", Laxmi Publications, 2008.
B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 2010.

Course Outcomes: Students will be able to:

- understand the methods which can be used to solve a variety of ordinary and partial differential equations
- demonstrate knowledge of a range of applications of analytical and numerical methods
- develop their attitude towards problem solving.
- Understand how to apply numerical methods to solve the mathematical models.

Branch/Course: CHEMICAL ENGINEERING

BTAM106-18	**Mathematics-I**	**4L:1T:0P**	**5 credits**

Course Objectives: The objective of this course is to introduce matrices, vectors, linear system of equations, eigen values and eigen vectors. Vectors are basic to this course. We will learn to manipulate them algebraically and geometrically. They will help us simplify the statements of problems and theorems and to find solutions and proofs. Determinants measure volumes and areas.

Detailed Contents:

Section-A

Unit-I: Linear Algebra: Matrices, Vectors, Determinants, Linear Systems (15 hours) Matrices, Vectors: Addition and Scalar Multiplication, Matrix Multiplication, Linear Systems of Equations, Linear Independence. Rank of a Matrix. Vector Space, Solutions of Linear Systems: Existence, Uniqueness, Determinants, Cramer's Rule, Inverse of a Matrix. Gauss Elimination and Gauss-Jordan methods.

Unit-II: Linear Algebra: Matrix Eigenvalue Problems (10 hours)

Eigenvalues, Eigenvectors, Applications of Eigenvalue Problems, Symmetric, Skew-Symmetric, and Orthogonal Matrices

Section-B

Unit-III: Vector Differential Calculus. Grad, Div, Curl (13 hours)

Vectors in 2-Space and 3-Space, Inner Product (Dot Product), Vector Product (Cross Product), Vector and Scalar Functions and Fields, Derivatives, Curves. Arc Length. Curvature, Gradient of a Scalar Field,

Directional Derivative, Divergence of a Vector Field, Curl of a Vector Field.

Unit-IV: Integral Calculus. Integral Theorems (12 hours):

Line Integrals, Path Independence of Line Integrals, Green's Theorem in the Plane, Surfaces for Surface integrals.

Suggested Text/Reference Books

G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.

Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.

D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.

T. Veerarajan, Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.

B. V. Ramana, Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.

N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.

B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.

V. Krishnamurthy, V.P. Mainra and J.L. Arora, An introduction to Linear Algebra, Affiliated East–West press, Reprint 2005.

Course Outcomes: The students will be able to

- Learn to manipulate how to use matrices to sole linear system of equations.
- Use vectors in various mathematical problems which arise in kinematics.

BTAM206-18	**Mathematics-II**	**4L:1T:0P**	**5 Credits**

Course Objective:

The objective of this course is to familiarize the prospective engineers with techniques in integral transform and differential equations. It aims to equip 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 disciplines.

Detailed Contents:

Section-A

Unit-I: Integral Transforms (10 hours)

Laplace Transforms, Inverse Laplace transforms, Fourier Series, half range Sine and Cosine series, Fourier transforms.

Unit-II: First-Order and second order linear ODEs (15 hours)

Basic Concepts, Solutions of separable ODEs, Exact ODEs, Linear ODEs, Solving ODEs by Laplace Transforms.

Homogeneous Linear ODEs of Second Order, Euler-Cauchy Equations, Wronskian, Nonhomogeneous ODEs, Solution by method of variation of Parameters

Section-B

Unit-III: Series Solutions of ODEs, Special Functions (15 hours)

Power Series Method, Legendre.'s Equation, Legendre Polynomials, Bessel's Equation, Bessel Functions, Sturm-Liouville boundary Problems, Orthogonal Functions

Unit-IV:Partial Differential Equations (10 hours)

Basic Concepts, Classification, Solution of PDEs: Separation of Variables, with the help of Fourier Series and Laplace Transforms.

Text Books/ Reference Books:

D. Poole, "Linear Algebra: A Modern Introduction", Brooks/Cole, 2005.
N.P. Bali and M. Goyal, "A text book of Engineering Mathematics", Laxmi Publications, 2008.
B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 2010.
V. Krishnamurthy, V. P. Mainra and J. L. Arora, "An introduction to Linear Algebra", Affiliated East-West press, 2005.

Course Outcomes: Students will be able to:

- demonstrate knowledge of a range of applications of these methods
- understand how integral transforms can be used to solve a variety of differential equations
- develop their attitude towards problem solving.
- Understand how to apply integral transforms to solve the mathematical models.

Branch/Course: BIOTECHNOLOGY ENGINEERING

BTAM107-18	**Basic Mathematics-I**	**4L:1T:0P**	**5 Credits**

Course Objectives: The objective of this course is to familiarize the students with the basic techniques of mathematics which are highly useful to solve simple problems. This introduction aims at making the students understand the basic concepts in mathematics.

Detailed Contents:

Section-A

Unit-I: Algebra (12 hours)

Complex numbers, Solution of quadratic equations, Permutations and combinations, Binomial theorem for positive/negative index and its simple applications, Arithmetic and geometric progression.

Unit-II: Trigonometry (13 hours)

Review of trigonometric functions, Sum and product formulae for trigonometric functions, Trigonometric equations and sum - to - product formulae for trigonometric functions, Identities related to double angle formulae.

Section-B

Unit-III: Determinants and Matrices (12 hours)

Matrices, Operations on matrices, Determinants and its properties, Singular and non-singular matrices, Adjoint and inverse of a matrix and its properties, Solution of system of linear equations using Cramer's rule and matrix method.

Unit-IV: Coordinate Geometry and Statistics (13 hours)

Rectangular coordinate system, Straight lines, Circles (in standard form only).

Measure of dispersion: mean deviation, Variance and standard deviation of grouped/ungrouped data. Correlation and regression.

Text books/Reference Books:

1) Mathematics, A Text books (Parts I & II), NCERT, New Delhi 2011.
2) E. Kreyszig, Advanced Engineering Mathematics, John Wiley, 1999.
3) V.K. Krishnamurthy, V.P. Mainra and J.L. Arora, An introduction to Linear Algebra, Associated East West Press 2007.
4) S.L. Loney, The elements of Coordinate Geometry, Michigan Historical Reprint series, 2012.
5) P.L. Meyer, Introductory Probability and Statistical Applications, Addison Wesley 1970.

Course Outcomes: Students will be able to

- acquire knowledge of basic algebra, trigonometry, matrices, coordinate geometry etc.
- apply these concepts to solve complex mathematical problems
- analyze the data of any experiment statistically to extract meaningful result

BTAM207-18	**Basic Mathematics-II**	**4L:1T:0P**	**5 credits**

Course Objectives: The objective is to develop basic computing skills and application of quantitative required for biological studies and rationalization of experimental designs.

Detailed Contents:

Section-A

Unit-I: Differentiation (12 hours)

Functions, Domain and range, Properties of standard functions (trigonometric, exponential and logarithmic) and their graphs, Limit, Continuity and Differentiability. Differentiation of standard functions (polynomials, trigonometric, inverse trigonometric exponentials and logarithmic), Product rule, Quotient rule, Chain rule.

Unit-II: Applications of derivatives (13 hours)

Applications of derivatives in graphing, Maximum and minimum of single variable function, Functions of several variables, Partial derivatives, Homogeneous functions, Maximum and minimum of several variable functions.

Section-B

Unit-III: Integration (12 hours)

Integral as anti-derivative, Integration: by substitution, by parts and partial fractions, Definite integral and its properties, Double integrals, Areas of bounded regions and rectification.

Unit-IV: Differential Equations (13 hours)

Order and degree, General and particular solution of differential equation, Techniques for solving first order ordinary differential equation and its applications to biological problems (population growth, radioactive decay).

Text books/Reference Books:

1. Mathematics, A Text books (Parts I & II), NCERT, New Delhi, 2011.
2. G.B. Thomas and R.L. Finney, Calculus and Analytical Geometry, Pearson Education, 10th ed., 2007.
3. E. Kreyszig, Advanced Engineering Mathematics, 8th Edition, John Wiley, 1999.
4. Shanti Narayan, Differential and Integral Calculus, S. Chand, 2005.

Course Outcomes: Students will be able:

- explain functions, related properties and determine their continuity and differentiability.
- apply derivatives in graphing and maxima and minima of single variable function.
- predict integration of function using by parts, by substitution and partial fraction methods and apply these to find areas of bounded regions and rectifications.
- learn methods to solve first order ordinary differential equations and apply it to biological problems

Category	Engineering Science Course				
Course title	**Basic Electrical Engineering (Theory & Lab.)**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	Semester –I/II
	3	**1**	**2**	**5**	
Pre-requisites (if any): Nil					

Course code: BTEE-101-18

Course Title: Basic Electrical Engineering **(4 credits)**
[L: 3; T:1; P : 0]
Internal Marks: 40 External Marks: 60 Total Marks: 100

Course Outcomes:
At the end of this course, students will:

CO 1	Have the knowledge of DC circuits, AC Circuits, basic magnetic circuits, working principles of electrical machines, and components of low voltage electrical installations
CO 2	Be able to analyze of DC circuits, AC Circuits
CO 3	Understand the basic magnetic circuits and apply it to the working of electrical machines
CO 4	Be introduced to types of wiring, batteries, and LT switchgear.

Detailed contents:

Module 1: DC Circuits (9 hours)
Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff's current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin's and Norton's Theorems. Time-domain analysis of first-order RL and RC circuits.

Module 2: AC Circuits (9 hours)
Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Three-phase balanced circuits, voltage and current relations in star and delta connections.

Module 3: Electrical Machines (16 hours)
Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections. Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Loss components and efficiency, starting and speed control of induction motor. Single-phase induction motor. Construction, working, torque-speed characteristic and speed control of separately excited dc motor. Construction and working of synchronous generators.
Module 4: Electrical Installations (7 hours)

Components of LT Switchgear: Switch Fuse Unit (SFU), Miniutature Circuit Breaker (MCB), Earth Leakage Circuit Breaker (ELCB), MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery backup. Contactors.

Suggested Text / Reference Books

D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2010.

T.K. Nagsarkar and M.S. Sukhija, "Basic Electrical Engineering", Oxford University Press
D. C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill, 2009.

L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2011.
E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.

V. D. Toro, "Electrical Engineering Fundamentals", Prentice Hall India, 1989.
B. L. Theraja, "Electrical Technology", S Chand Publishing
J. B. Gupta, "Basic Electrical Engineering", S.K. Kataria& Sons

Course code: BTEE-102-18
Course Title: Basic Electrical Engineering Laboratory (1 credit)
[L: 0; T:0; P : 2]
Internal Marks: 30 External Marks: 20 Total Marks: 50

List of experiments/demonstrations:

List of experiments/demonstrations:

- Basic safety precautions. Introduction and use of measuring instruments – voltmeter, ammeter, multi-meter, oscilloscope. Real-life resistors, capacitors and inductors.
- Measuring the steady-state and transient time-response of R-L, R-C, and R-L-C circuits to a step change in voltage (transient may be observed on a storage oscilloscope). Sinusoidal steady state response of R-L, and R-C circuits – impedance calculation and verification. Observation of phase differences between current and voltage. Resonance in R-L-C circuits.
- Transformers: Observation of the no-load current waveform on an oscilloscope (non-sinusoidal wave-shape due to B-H curve nonlinearity should be shown along with a discussion about harmonics). Loading of a transformer: measurement of primary and secondary voltages and currents, and power.
- Three-phase transformers: Star and Delta connections. Voltage and Current relationships (line-line voltage, phase-to-neutral voltage, line and phase currents). Phase-shifts between the primary and secondary side. Cumulative three-phase power in balanced three-phase circuits.
- Demonstrate of cut-out sections of machines: dc machine (commutator-brush arrangement), induction machine (squirrel cage rotor), synchronous machine (field winging - slip ring arrangement) and single-phase induction machine.
- Torque Speed Characteristic of separately excited dc motor.
- Synchronous speed of two and four-pole, three-phase induction motors. Direction reversal by change of phase-sequence of connections. Torque-Slip Characteristic of an induction motor. Generator operation of an induction machine driven at super-synchronous speed.
- Synchronous Machine operating as a generator: stand-alone operation with a load. Control of voltage through field excitation.

Laboratory Outcomes

CO 1	The ability to use common electrical measuring instruments and understand the fundamentals of electrical engineering.
CO 2	The ability to make electrical connections, and measure power, power factor using appropriate equipments.
CO 3	Have the knowledge of electrical machines, components and their ratings.
CO 4	Understand the operation of transformers and electrical machines.

S. No.	Suggested List of Experiments
1.	To verify Ohm's Law and its limitations.
2.	To verify Kirchhoff's Laws.
3.	To measure the resistance and inductance of a coil by ammeter-voltmeter method
4.	To find voltage-current relationship in a R-L series circuit and to determine the power factor of the circuit.
5.	To verify the voltage and current relations in star and delta connected systems.
6.	To measure power and power factor in a single- phase AC circuit.
7.	To verify series and parallel resonance in AC circuits.
8.	To observe the B-H loop of ferromagnetic core material on CRO.
9.	To use a bridge rectifier for full- wave rectification of AC supply and to determine the relationship between RMS and average values of the rectified voltage.
10.	To measure the minimum operating voltage, current drawn, power consumed, and the power factor of a fluorescent tube light, Bulb, Single phase induction motor,
11.	To connect measuring analog and digital instruments to measure current, voltage, power and power factor.
12.	To perform open- and short circuit tests on a single- phase transformer and calculate its efficiency.
13.	To start and reverse the direction of rotation of a (i) DC motor (ii) three phase Induction motor
14.	Study of starters for (i) DC motor (ii) Induction motor
15.	Study of Cut section of DC Series motor, DC shunt motor and three phase induction motor

Note: A student to perform any 8-10 Experiments from the above list.

Course code	BTME101-**19**				
Category	Engineering Science Courses				
Course title	Engineering Graphics & Design (Theory & Lab.)				
Scheme and Credits	L	T	P	Credits	Semester – I
	1	0	**6**	**4**	
Pre-requisites (if any)	-				
	Common to all branches				

Engineering Graphics & Design [A total of 10 lecture hours &**9**0 hours of lab.]
[[L : 1; T:0; P : **6** (**4**credits)]

Detailed contents

Traditional Engineering Graphics:
Principles of Engineering Graphics; Orthographic Projection; Descriptive Geometry; Drawing Principles; Isometric Projection; Surface Development; Perspective; Reading a Drawing; Sectional Views; Dimensioning & Tolerances; True Length, Angle; intersection, ShortestDistance.
Computer Graphics:
Engineering Graphics Software; -Spatial Transformations; Orthographic Projections; Model Viewing; Co-ordinate Systems; Multi-view Projection; Exploded Assembly; Model Viewing; Animation; Spatial Manipulation; Surface Modelling; Solid Modelling; Introduction to Building Information Modelling(BIM)

(Except the basic essential concepts, most of the teaching part can happen concurrently in the laboratory)

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 VernierScales;

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

Module 3: Projections of Regular Solids covering,
those inclined to both the Planes- Auxiliary Views; Draw simple annotation, dimensioning and scale. Floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower,etc.

Module 4:Sections and Sectional Views of Right Angular Solids covering,
Prism, Cylinder, Pyramid, Cone – Auxiliary Views; Development of surfaces ofRight Regular Solids - Prism, Pyramid, Cylinder and Cone; Draw the sectional orthographic views of geometrical solids, objects from industry and dwellings (foundation to slabonly)

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;

Module 6: Overview of Computer Graphics covering,
listing the computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software [such as: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars),

The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.; Isometric Views of lines, Planes, Simple and compound Solids];

Module 7: Customisation& CAD Drawing
consisting of set up of the drawing page and the printer, including scale settings, Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerancing; Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawingcircles;

Module 8: Annotations, layering & other functions covering
applying dimensions to objects, applying annotations to drawings; Setting up and use oflayers, layers to create drawings, Create, edit and use customized layers; Changing line lengths through modifying existing lines (extend/lengthen); Printing documents to paper using the print command; orthographic projection techniques; Drawing sectional views of composite right regular geometric solids and project the true shape of the sectioned surface; Drawing annotation, Computer-aided design (CAD) software modeling of parts and assemblies. Parametric and non-parametric solid, surface, and wireframe models. Part editing and two-dimensional documentation of models. Planar projection theory, including sketching of perspective, isometric, multiview, auxiliary, and section views. Spatial visualization exercises. Dimensioning guidelines, tolerancing techniques; dimensioning and scale multi views ofdwelling;

Module 9: Demonstration of a simple team design project that illustrates
Geometry and topology of engineered components: creation of engineering models and their presentation in standard 2D blueprint form and as 3D wire-frame and shaded solids; meshed topologies for engineering analysis and tool-path generation for component manufacture; geometric dimensioning and tolerancing; Use of solid-modeling software for creating associative models at the component and assembly levels; floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc. Applying colour coding according to building drawing practice; Drawing sectional elevation showing foundation to ceiling; Introduction to Building Information Modelling (BIM).

Suggested Text/Reference Books:

(i) Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar PublishingHouse
(ii) Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education
(iii) Agrawal B. & Agrawal C. M. (2012), EngineeringGraphics, TMH Publication
(iv) Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers
(v) (Corresponding set of) CAD Software Theory and UserManuals Course Outcomes

Course Outcomes

All phases of manufacturing or construction require the conversion of new ideas and design concepts into the basic line language of graphics. Therefore, there are many areas (civil, mechanical,electrical,architecturalandindustrial)inwhichtheskillsoftheCADtechniciansplay major roles in the design and development of new products or construction. Students prepare for actual work situations through practical training in a new state-of-the-art computer designed CAD laboratory using engineering software. This course is designed toaddress:

- to prepare you to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
- to prepare you to communicate effectively
- to prepare you to use the techniques, skills, and modern engineering tools necessary for engineering practice

The student will learn :

- Introduction to engineering design and its place in society
- Exposure to the visual aspects of engineering design
- Exposure to engineering graphics standards

- Exposure to solid modelling
- Exposure to computer-aided geometric design
- Exposure to creating working drawings
- Exposure to engineering communication

Paper Title : Engineering Graphics & Design (Practical)

Course Assessment Methods

End Semester Assessment:

1. University Theory Exam: Nil
2. University Practical Exam: 40 Marks (Evaluation of Traditional Engineering Graphics part of 20 Marks should be based upon written test by External Practical Examiner & Evaluation of Computer Graphics part of 20 marks should be based upon lab performance using computer graphics software & viva voce by External Practical Examiner)

Internal Assessment:

1. 60 Marks (20 marks for day to day work, 20 marks for written test & 20 marks for internal viva voce)

Semester 2nd

Course code	**BTCH101-18**				
Category	**Basic Science Course**				
Course title	**Chemistry-I (Theory)**				
	Contents				
	(i) Chemistry-I (Concepts in chemistry for engineering)				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester –II**
	3	**1**	**0**	**4**	
Pre-requisites (if any)	**-**				

(i)Chemistry-I (Concepts in chemistry for engineering) [L : 3; T:1; P : 0 (4 credits)]

Detailed contents

(i) Atomic and molecular structure (12 lectures)

Schrodinger equation. Particle in a box solutions and their applications for conjugated molecules and nanoparticles. Forms of the hydrogen atom wave functions and the plots of these functions to explore their spatial variations. Molecular orbitals of diatomic molecules and plots of the multicenter orbitals. Equations for atomic and molecular orbitals. Energy level diagrams of diatomic. Pi-molecular orbitals of butadiene and benzene and aromaticity. Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties. Band structure of solids and the role of doping on band structures.

(ii) Spectroscopic techniques and applications (8 lectures)

Principles of spectroscopy and selection rules. Electronic spectroscopy. Fluorescence and its applications in medicine. Vibrational and rotational spectroscopy of diatomic molecules. Applications. Nuclear magnetic resonance and magnetic resonance imaging, surface characterisation techniques. Diffraction and scattering.

(iii) Intermolecular forces and potential energy surfaces (4 lectures)

Ionic, dipolar and van Der Waals interactions. Equations of state of real gases and critical phenomena. Potential energy surfaces of H_3, H_2F and HCN and trajectories on these surfaces.

(iv) Use of free energy in chemical equilibria (6 lectures)

Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies. Free energy and emf. Cell potentials, the Nernst equation and applications. Acid base, oxidation reduction and solubility equilibria. Water chemistry. Corrosion.

Use of free energy considerations in metallurgy through Ellingham diagrams.

(v) Periodic properties (4 Lectures)

Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries

(vi) Stereochemistry (4 lectures)

Representations of 3 dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis. Isomerism in transitional metal compounds

(vii) Organic reactions and synthesis of a drug molecule (4 lectures)

Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings. Synthesis of a commonly used drug molecule.

Suggested Text Books

(i) University chemistry, by B. H. Mahan
(ii) Chemistry: Principles and Applications, by M. J. Sienko and R.A. Plane
(iii) Fundamentals of Molecular Spectroscopy, by C. N. Banwell
(iv) Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan
(v) Physical Chemistry, by P. W. Atkins
(vi) Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore, 5th Edition http://bcs.whfreeman.com/vollhardtschore5e/default.asp

Course Outcomes

The concepts developed in this course will aid in quantification of several concepts in chemistry that have been introduced at the 10+2 levels in schools. Technology is being increasingly based on the electronic, atomic and molecular level modifications.

Quantum theory is more than 100 years old and to understand phenomena at nanometer levels, one has to base the description of all chemical processes at molecular levels. The course will enable the student to:

- Analyse microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces.
- Rationalise bulk properties and processes using thermodynamic considerations.
- Distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques.
- Rationalise periodic properties such as ionization potential, electronegativity, oxidation states and electronegativity.
- List major chemical reactions that are used in the synthesis of molecules.

Course code	**BTCH102-18**
Category	**Basic Science Course**
Course title	**Chemistry-I (Lab.)**
	Contents

	(ii) Chemistry Laboratory				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester –II**
	0	**0**	**3**	**1.5**	
Pre-requisites (if any)	**-**				

(ii)Chemistry Laboratory [L : 0; T:0 ; P : 3 (1.5 credits)]

Choice of 10-12 experiments from the following

- Determination of surface tension and viscosity
- Thin Layer Chromatography
- Ion exchange column for removal of hardness of water
- Colligative properties using freezing point depression
- Determination of the rate constant of a reaction
- Determination of cell constant and conductance of solutions
- Potentiometry-determination of redox potentials and emf
- Synthesis of a polymer/drug
- Saponification/acid value of an oil
- Chemical analysis of a salt
- Lattice structures and packing of spheres
- Models of potential energy surfaces
- Chemical oscillations- Iodine clock reaction
- Determination of the partition coefficient of a substance between two immiscible liquids
- Adsorption of acetic acid by charcoal
- Use of the capillary viscometers to the demonstrate of the isoelectric point as the pH of minimum viscosity for gelatin sols and/or coagulation of the white part of egg.

Laboratory Outcomes

The chemistry laboratory course will consist of experiments illustrating the principles of chemistry relevant to the study of science and engineering. The students will learn to:

- Estimate rate constants of reactions from concentration of reactants/products as a function of time
- Measure molecular/system properties such as surface tension, viscosity, conductance of solutions, redox potentials, chloride content of water, etc
- Synthesize a small drug molecule and analyse a salt sample

Course code	BTPS101-18				
Category	EngineeringScienceCourse				
Coursetitle	**Programmingfor ProblemSolving (Theory)**				
Schemeand Credits	**L**	**T**	**P**	**Credits**	Semester –II [Thelab component should have onehourof tutorial followed or preceded bylaboratory assignments.]
	3	**0**	**0**	**3**	
Pre-requisites (if any)	**-**				

(i)ProgrammingforProblemSolving([L: 3; T:0;P :0 (3credits)]
[contacthrs:40]

Detailedcontents

Unit 1

Introduction to Programming **(4 lectures)**

Introduction to components of a computer system(disks, memory, processor, wherea program is stored andexecuted, operatingsystem, compilers etc.)–
(1 lecture).

IdeaofAlgorithm: steps to solvelogical and numerical problems. Representation of Algorithm: Flowchart/Pseudocodewith examples.**(1 lecture)**

From algorithms to programs;source code, variables (with datatypes) variables and memory locations, SyntaxandLogical Errors in compilation, object and executablecode-**(2 lectures)**

Unit 2

Arithmetic expressions and precedence**(2 lectures)**
Conditional BranchingandLoops**(6lectures)**
Writingand evaluation of conditionals and consequent branching **(3lectures)**
Iteration and loops**(3 lectures)**

Unit 3

Arrays **(6lectures)**
Arrays (1-D, 2-D), Characterarraysand Strings

Unit 4

Basic Algorithms**(6 lectures)**
Searching,Basic Sorting Algorithms (Bubble,Insertion and Selection), Findingroots of equations, notion of order of complexitythrough exampleprograms (noformal definition required)

Unit 5

Function **(5lectures)**
Functions (includingusingbuilt in libraries), Parameter passingin functions, callbyvalue, Passingarrays to functions: ideaof callbyreference

Unit 6
Recursion **(4 -5 lectures)**
Recursion, as adifferent wayof solvingproblems.Exampleprograms, suchas Finding Factorial, Fibonacci series, Ackermanfunction etc. Quick sort orMergesort.

Unit 7
Structure**(4lectures)**
Structures, Definingstructures and Arrayof Structures

Unit 8
Pointers **(2lectures)**
Ideaof pointers, Definingpointers, Useof Pointers in self-referential structures, notion of linked list (no implementation)

Unit 9
Filehandling(onlyif timeisavailable, otherwiseshould bedone as part ofthe lab)

Suggested Text Books
(i) Byron Gottfried, Schaum's Outline ofProgrammingwith C, McGraw-Hill
(ii)E. Balaguruswamy, Programmingin ANSIC, TataMcGraw-Hill

SuggestedReferenceBooks
(i) Brian W. Kernighan andDennis M. Ritchie, TheC Programming Language, Prentice Hall of India.

CourseOutcomes

Thestudentwilllearn
To formulatesimple algorithms for arithmetic andlogical problems.
To translatethe algorithms to programs (in Clanguage).
To test and execute theprograms and correct syntaxand logical errors.
To implement conditional branching, iteration andrecursion.
To decomposeaprobleminto functions and synthesizea complete program using divide and conquerapproach.
To use arrays, pointers andstructures to formulate algorithms and programs.
To applyprogrammingto solve matrixaddition and multiplication problems and searching and sortingproblems.
To applyprogrammingto solve simple numericalmethod problems, namelyrot findingoffunction, differentiation offunction andsimple integration.

Course code	BTPS102-18				
Category	EngineeringScienceCourse				
Coursetitle	**Programmingfor ProblemSolving (Lab)**				
Schemeand Credits	**L**	**T**	**P**	**Credits**	Semester –II [Thelab component should have onehourof tutorial followed or preceded bylaboratory assignments.]
	0	**0**	**4**	**2**	
Pre-requisites (if any)	**-**				

(ii) Laboratory -Programming forProblemSolving[L:0; T:0; P:4(2credits)]
[Thelaboratory shouldbeprecededorfollowedby a tutorialto explaintheapproachor algorithmto be implemented fortheproblemgiven.]

Tutorial1: Problem solvingusingcomputers:
Lab1: Familiarization with programming environment

Tutorial2: Variable types and type conversions:
Lab2: Simple computational problems usingarithmetic expressions

Tutorial3: Branching and logicalexpressions:
Lab3: Problems involvingif-then-else structures

Tutorial4: Loops, whileand for loops:
Lab4: Iterativeproblems e.g., sum of series

Tutorial5: 1D Arrays: searching, sorting:
Lab5: 1D Arraymanipulation

Tutorial 6: 2D arraysand Strings
Lab6: Matrixproblems,Stringoperations

Tutorial7: Functions, callbyvalue:
Lab7: Simple functions

Tutorial8 &9: Numerical methods (Root finding, numerical differentiation, numerical integration):
Lab8 and9: Programmingfor solvingNumericalmethods problems

Tutorial10: Recursion, structureof recursive calls
Lab10: Recursivefunctions

Tutorial11: Pointers, structures and dynamicmemoryallocation
Lab11: Pointers and structures

Tutorial12: Filehandling:
Lab12: Fileoperations

Laboratory Outcomes

To formulatethe algorithms forsimple problems
To translategiven algorithms to a working and correct program
To be able to correct syntaxerrors as reported bythe compilers
To be able to identifyand correct logical errors encounteredat run time
To be able to writeiterative as wellas recursiveprograms
Tobeabletorepresentdatainarrays,stringsandstructuresandmanipulatethem through aprogram
Tobeabletodeclarepointersofdifferenttypesandusethemindefiningself referential structures.
To be able to create,readand writeto and from simple text files.

Course code	BTMP101-**19**				
Category	Engineering Science Courses				
Course title	Workshop/Manufacturing Practices (Theory & Lab.)				
Scheme and Credits	L	T	P	Credits	Semester-II
	1	0	**6**	**4**	
Pre-requisites (if any)	-				
	Common to all branches				

Workshop/Manufacturing Practices [[L:1;T:0;P:0(1credit)]
Lectures & videos: (10 hours)

Detailed contents

1. ManufacturingMethods-casting,forming,machining,joining,advancedmanufacturing methods (3lectures)
2. CNC machining, Additive manufacturing (1lecture)
3. Fitting operations & power tools (1lecture)
4. Electrical &Electronics (1lecture)
5. Carpentry (1lecture)
6. Plastic moulding, glass cutting (1lecture)
7. Metal casting (1lecture)
8. Welding (arc welding & gas welding), brazing (1lecture)

Suggested Text/Reference Books:

(i) Hajra Choudhury S.K., Hajra Choudhury A.K. and NirjharRoy S.K., " Elementsof Workshop Technology" , Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited,Mumbai.
(ii) Kalpakjian S. And Steven S. Schmid, " Manufacturing Engineering and Technology" , 4th edition, Pearson Education India Edition,2002.
(iii) Gowri P. Hariharan and A. Suresh Babu," Manufacturing Technology – I" Pearson Education,2008.
(iv) Roy A. Lindberg, " Processes and Materials of Manufacture", 4thedition, Prentice Hall India,1998.
(v) Rao P.N., " Manufacturing Technology" , Vol. I and Vol. II, Tata McGrawHill House, 2017.

Course Outcomes

Upon completion of this course, the students will gain knowledge of the different manufacturing processes which are commonly employed in the industry, to fabricate components using different materials.

(ii) Workshop Practice:(90hours)[L : 0; T:0 ; P : 6 (3credits)]

1. **Machine shop (15hours)**
2. **Fitting shop (12hours)**
3. **Carpentry (9hours)**
4. **Electrical &Electronics(12hours)**
5. **Welding shop (12 hours (Arc welding 6 hrs + gas welding 6hrs)**
6. **Casting (12 hours)**
7. **Smithy (9hours)**
8. **Plastic moulding& Glass Cutting (9hours)**

Examinations could involve the actual fabrication of simple components, utilizing one or more of the techniques coveredabove.

LaboratoryOutcomes

- Upon completion of this laboratory course, students will be able to fabricate components with their ownhands.
- They will also get practical knowledge of the dimensional accuracies and dimensional tolerances possible with different manufacturing processes.
- By assembling different components, they will be able to produce small devices of theirinterest.

BTHU-101-18 English 2L: 0T: 0P 2 credits

Course Outcomes:

- The objective of the course is to help the students become the independent users of English language.
- Students will acquire basic proficiency in reading & listening, comprehension, writing and speaking skills.
- Students will be able to understand spoken and written English language, particularly the language of their chosen technical field.
- They will be able to converse fluently.
- They will be able to produce on their own clear and coherent texts.

Detailed contents

Unit-1 Vocabulary Building & Basic Writing Skills

- The concept of Word Formation
- Root words from foreign languages and their use in English
- Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives.
- Synonyms, antonyms, and standard abbreviations.
- Sentence Structures
- Use of phrases and clauses in sentences
- Importance of proper punctuation
- Creating coherence
- Organizing principles of paragraphs in documents
- Techniques for writing precisely

Unit-2 Identifying Common Errors in Writing

- Subject-verb agreement
- Noun-pronoun agreement
- Misplaced modifiers
- Articles
- Prepositions
- Redundancies
- Clichés

Unit-3 Mechanics of Writing

- Writing introduction and conclusion
- Describing
- Defining

- Classifying
- Providing examples or evidence

Unit-4 Writing Practices

- Comprehension
- Précis Writing
- Essay Writing
- Business Writing-Business letters, Business Emails, Report Writing, Resume/CV

Suggested Readings:

(i) *Practical English Usage*. Michael Swan. OUP. 1995.

(ii) *Remedial English Grammar*. F.T. Wood. Macmillan.2007

(iii) *On Writing Well*. William Zinsser. Harper Resource Book. 2001

(iv) *Study Writing*. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.

(v) *Communication Skills*. Sanjay Kumar and Pushp Lata. Oxford University Press. 2011.

(vi) *Exercises in Spoken English*. Parts. I-III. CIEFL, Hyderabad. Oxford University Press

BTHU-102-18 (English Laboratory)

0L: 0T: 2P 1 credit

Course Outcomes:

- The objective of the course is to help the students become the independent users of English language.
- Students will acquire basic proficiency in listening and speaking skills.
- Students will be able to understand spoken English language, particularly the language of their chosen technical field.
- They will be able to converse fluently
- They will be able to produce on their own clear and coherent texts.

Detailed contents

Interactive practice sessions in Language Lab on Oral Communication

- Listening Comprehension
- Self-Introduction, Group Discussion and Role Play
- Common Everyday Situations: Conversations and Dialogues
- Communication at Workplace
- Interviews
- Formal Presentations

Suggested Readings:

(i) *Practical English Usage*. Michael Swan. OUP. 1995.

(ii) *Communication Skills*. Sanjay Kumar and Pushp Lata. Oxford University Press. 2011.

(iii)*Exercises in Spoken English*. Parts. I-III. CIEFL, Hyderabad. Oxford University Press

3rd Sem Syllabus

Third Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
1	Professional Core courses	BTCE-301-18	**Surveying & Geomatics**	3	1	0	4

External Marks: 60, Internal Marks: 40, Total Marks: 100

Course Outcome

The course will enable the students to:

1. Understand the concept, various methods and techniques of surveying
2. Compute angles, distances and levels for given area
3. Apply the concept of tachometry survey in difficult and hilly terrain.
4. Select appropriate instruments for data collection and survey purpose
5. Analyze and retrieve the information from remotely sensed data and interpret the data for survey.
6. Understand the concepts related to GIS and GPS and analyze the geographical data.

Content

Unit-I:*Introduction to Surveying*: Principles, Survey stations, Survey lines- ranging, direct &indirect ranging, Bearing and its measurement with prismatic compass, calculation of angles from bearings, Local Attraction Levelling:, Principles of levelling- booking and reducing levels; differential, reciprocal leveling, profile levelling and cross sectioning. Digital and Auto Level, Errors in levelling; contouring: Characteristics, methods, uses; areas and volumes. Setting up the plane table and methods of plane tabling(Radiation and three point problem only).

Unit-II:*Triangulation and Trilateration*: Theodolite survey: Instruments, Measurement of horizontal and vertical angle; Balancing of Traverse, Omitted Measurements, Tachometry: Definition, determination of tachometer constants and reduced level from tachometric observations. Triangulation - network- Signals. Baseline - choices - extension of base lines - corrections - Trigonometric leveling .

Unit-III:*Curves*: Elements of simple and compound curves – Method of setting out Transition curve – length of curve – Elements of transition curve.

Photogrammetry Surveying: Introduction, Basic concepts, flight planning; Stereoscopy, photographic mapping- mapping using paper prints, mapping using stereoplotting instruments, mosaics, map substitutes.

Unit-IV:*Modern Field Survey Systems*: Principle of Electronic Distance Measurement, Modulation, Types of EDM instruments, Distomat, Total Station – Parts of a Total Station – Accessories –Advantages and Applications,Field Procedure for total station survey, Errors in Total Station Survey; Global Positioning Systems- Segments, GPS measurements, errors and biases, Surveying with GPS, LADAR (drone and vehicle based)

Remote Sensing: Introduction –Electromagnetic Spectrum, interaction of electromagnetic radiation with the atmosphere and earth surface, remote sensing data acquisition: platforms and sensors.

Refernces& Books

1. Duggal, S.K., Surveying Vol I & II, Tata McGraw Hill
2. Punmia, B.C., Jain, Ashok Kumar and Jain, Arun Kumar, Surveying Vol. I, II& III, Laxmi Publications
3. Agor, R., Surveying, Khanna Publishers
4. Bhavikatti, S.S. Surveying & Levelling Volume I & II

S. No.	Category	Code	Course Title	Hours per week			Credits
				L	T	P	
2	Professional Core courses#	BTCE-302-18	**Solid Mechanics**	3	0	0	3

External Marks: 60, Internal Marks: 40, Total Marks: 100

Course Outcomes

1. Understand the concept of static equilibrium, deformations, and material constitutive behaviour.
2. Describe the concepts of stress, strain and elastic behaviour of materials including Hooke's law relationships to analyze structural members subjected to tension, compression and torsion.
3. Apply the concept of Mohr's circle in the stress/strain calculations.
4. Develop SFD and BMD for different type of beams subjected to different types of loads
5. Plot elastic curves for beams undergoing displacements under different loadings
6. Understand the behaviour of columns and struts under axial loading.

Content

Unit-I: ***Concept of Equilibrium****:* Loads, supports, reactions, displacements; General equilibrium equations; Equilibrium of a point and a member; Concept of free body diagram; Statical determinacy of a problem.

Stresses and Strains*:* Concept of stress and strain; Type of stresses and strains; Stress-strain diagrams for ductile, brittle materials; Generalized Hooke's law; Concept of working stress and factor of safety; Lateral strain, Poisson's ratio and Volumetric strain; Elastic moduli and relationship between them; Bars of varying section, composite bars, thermal stresses.

Unit-II:***Principal Stressres and Strains:***Concept of principal stresses, principal strains and principal planes; use of Mohr circle in computation of stresses and strains; Rectangular block subjected to normal stress along and across two planes, combination of normal and tangential stressalsowith shear stress.

Shear Force and Bending Moment Diagrams*:* Introduction to the concept of shear force, bending moment and the sign convention; Shear force and bending moment diagrams for cantilever, simply supported and overhang beams subjected to point loads, uniformly distributed loads, uniformly varying loads, moments or their combination, point of contra flexure.

Unit-III: 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..

Bending and Shear Stresses: Assumptions - theory of simple bending; Derivation of bending equation; Centroid and section modulus of various cross sectional shapes including rectangular, circular, I, channel, angle etc.; Determination of bending stresses, bending stress distribution across various beam sections; Determination of shear stress, shear stress distribution across various beam sections.

Unit-IV: ***Columns and Struts****:* Stability of Columns; buckling load of axially loaded columns with various end conditions; Euler's and Rankine's formula; Columns under eccentric load, lateral load.

Torsion of Circular Shafts*:* Derivation of torsion equation and its assumptions, application of equation to circular shafts; combined torsion and bending of circular shafts, principal stress and maximum shear stress under combined loading of torsion and bending.

Stresses and strains in thin cylinders :spherical shells subjected to internal pressures; Normal stress, tangential stress.

Text/Reference Books

1. 'Elements of Strength of Materials', Timoshenko, S. and Young, D. H., DVNC, New York, USA.
2. 'Solid Mechanics', Kazmi, S. M. A., TMH, New Delhi.
3. 'Mechanics of Materials', Hibbeler, R. C., Pearson Prentice Hall.
4. 'An Introduction to the Mechanics of Solids', Crandall, S. H., N. C. Dahl, and T. J. Lardner, McGraw Hill.
5. 'Mechanics of Materials', Ferdinand P. Beer, E. Russel Jhonston Jr. and John T. D. Ewolf, TMH.
6. 'Strength of Materials', James M. Gere and Barry J. Goodno, Cengage Learning India Pvt. Ltd., New Delhi.
7. 'Strength of Materials', R. Subramanian, Oxford University Press, New Delhi.

S. No.	Category	Code	Course Title	Hours per week			Credits
				L	T	P	
3	Professional Core courses #	BTCE-303-	**Fluid Mechanics**	3	0	0	3

External Marks: 60, Internal Marks: 40, Total Marks: 100

Course Outcomes

After completion of the course, student is able to

1. Understand the basic terms used in fluid mechanics and its broad principles
2. Estimate the forces induced on a plane/ submerged bodies
3. Formulate expressions using dimensionless approach and able to determine design parameters by creating replica of prototype at appropriate scale.
4. Apply the continuity, momentum and energy principles and design the pipelines used for water supply or sewage under different situation.
5. Calculate drag force exerted by fluid on the body of varying shapes and able to minimize them.
6. Design and addressing problems in open channel (lined/ unlined) of different shapes and size optimally as per site condition.

Content

Unit-I: ***Basic Concepts and Definitions*** – Distinction between a fluid and a solid; Density, Specific weight, Specific gravity, Kinematic and dynamic viscosity; variation of viscosity with temperature, Newton law of viscosity; surface tension, capillarity, Bulk modulus of elasticity, compressibility.

Fluid Statics - Fluid Pressure: Pressure at a point, Pascals law, Piezometer, U-Tube Manometer, U-Tube Differential Manometer, Micromanometers. pressure gauges, Hydrostatic pressure and force: horizontal, vertical and inclined surfaces. Buoyancy and stability of floating bodies.

Unit-II:*Fluid Kinematics*- Classification of fluid flow : steady and unsteady flow; uniform and non-uniform flow; laminar and turbulent flow; rotational and irrotational flow; compressible and incompressible flow; ideal and real fluid flow; one, two and three dimensional flows; Stream line, path line, streak line and stream tube; stream function, velocity potential function. One-, two- and three -dimensional continuity equations in Cartesian coordinates

Fluid Dynamics **-** Surface and body forces; Equations of motion - Euler's equation; Bernoulli's equation – derivation; Energy Principle; Practical applications of Bernoulli's equation : venturimeter, orifice meter and pitot tube; Momentum principle; Forces exerted by fluid flow on pipe bend; Dimensional Analysis and Dynamic Similitude - Definitions of Reynolds Number, Froude Number, Mach Number, Weber Number and Euler Number; Buckingham's π-Theorem.

Unit-III:*Laminar Flow & Turbulent Flow* - Laminar flow through: circular pipes, parallel plates. Stoke'slaw, Reynolds experiment, Transition from laminar to turbulent flow. Prandtl's mixing length theory, universal velocity distribution equation. Resistance to flow of fluid in smooth and rough pipes, Moody's diagram. 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

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.

Unit-IV:*Open Channel Flow*- Introduction, Comparison between open channel flow and pipe flow, geometrical parameters of a channel, Uniform Characteristics of uniform flow, Chezy's formula, Manning's formula. Most economical section of channel. Specific energy, Specific energy curve, critical flow, discharge curve Specific force Specific depth, and Critical depth. Channel Transitions. 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.

References:

1. Fluid Mechanics & Hydraulic Machines : Dr. R.K. Bansal
2. Hydraulic and Fluid Mechanic by P.N. Modi & S.M. Seth
3. Engineering Fluid Mechanics by R.J. Garde & A.G. Mirajgaoker
4. Fluid Mechanics by Douglas JF, Gasiorek JM, Swaffield JP; Pitman
5. Fluid Mechanics: Streetes VL & Wylie EB;
6. Fluid Mechanics by Potter, Cengage Learning

S. No.	Category	Code	Course Title	Hours per week			Credits
				L	T	P	
4	Basic Science Course	BTAM-301-18	**Mathematics-III (Transform & Discrete Mathematics)**	4	1	0	4

External Marks: 60, Internal Marks: 40, Total Marks: 100

Course Outcomes:

1. Understand the basic results on vector function, their properties and fields so as to apply them for solving problems of engineering.

2. Find length, area and volume using integral calculus that is an important application in engineering.

3. Solve some real problems in engineering using Gauss Divergence and Stokes' theorem

4. To formulate Laplace transform of functions and its applications to solve differential equations that form real life problems in engineering.

5. To formulate Fourier Series, its properties and its applications to solve problems in engineering.

Detailed Content

Section A **(20 lectures)**

Unit I: ***Vector Calculus-I:***Scalar and Vector point function, Gradient, Directional derivatives, Divergence, Curl and their identities, line, surface, volume integrals and their applications, Solenoidal and Irrotational fields.

Unit II: ***Vector Calculus-II*:**Applications of Green, Gauss and Stokes Theorems, orthogonal curvilinear coordinates, Simple applications involving cubes, sphere and rectangular parallelepipeds.

Section B **(20 lectures)**

Unit III: ***Transforms Calculus-I*:**Laplace Transform, Properties of Laplace Transform, Laplace Transform of Unit step function, Impulse function, Dirac-delta function, Periodic functions. Inverse Laplace Transform, convolution theorem, Evaluation of integrals by Laplace Transform, Applications to ODEs and PDEs.

Unit IV :***Transforms Calculus-II*:** Fourier Series, half range Fourier Sine and Cosine series, Fourier integrals, Gibbs Phenomenon, Fourier transforms, Relation between Laplace and Fourier transform, Properties of Fourier Transforms, Convolution Theorem and applications

Textbooks/References:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.
3. Veerarajan T., Engineering Mathematics, Tata McGraw-Hill, New Delhi, 2008.
4. Thomas and Finney, Calculus and Analytic Geometry, 9th Edition, Pearson, 2017.
5. R. K. Jain and S.R.K Iyengar Advanced Engineering Mathematics, 5th Edition, 2017.

S. No.	Category	Code	Course Title	Hours per week			Credits
				L	T	P	
5	Engineering Science Course	BTEC- 305-18	**Basic Electronics & applications in Civil Engineering**	3	0	0	3

External Marks: 60, Internal Marks: 40, Total Marks: 100

Course Objectives:
The objective of this Course is to provide the students with an introductory and broad treatment of the field of Electronics Engineering to facilitate better understanding of the Devices, Instruments and Sensors used in Civil Engineering applications in subsequent courses.

Course Outcomes:
After undergoing this course students will be able to

1. Understand construction of diodes and their rectifier applications.
2. Appreciate the construction and working bipolar junction transistors and MOSFETs.
3. Design Op-Amp IC based fundamental applications.
4. Comprehend working of basic elements of digital electronics and circuits.

Unit I: **SemiconductorDiodes and Applications**- Semiconductor Diode - Ideal versus Practical, 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;

Unit II:**Transistors & Amplifiers**- Bipolar Junction Transistor (BJT) – Construction, Operation, Common Base, Common Emitter and Common Collector Configurations, Distortion, Operating Point, Voltage Divider Bias Configuration; Introduction to nMOS and pMOS.

Unit III: Operational Amplifiers and Applications - Introduction to Op-Amp, Block Diagram, Pin Configuration of 741 Op-Amp, Characteristics of Ideal Op-Amp, Concept of Virtual Ground, Op-Amp Applications – Adder, Subtractor, Voltage Follower and Comparator; Differentiator and Integrator, Square Wave and Triangular Wave Generation.

Unit IV: Digital Electronics -Boolean Algebra - Binary, Octal, Hexadecimal Number Systems, Addition, Subtraction using 1's and 2's compliment method,Logic Gates – NOT, OR, AND, NOR, NAND, XOR and XNOR Integrated Circuits (ICs); K-Map simplification Truth Tables and Functionality of Flip-Flops – SR, JK and D Flip-Flop.

Text/Reference Books:

1.David. A. Bell (2003), Laboratory Manual for Electronic Devices and Circuits, Prentice Hall, India.

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

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

4.Paul B. Zbar, A.P. Malvino and M.A. Miller (2009), Basic Electronics – A Text-Lab. Manual, TMH

5.R. T. Paynter (2009), Introductory Electronic Devices & Circuits, Conventional Flow Version, Pearson.

S. No.	Category	Code	Course Title	Hours per week			Credits
				L	T	P	
6	Humanities and Social Sciences including Management	HSMC-132-18	**Civil Engineering- Introduction, Societal & Global Impact**	3	0	0	3

External Marks: 60, Internal Marks: 40, Total Marks: 100

Course Outcomes

1. Introduction to what constitutes Civil Engineering
2. Understanding the vast interfaces this field has with the society at large
3. Providing inspiration for doing creative and innovative work for the benefit of the society
4. Need to think innovatively to ensure Sustainability
5. Highlighting the depth of engagement possible within civil engineering and exploration of various possibilities of a career in this field

Content

Unit I: ***Civil Engineering and its historical developments;*** Understanding the importance of Civil Engineering in shaping and impacting the world; the ancient and modern Marvels and Wonders in the field of Civil Engineering; Scope of work involved in various branches of Civil Engineering and future vision; Recent Civil Engineering breakthroughs and innovations; Avenues for entrepreneurial working.

Unit II: ***Understanding the past to look into the future***; Pre-industrial revolution days, Agricultural revolution, first and second industrial revolutions, IT revolution and how these eras helped the civil engineering to grow; Concept of sustainability and the steady erosion of the environment due to haphazard developments; Global warming, its impact and possible causes; Atmospheric pollution; Pollution Mitigation measures; Health & Safety aspects for stakeholders; Environmental Impact Analysis: Concept and procedures; Innovations and methodologies for ensuring Sustainability.
Unit III: ***Infrastructure development and growth of the Nation***; its effects on the GDP, employment, living standards of the people, etc.; Introduction and overview to Futuristic systems: Megacities, Smart Cities, Stadia; Roads, Railways, Metros, Hyper Loop, Airports, Seaports, River ways, Sea canals, Tunnels, bridges.
Unit IV: ***Energy Generation***: Hydro, Solar, Wind, Wave, Tidal, Geothermal, Thermal energy; Telecommunication needs: towers, above-ground and underground cabling; Flood control: Dams, Canals, River interlinking; Energy efficient built-environments and LEED ratings; Awareness of various Codes & Standards governing Infrastructure development.

Suggested Readings

1 Salvadori, M and Heller, M, Strctures in Architectures, PHI.
2. Fintel, C, Handbook of Civil Engineering, CBS Publications.
3. *Ž iga*Turk (2014), Global Challenges and the Role of Civil Engineering, Chapter 3 in:Fischinger M. (eds) Performance-Based Seismic Engineering: Vision for an Earthquake Resilient Society. Geotechnical, Geological and Earthquake Engineering, Vol. 32. Springer, Dordrecht
4.Brito, Ciampi, Vasconcelos, Amarol, Barros (2013) Engineering impacting Social, Economical and Working Environment, 120th ASEE Annual Conference and Exposition
5.NAE Grand Challenges for Engineering (2006), Engineering for the Developing World, The Bridge, Vol 34, No.2, Summer 2004

S. No.	Category	Code	Course Title	Hours per week			Credits
				L	T	P	
7	Professional Core courses	BTCE-306-18	**Surveying & Geomatics Lab**	0	0	2	1

External Marks: 20, Internal Marks: 30, Total Marks: 50

Course Outcomes

After completing the course the students must demonstrate the knowledge and ability to:

1. Assess horizontal & vertical angles by Theodolite.
2. Survey the area using different methods of plane tabling and compass survey and to adjust the compass traverse graphically.
3. Compute the reduce levels using various methods of leveling.
4. Predict the location of any point horizontally and vertically using Tachometry.
5. Setting out curves in the field.
6. Use electronic survey instruments.

Course Content

1. Measurement of bearing and angles with compass, adjustment of traverse by graphical method.
2. Different methods of levelling, height of instrument, rise & fall methods.
3. Measurement of horizontal and vertical angle by theodolite.
4. Determination of tachometric constants and determination of reduced levels by tachometric observations.
5. Plane table survey, different methods of plotting, Three point problem.
6. Determination of height of an inaccessible object.
7. Setting out of circular curves in the field using different methods.
8. Plotting of traverse using the Total Station and GPS.

S. No.	Category	Code	Course Title	Hours per week			Credits
				L	T	P	
8	Professional Core courses	BTCE-307-18	**Fluid Mechanics Lab**	0	0	2	1

External Marks: 20, Internal Marks: 30, Total Marks: 50

Course Outcome

1 Select appropriate pressure measuring device under different condition of flow.
2 Determine the stability of a floating body.
3 Understand and apply Bernoulli's theorem practically.
4 Find discharge of fluid through pipe, orifices and in open channel.
5 Estimate the major and minor losses in pipe.
6 Estimate the various elements and energy losses in hydraulic jump.

Lab Experiments

1. To study of pressure measuring devices as peizometer, U-tube manometer, and pressure gauges.
2. To verify Bernoulli's Theorem
3. To determine the meta centric height of a of Floating Body under different condition.
4. To determine the coefficient of discharge of a Venturimeter.
5. To determine the coefficient of discharge of a Orifice Meter
6. To determine the coefficient of friction of different diameter pipes.
7. To estimate the minor losses as energy loss in pipe bend, sudden contraction or enlargement in pipe.
8. To determine the coefficient of discharge on rectangular and V-notches.
9. To determine the various element of a hydraulic jump.

Text/Reference Books

1. Fluid Mechanics and Machinery, C.S.P.Ojha, R. Berndtsson and P. N. Chadramouli, Oxford University Press, 2010
2. Hydraulics and Fluid Mechanics, P M Modi and S M Seth, Standard Book House
3. Theory and Applications of Fluid Mechanics, K. Subramanya, Tata McGraw Hill
4. Fluid Mechanics with Engineering Applications, R.L. Daugherty, J.B. Franzini and E.J. Finnemore, International Student Edition, Mc Graw Hill.

S. No.	Category	Code	Course Title	Hours per week			Credits
				L	T	P	
9	Professional Core courses	BTCE-308-18	**Solid Mechanics Lab**	0	0	2	1

External Marks: 20, Internal Marks: 30, Total Marks: 50

Course Outcomes

1. Understand the importance of physical properties of steel.
2. Identify and comprehend code provisions for testing different properties of steel.
3. Develop stress-strain curve for axial compression, axial tension and shear.
4. Assess hardness and impact strength of steel.
5. Assess flexural strength of a given material.
6. Evaluate fatigue and impact strength of steel.

Content

1.Determination of physical properties of steel including strength and ductility.
2.Study of tensile and compressive stress-strain behaviour of steel.
3.Compression test on brick.
4.Development of shear stress-strain curve for steel in torsion.
5.Determination of hardness of a material by Rockwell and Brinell hardness testing machine.
6.Determination of impact strength of a material by Izod and Charpy tests.
7.Determination of bending strength of a wooden beam specimen.
8.Determination of fatigue strength of a material.
9. Study of behaviour of columns and struts with different end conditions.
10. To veify the moment area theorm for slope and deflection of a given beam.

Text/Reference Books

1.Laboratory Manual of Testing Materials, William Kendrick Hall

S. No.	Category	Code	Course Title	Hours per week			Credits
				L	T	P	
10	Professional core	BMPD-301-18	**Mentoring and professional development**	-	-	2	0

Guidelines regarding Mentoring and Professional Development

The objective of mentoring will be development of:

- Overall Personality
- Aptitude (Technical and General)
- General Awareness (Current Affairs and GK)
- Communication Skills
- Presentation Skills

The course shall be split in two sections i.e. outdoor activities and class activities. For achieving the above, suggestive list of activities to be conducted are:

Part – A (Class Activities)

1. Expert and video lectures
2. Aptitude Test
3. Group Discussion
4. Quiz (General/Technical)
5. Presentations by the students
6. Team building Exercises

Part – B (Outdoor Activities)

1. Sports/NSS/NCC
2. Society Activities of various students chapter i.e. ISTE, SCIE, SAE, CSI, Cultural Club, etc.

Evaluation shall be based on rubrics for Part – A & B.
Mentors/Faculty incharges shall maintain proper record student wise of each activity conducted and the same shall be submitted to the department.

S. No.	Category	Code	Course Title	Hours per week			Credits
				L	T	P	
10	Skill Enhancement	BTCE-332-18	**Training -I**	-	-	4	1

External Marks: 40, Internal Marks: 60, Total Marks: 100

Course Outcomes:

After completing this course the student must demonstrate the ability to:

1. Visulize things/ concepts and express the thoughts in the form of sketchs, models, etc
2. Create a well organized document using computers
3. Work in teams
4. Acknowledge the work of other in a consistent manner
5. Understanding of ethical and professional issues
6. Demonstrate effective oral communication and presentation skills

Content

Module I – Instititionl Training (3 weeks)

1. Hands-on-training on MS Office/ Office suite (Word processor, Spreadsheet, Math tools, presentation/ ppt, etc.)

2. Introduction to Civil Engineering softwares and basic overview of drafting tools such as AutoCad, etc.

Module II – Field and Market Study

1. Student shall visit construction site of significantly scale and make an inventory construction and finishing materials being used.

2. Student shall do Market Survey for availability and rates of materials in the already prepared inventory.

Note:

1. The students need to submit a summary report of the institunal training in Module I, and A detailed report/ scrapbook ofnventory and market survey done in Module II.

2. The viva exam for the subject will be conducted alongwith the practical exams of the End-Semster Examination of Third Semester.

4th Sem Syllabus

S. No.	Category	Code	Course Title	Hours per week			Credits
				L	T	P	
1	Professional Core courses	BTCE-401-18	**Concrete Technology**	3	0	0	3

External Marks: 60, Internal Marks: 40, Total Marks: 100

Course Outcomes

1. Understand the relevance of different properties of constituent materials on properties of concrete.
2. Understand the behaviour and durability aspects of concrete under different loading and exposure conditions.
3. Understand the issues involved in production and use of concrete.
4. Design of concrete mixes as per BIS specifications.
5. Understand various testing methods for concrete and their applicability.
6. Knowledge of special type of non-conventional concretes.

Content:

Unit I: ***Concrete and its ingredients****:* Properties of cement, aggregate, admixture, water and other additives; Related Indian Standard codes& guidelines.

Concrete behaviour in fresh and hardened states*:* Workability, Elasticity, Shrinkage, Creep, Fatigue, Strength in compression, tension, shear and bond; Influence of various factors on test results; Concrete cracking and type of cracks; Permeability and durability characteristics of concrete including resistance to sulphate & acid attack, alkali-aggregate reaction, freezing and thawing; Fire resistance.

Unit II: ***Production of concrete****:* Mixing, handling, placing, compaction of concrete and related issues; Quality control; Behaviour in extreme environmental conditions like hot weather, cold weather and under water conditions.

Concrete mix design: Basic considerations, proportioning of material, effect of various parameters, trial mixes, Design by IS code.

Unit III: ***Inspection and testing of concrete****:* Defects in concrete; Deterioration of concrete; Strength tests including compressive, split tensile, flexural, pullout etc.; Durability tests including permeability, carbonation, rapid chlorine ion penetration etc.; Destructive and Non-destructive testing of concrete; Acceptance and compliance requirements of concrete as per IS codes.

Unit IV: ***Special concretes:*** Types and specifications; Fibre reinforced and steel reinforced concrete; Polymer concrete; Light weight concrete, High strength concrete, Prestressed concrete, Self Compacting Concrete, Pervious Concrete, Self Healing Concrete.

Text/Reference Books

1. 'Properties of Concrete', A. M. Neville, Prentice Hall
2. 'Concrete Technology', M. S. Shetty, S.Chand& Co.
3. 'Concrete Technology', M. L. Gambhir, Tata McGraw Hill Publishers, New Delhi
4. 'Concrete Technology', A. R. Santha Kumar, Oxford University Press, New Delhi

S. No.	Category	Code	Course Title	Hours per week			Credits
				L	T	P	
2	Professional Core courses	BTCE-402-18	**Materials, Testing & Evaluation**	4	0	0	4

External Marks: 60, Internal Marks: 40, Total Marks: 100

Course Outcomes

1. Appraisal about the role of materials in civil engineering
2. Introduce common measurement instruments, equipments and devices to capture the material response under loading
3. Exposure to a variety of established material testing procedures/techniques and the relevant codes of practice
4. Ability to write a technical laboratory report.

Unit-I: Introduction to Engineering Materials: Types, properties, advantages and uses of: Cement; Concrete; Admixtures; Glass and Plastics; Paints and Varnishes,;Acoustical material; Geo-synthetics, Bitumen and Asphalt; Ceramics and Refractories ;Bricks; Concrete hollow blocks & Interlocking tiles.
Sand: Composition, types, Physical Properties, uses. Fly ash: Source, types, properties and uses Timbers: Properties, Seasoning, defects, preservation methods, laminates and adhesives,
Unit-II: Ferrous and nonferrous metals, Importance of Structural steel; Their characteristics and mechanical behaviour (elastic, plastic and elasto plastic, strength and durability w.r.t Climatic variation); Creep – fundaments and characteristics, concept of fatigue of materials; Impact test, toughness – different materials.
Unit-III: Testing Procedures for bricks, reinforcing steel, fine aggregates, coarse aggregates, Physical identification of tests for soils. Documenting the experimental program, including the test procedures, collected data, method of interpretation and final results.
Unit-IV: Quality control- Use of test data/ testing reports in the material selection for various civil engineering projects /construction, Sampling, Acceptance criterion, Code of practice and guidelines in this regards for Cements; Aggregates; Concrete (plain and reinforced); Soils; Bitumen and asphaltic materials; Timbers; Glass and Plastics; Structural Steel.

Text/Reference Books:

1. Chudley, R., Greeno (2006), 'Building Construction Handbook' (6th ed.),R. Butterworth- Heinemann
2.Khanna, S.K., Justo, C.E.G and Veeraragavan, A, ' Highway Materials and Pavement Testing', Nem Chand& Bros, Fifth Edition
3.Various related updated & recent standards of BIS, IRC, ASTM, RILEM, AASHTO, etc. corresponding to materials used for Civil Engineering applications
4.Kyriakos Komvopoulos (2011), Mechanical Testing of Engineering Materials, Cognella
5.E.N. Dowling (1993), Mechanical Behaviour of Materials,Prentice Hall International Edition
6.American Society for Testing and Materials (ASTM), Annual Book of ASTM Standards
(post 2000)

S. No.	Category	Code	Course Title	Hours per week			Credits
				L	T	P	
3	Professional Core courses	BTCE-403-18	**Hydrology & Water Resources Engineering**	3	1	0	4

External Marks: 60, Internal Marks: 40, Total Marks: 100

Outcomes

At the end of the course, students must be in a position to:

1 Understand the interaction among various processes in the hydrologic cycle.
2 Calculate the average annual rainfall of any area using the rain gauge data and inter-relations of various parameters as infiltration, evapotranspiration etc
3 Understand the various component of hydro graphs and able to estimate the run off.
4 Find the water requirement for different crops and able to proposed appropriate method of applying water.
5 Understand the distribution system of canal and various components of irrigation system.
6 Classify dams and spillways, their problems and able to determine forces exerted by fluid on dams.

Content

Unit I: ***Introduction*** **-** Hydrologic Cycle, History of Hydrology, Water-Budget Equation, , World Water Balance, Applications in Engineering, Sources of Data.

Precipitation **-** Forms of Precipitation, Characteristics of Precipitation in India, Measurement of Precipitation, Rain Gauge Network, Mean Precipitation over an Area, Depth Area-Duration Relationships, Maximum Intensity/Depth-Duration-Frequency Relationship, Probable Maximum Precipitation (PMP), Rainfall Data in India.

Unit II: ***Abstractions from precipitation*** - Evaporation Process, Evaporimeters, Analytical Methods of Evaporation Estimation, Reservoir Evaporation and Methods for its Reduction, Evapotranspiration, Interception, Depression Storage, Infiltration, Infiltration Capacity, Measurement of Infiltration, Modelling Infiltration Capacity, Classification of Infiltration Capacities, Infiltration Indices.

Runoff **-**Runoff Volume, SCS-CN Method of estimating runoff volume, Flow Duration Curve, Flow-Mass Curve, Hydrograph, Factors Affecting Runoff Hydrograph, Components of Hydrograph, Base Flow Separation, Effective Rainfall, Unit Hydrograph Surface Water Resources of India, Environmental Flows.

Unit III: ***Water withdrawals and uses*** **–** Water for Energy Production, Water for Agriculture, Water for Hydroelectric Generation; Flood Control. Analysis of Surface Water Supply, Water Requirement of Crops-Crops and Crop Seasons in India, Cropping Pattern, Duty And Delta; Quality of Irrigation Water; Soil-Water Relationships, 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.

Distribution systems **-** Canal Systems, Alignment of Canals, Canal Losses, Estimation of Design Discharge. Design of Channels- Rigid Boundary Channels, Alluvial Channels, Kennedy's and Lacey's Theory of Regime Channels. Canal Outlets: Non-Modular, Semi-Modular And Modular Outlets.

Unit IV: ***Water Logging****:* Causes, Effects And Remedial Measures. Lining of Canals, Types of Lining. Drainage of Irrigated Lands: Necessity, Methods.

Dams and spillways - embankment dams: Classification, design considerations, estimation and control of seepage, slope protection. Gravity dams: forces on gravity dams, causes of failure, stress analysis, elementary and practical profile. Arch and buttress dams. Spillways: components of spillways, 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.

Text/Reference Books

1. K Subramanya, Engineering Hydrology, Mc-Graw Hill.
2. K N Muthreja, Applied Hydrology, Tata Mc-Graw Hill.
3. K Subramanya, Water Resources Engineering through Objective Questions, Tata McGraw Hill.
4. G L Asawa, Irrigation Engineering, Wiley Eastern
5. L W Mays, Water Resources Engineering, Wiley.
6. J. D Zimmerman, Irrigation, John Wiley & Sons
7. C S P Ojha, R Berndtsson and P Bhunya, Engineering Hydrology, Oxford.

S. No.	Category	Code	Course Title	Hours per week			Credits
				L	T	P	
4	Professional Core courses	BTCE-404-18	**Transportation Engineering**	3	1	0	4

External Marks: 60, Internal Marks: 40, Total Marks: 100

Course Outcomes

After completing this course the student must demonstrate the knowledge and ability to:

1. Appreciate the importance of different modes of transportation and characterize the road transportation.
2. Alignment and geometry of pavement as per Indian Standards according to topography.
3. Assess the properties of highway materials in laboratory
4. Understand the importance of railway infrastructure planning and design.
5. Identify the functions of different component of railway track.
6. Outline the importance of Airport Infrastructure

Course Content

Unit I: ***Introduction:*** Importance of Transportation, Different Modes of Transportation,Characteristics of Road Transport.

Transportation Systems*:* Multi modal transportation system, Characteristics of Mass Transit systems including technical, demand operational and economic problems, fixed Track Facility, Mass Rapid Transit System-Elevated, Surface and Underground construction, Express Bus System, integrated Operating Characteristics of Terminal and Transfer facilities.

Unit II: ***Highway Development & Planning****:* Principles of Highway Planning, Road Development inIndia, Classification of Roads, Road Patterns, Planning Surveys; Highway Construction:Right of way; Earthen/Gravel Road, Water Bound Macadam, Wet Mix Macadam,Bituminous Pavements, Cement Concrete Pavements

Unit III: ***Railway Engineering****:* History of Railways, Development of IndianRailway, Organisation of Indian Railway, Important Statistics of Indian Railways. RailwayGauges: Definition, Gauges on World Railways, Choice of Gauge, Uniformity of Gauge,Loading Gauge, Construction Gauge.

Railway Track*:* Requirements of a Good Track, Track Specifications,Detailed Cross-Section of Single/Double Track used in Indian Railways. Components of permanent way - Rails, Sleepers, Ballast, Sub-grade and Formation, Track Fixtures & Fastenings,Coning of Wheels, Tilting of Rails, Adzing of Sleepers, Rail Joints, Creep of Rails.

Unit IV: ***Airport Engineering*****:**Introduction, Air Transport Scenario in India and Stages ofDevelopment, National and International Organizations; Airport planning - Site selection, runway orientation, etc. Concept of Head Wind, Cross Wind, Wind Rose Diagram, Runway Configuration.

Aircraft Parking System &Visual Aids*:* Main Taxiway, Exit Taxiway, Separation Clearance, Holding Aprons.: Marking and Lighting of Runway and Taxiway, Landing Direction Indicator, and Wind Direction Indicator, IFR/VFR.

References

•Khanna S.K., and Justo, C.E.G. "Highway Engineering", Nem Chand and Brothers, Roorkee,1998.
•Kadiyali, L.R. "Principles and Practice of Highway Engineering", Khanna Publishers, New Delhi, 1997.
•Flaherty, C.A.O. "Highway Engineering", Volume 2, Edward Arnold, London, 1986.
•Sharma, S.K. "Principles, Practice & Design of Highway Engineering", S. Chand & Company Ltd., New Delhi, 1985.
•Mannering, "Principles of Highway Engineering & Traffic Analysis", Wiley Publishers, NewDelhi.

S. No.	Category	Code	Course Title	Hours per week			Credits
				L	T	P	
5	Professional Core courses	BTCE-405-18	**Disaster Preparedness & Planning**	3	0	0	3

External Marks: 60, Internal Marks: 40, Total Marks: 100

Course Outcomes

After completing this course the student must demonstrate the knowledge and ability to:

1. Identify various types of disasters, their causes, effects & mitigation measures.
2. Demonstrate the understanding of various phases of disaster management cycle and create vulnerability and risk maps.
3. Understand the use of emergency management system to tackle the problems.
4. Discuss the role of media, various agencies and organisations for effective disaster management.
5. Design early warning system and understand the utilization of advanced technologies in disaster management.
6. Compare different models for disaster management and plan & design of infrastructure for effective disaster management.

Content

Unit I: ***Introduction to Disaster Management:*** Define and describe disaster, hazard, vulnerability, risk-severity, frequency and details, capacity, impact, prevention, mitigation.

Disasters*:* Identify and describe the types of natural and manmade disasters, hazard and vulnerability profile of India, mountain and coastal areas, Factors affecting vulnerability such as impact of development projects and environment modifications (including dams, land-use changes, urbanization etc.), Disaster impacts (environmental, physical, social, ecological, economic etc.); health, psycho-social issues; demographic aspects (gender,age,special needs), Lessons and experiences from important disasters with specific reference to civil engineering.

Unit II :***Disaster Mitigation and Preparedness:***Disaster Management Cycle-its phases; prevention, mitigation, preparedness, relief and recovery; structural and non structural measures; Preparedness for natural disasters in urban areas.

Risk Assessment*:* Assessment of capacity, vulnerability and risk, vulnerability and risk mapping, stages in disaster recovery and associated problems; Use of Remote Sensing Systems (RSS) and GIS in disaster Management, early warning systems.

Unit III : ***Post disaster response****:*Emergency medical and public health services; Environmental post disaster response (water, sanitation, food safety, waste management, disease control, security, communications); reconstruction and rehabilitation; Roles and responsibilities of government, community, local institutions, role of agencies like NDMA, SDMA and other International agencies, organizational structure, role of insurance sector, DM act and NDMA guidelines.

Unit IV: ***Integration of public policy****:*Planning and design of infrastructure for disaster management, Community based approach in disaster management, methods for effective dissemination of information, ecological and sustainable development models for disaster management.

Books and References

1. www.http//ndma.gov.in
2. http://www.ndmindia.nic.in
3. Natural Hazards in the Urban Habitat by Iyengar, C.B.R.I., Tata McGraw Hill, Publisher
4. Natural Disaster management, Jon Ingleton (Ed), Published by Tudor Rose, Leicester 92
5. Singh B.K., 2008, Handbook of disaster management: Techniques & Guidelines, Rajat Publications.
6. Disaster Management, R.B. Singh (Ed), Rawat Publications
7. ESCAP: Asian and the Pacific Report on Natural Hazards and Natural Disaster Reduction

S. No.	Category	Code	Course Title	Hours per week			Credits
				L	T	P	
6	Mandatory Courses (Non Credit)	EVS-101-18	**Envrionmental Science**	2	0	0	0

*** 40 Hours are kept for various activities under the head of activities. There will be a final theory examination for the students of 50 marks but these marks will not be added to their final result as assessment will be satisfactory or non-satisfactory**

We as human being are not an entity separate from the environment around us rather we are a constituent seamlessly integrated and co-exist with the environment around us. We are not an entity so separate from the environment that we can think of mastering and controlling it rather we must understand that each and every action of ours reflects on the environment and vice versa. Ancient wisdom drawn from Vedas about environment and its sustenance reflects these ethos. There is a direct application of this wisdom even in modern times. Idea of an activity based course on environment protection is to sensitize the students

Course Outcomes:

1.Students will enable to understand environmental problems at local and national level through literature and general awareness.

2.The students will gain practical knowledge by visiting wildlife areas, environmental institutes and various personalities who have done practical work on various environmental Issues.

3.The students will apply interdisciplinary approach to understand key environmental issues and critically analyze them to explore the possibilities to mitigate these problems.

4.Reflect critically about their roles and identities as citizens, consumers and environmental actors in a complex, interconnected world.

Detailed Contents

Unit- I : Natural Resources :Renewable and non-renewable resources

Natural resources and associated problems.Forest resources : Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people. Water resources : Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. Mineral resources : Use and exploitation, environmental effects of extracting and using mineral resources, case studies. Food resources : World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. Energy resources : Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. Case studies. Land resources : Land as a resource, land degradation, man induced landslides, soil erosion and desertification., Role of an individual in conservation of natural resources, Equitable use of resoureces for sustainable lifestyles.

Unit-II : Ecosystems : Concept of an ecosystem, Structure and function of an ecosystem, Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of following ecosystems: a. Forest ecosystem b. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Unit-III : Biodiversity and its conservation : Introduction – Definition : genetic, species and ecosystem diversity, Biodiversity at global, National and local levels, Inida as a mega-diversity nation, Hot-sports of biodiversity, Threats to biodiversity : habitat loss, poaching of wildlife, man-wildlife conflicts, Endangered and endemic species of India

Unit-IV : Social Issues and the Environment : From Unsustainable to Sustainable development, Resettlement and rahabilitation of people; its problems and concerns., Environmental ethics : Issues and possible solutions, Climate change, global warming, acid rain, ozone layer depletion, Nuclear accidents and holocaust, Case Studies, Public awareness.

***ACTIVITIES**

Nature club (bird watching, recognizing plants at institute/at home, recognizing local animals, appreciating biodiversity

Impart knowledge and inculcate the habit of taking interest and understanding biodiversity in and around the college campus. The students should be encouraged to take interest in bird watching, recognizing local plants, herbs and local animals. The students should be encouraged to appreciate the difference in the local biodiversity in their hometown, in the place of their study and other places they visit for vacation/breaks etc.

Following activities must be included.

Identify a tree fruit flower peculiar to a place or having origin from the place.Making high resolution big photographs of small creatures (bees, spiders, ants. mosquitos etc.) especially part of body so that people can recognize (games on recognizing animals/plants).Videography/ photography/ information collections on specialties/unique features of different types of common creatures.Search and explore patents and rights related to animals, trees etc. Studying miracles of mechanisms of different body systems.

1 ***(A) Awareness Activities:***

a) Small group meetings about water management, promotion of recycle use, generation of less waste, avoiding electricity waste
b) Slogan making event
c) Poster making event
d) Cycle rally
e) Lectures from experts
f) Plantation
g) Gifting a tree to see its full growth
h) Cleanliness drive
i) Drive for segregation of waste
i) To live with some eminent environmentalist for a week or so to understand his work vi) To work in kitchen garden for mess
j) To know about the different varieties of plants
k) Shutting down the fans and ACs of the campus for an hour or so
l) Visit to a local area to document environmental assets

river/forest/grassland/hill/mountain/lake/Estuary/Wetlands

m) Visit to a local polluted site-Urban/Rural/Industrial/Agricultural
n) Visit to a Wildlife sanctuary, National Park or Biosphere Reserve

References & Books

1. Textbook of Environmental studies, ErachBharucha, UGC
Weblink: https://www.ugc.ac.in/oldpdf/modelcurriculum/env.pdf
2. Fundamental concepts in Environmental Studies, D D Mishra, S Chand & Co Ltd
3. Environment Biology by Agarwal, K. C., Nidi Publ. Ltd. Bikaner.
4. Principle of Environment Science by Cunninghan, W.P.
5. Essentials of Environment Science by Joseph.
6. Perspectives in Environmental Studies by Kaushik, A.
7. Elements of Environment Science & Engineering by Meenakshi.
8. Elements of Environment Engineering by Duggal.

S. No.	Category	Code	Course Title	Hours per week			Credits
				L	T	P	
7	Professional Core courses	BTCE-406-18	**Concrete Testing Lab**	0	0	2	1

External Marks: 40, Internal Marks: 60, Total Marks: 100

Course Outcomes

1. Evaluate properties of building materials, such as cement and aggregates.
2. Conduct experiments and check the acceptance criteria (if any).
3. Design concrete mixes as per BIS provisions.
4. Analyze the properties of concrete in fresh and hardened state.
5. Create a well organized document and present the results appropriately.
6. Understand and apply non destructive testing (NDT) for evaluating concrete quality.

Content

1. Tests on cement
   - Fineness
   - Consistency
   - Setting time
   - Soundness
   - Specific gravity
   - Strength
2. Tests on aggregates (fine and coarse)
   - Specific gravity
   - Bulk Density
   - Fineness Modulus
   - Moisture content
   - Water Absorption
   - Bulking of sand
3. Design mix of concrete as per BIS method.
4. Workability tests on concrete
   - Slump test
   - Compaction Factor test
   - Vee-Bee test
5. Strength tests on concrete
   - Compressive strength (Cube and Cylinder)
   - Split Tensile strength
   - Flexural strength
   - Abrasion resistance
6. Non-Destructive Techniques
   - Rebound hammer test
   - Ultra sonic pulse velocity test

Text/Reference Books

1. 'Concrete Lab Manual', M. L. Gambhir, Dhanpat Rai & Sons, New Delhi.
2. 'Concrete Lab Manual', TTTI Chandigarh.

S. No.	Category	Code	Course Title	Hours per week			Credits
				L	T	P	
8	Professional Core courses	BTCE-407-18	**Transportation Lab**	0	0	2	1

External Marks: 40, Internal Marks: 60, Total Marks: 100

Course Outcomes

After completing this course the student must demonstrate the knowledge and ability to:

1.Characterize the pavement materials as per the Indian Standard guidelines.
2.Evaluate the strength of subgrade soil by CBR test.
3.Conduct experiments to evaluate aggregate properties.
4.Determine properties of bitumen material and mixes
5.Evaluate the pavement condition by rough meter and Benkelman beam test.
6.Create a well organized report and present the results appropriately

Course Content

I *Tests on Sub-grade Soil*
1.. California Bearing Ratio Test

II *Tests on Road Aggregates*
2. Crushing Value Test
3. Los Angles Abrasion Value Test
4. Impact Value Test
5. Shape Test (Flakiness and Elongation Index)

III *Tests on Bituminous Materials and Mixes*
6. Penetration Test
7. Ductility Test
8. Softening Point Test
9. Flash & Fire Point Test
10. Bitumen Extraction Test

IV *Field Tests*
11. Study of Roughometer/Bump Indicator
12. Study of Benkelman Beam Method

References

Khanna S.K., and Justo, C.E.G. "Highway Material & Pavement Testing", NemChandandBrothers, Roorkee.

S. No.	Category	Code	Course Title	Hours per week			Credits
				L	T	P	
9	Professional Skill enhancement	BTCE-432-18	**Training-II**	-	-	-	1

Content

Module I –Survey camp of an area (2 weeks)

1. Hands-on-training of modern surveying equipment such as Digital Theodolite, Total Stations, Autolevel, and GPS.
2. On-site application of traversing, etc. for preparation of topographical maps of an area.

Module II – 4 week Summer Internship in Industry/ Construction site/ Appropriate workplace

Note:

1. The students need to submit a topographical maps preaperd in Survey Camp and a report of thesummer internship.
2. The viva exam for the subject will be conducted alongwith the practical exams of the End-Semster Examination of Fifth Semester.

S. No.	Category	Code	Course Title	Hours per week			Credits
				L	T	P	
10	Professional core	BMPD-401-18	**Mentoring and professional development**	-	-	2	0

Guidelines regarding Mentoring and Professional Development

The objective of mentoring will be development of:

- Overall Personality
- Aptitude (Technical and General)
- General Awareness (Current Affairs and GK)
- Communication Skills
- Presentation Skills

The course shall be split in two sections i.e. outdoor activities and class activities. For achieving the above, suggestive list of activities to be conducted are:

Part – A (Class Activities)

1. Expert and video lectures
2. Aptitude Test
3. Group Discussion
4. Quiz (General/Technical)
5. Presentations by the students
6. Team building Exercises

Part – B (Outdoor Activities)

1. Sports/NSS/NCC
2. Society Activities of various students chapter i.e. ISTE, SCIE, SAE, CSI, Cultural Club, etc.

Evaluation shall be based on rubrics for Part – A & B.
Mentors/Faculty incharges shall maintain proper record student wise of each activity conducted and the same shall be submitted to the department.

5th Sem Syllabus

Fifth Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
1	Professional Core courses	BTCE-501-18	**Engineering Geology**	3	0	0	3

External Marks: 60, Internal Marks: 40, Total Marks: 100

Course Outcome

The course will enable the students understand:
1. The basic concepts of geological processes and their importance in civil Engineering
2. Identification of rocks and minerals and their characteristics
3. Significance of geological structures in civil engineering projects
4. Site characterization and geologic considerations in construction

Content

Unit-I General Geology: Scope of geology in Civil Engineering - the earth, its structure and environment - Standard geological time scale, unit & fossils. physiographic, stratigraphic and tectonic divisions of India - geomorphological (surface) processes – weathering – types , weathered products, assessment of degree of weathering , Fluvial processes, glaciation, wind action, and their significance in Civil Engineering

Unit-II Mineralogy and Petrology: Physical properties of minerals – classification - study of important rock forming minerals – Quartz family, feldspar family, Augite, Hornblend, Mica family, calcite, Iron oxide minerals, Augite, Hornblend, and Clay minerals and their behaviour and significance in the field of Civil Engineering . Classification of rock - mode of formation - distinction between igneous, sedimentary and metamorphic rocks. Formation, textures, structure, Classification, and Engineering, Characteristic of rocks. Study of imp rocks granite, syenite, diorite, gabbro, pegmatite, dolerite , basalt , sand stone, limestone, shale, breccia , conglomerate , gneiss, quartzite, marble, slate, schist, phyllite and conglomerate

Unit-III Structural Geology and Geophysical methods: Attitude of beds - out crops, study of structures such as folds, faults, joints, unconformities in lier and out lier their brief classification and their bearing on engineering construction – principles of geophysical methods, electrical resistivity method , seismic method and its applications in civil engineering

Unit-IV Geology and construction: Role of geology in site investigation , Geotechnical classification of rock, geological considerations in open excavation, tunnels and dam site, reservoir site, buildings, road cuttings, landslides and land subsidence its causes, classification and preventive measures, – earthquake, its causes, classification, earthquake zones of India, groundwater-types of aquifers , properties of geological formations affecting groundwater and its role as a geological hazard

Text/Reference Books:

1. Engineering and General Geology, Parbin Singh, 8th Edition (2010), S K Kataria& Sons.
2. Text Book of Engineering Geology, N. ChennaKesavulu, 2nd Edition (2009), Macmillan Publishers India.
3. Geology for Geotechnical Engineers, J.C.Harvey, Cambridge University Press (1982).
4. Reddy,D.," Engineering Geology for Civil Engineers", Oxford & IBH , 1995
5. Leggot, R.F.," Geology and Engineers ", McGraw Hill , New York.2002 2.
6. Blyth, F.G.M., " A Geology for Engineers", Arnold, Londo,(2003.
7. Bell.F.G, " Fundamentals of Engineering Geology" Butterworth, 1983

Fifth Semester

S. No.	Category	Code	Course Title	Hours per week			Credits
				L	T	P	
2	Professional Core courses	BTCE-502-18	**Elements of Earthquake Engineering**	3	0	0	3

External Marks: 60, Internal Marks: 40, Total Marks: 100

Course Outcome

The course will enable the students to:

i) Understand the phenomenon of occurrence and history of earthquakes and classify their kinds and effects.
ii) Appreciate the role of earthquake forces in structural design of building.
iii) Evaluate and analyze Degree of Freedom, Spring action, Damping, Equations of motions, Lateral Force analysis, Floor Diaphragm action, Moment resisting frames and Shear walls.
iv) Apply various codal provisions related to seismic design of buildings.
v) Acquire new basic knowledge in earthquake engineering

Content

Unit 1: Introduction to Earthquakes, Causes of Earthquakes, Basic Terminology, Magnitude, Intensity, Peak ground motion parameters.

Unit 2: Past Earthquakes and Lessons learnt, Various Types of Damages to Buildings.

Unit 3: Introduction to theory of Vibrations, Sources of Vibrations, Types of Vibrations, Degree of Freedom, Spring action and damping, Equation of motion of S.D.O.F. systems, Undamped, Damped system subjected to transient forces, general solution, green's function.

Unit 4: Lateral Force analysis, Floor Diaphragm action, moment resisting frames, shear walls.

Unit 5: Concepts of seismic design, Lateral Strength, Stiffness, ductility and structural configuration.

Unit 6: Introduction to provisions of IS 1893-2002 Part-I for buildings. Estimation of lateral forces due to earthquake.

Unit 7: Introduction to provisions of IS 4326.

Unit 8: Introduction to provision of IS 13920.

Text /Reference Books :

1. Earthquake Resistant Design of Structures, Pankaj Agrawal, Manish Shrikhande, PHI Learning
2. Dynamics of Structures: Theory and Applications to Earthquake Engineering, AK Chopra, Prentice Hall
3. Dynamics of Structures, R.W. Clough and Joseph Penzien, McGraw-Hill Education
4. Structural Dynamics by Mario & Paz, Springer.
5. Earthquake Resistant Design by David J. Dowrick, Wiley India Pvt Ltd
6. Elements of Earthquake Engg by Jai Krishna, A.R. Chandrasekaran, Brijesh Chandra, South Asian Publishers.
7. IS 1893-2016Indian Standard Criteria for Earthquake Resistant Design of Structures.
8. IS 4326-1993 Indian Standard for Earthquake Resistant Design and Construction ofBuildings.
9. IS 13920:2016-Ductile design and detailing of Reinforced Concrete Structures subjected toSeismic Forces- code of practice

Fifth Semester

S. No.	Category	Code	Course Title	Hours per week			Credits
				L	T	P	
3	Professional Core courses	BTCE-503-18	**Construction Engineering & Management**	3	0	0	3

External Marks: 60, Internal Marks: 40, Total Marks: 100

Course Outcome

The course will enable the students to:

An idea of how structures are built and projects are developed on the field

i. An understanding of modern construction practices
ii. A good idea of basic construction dynamics- various stakeholders, project objectives, processes, resources required and project economics
iii. A basic ability to plan, control and monitor construction projects with respect to time and cost
iv. An idea of how to optimise construction projects based on costs
v. An idea how construction projects are administered with respect to contract structures and issues.
vi. An ability to put forward ideas and understandings to others with effective communication processes

Contents

Unit 1: *Basics of* Construction- Unique features of construction, construction projects types and features, phases of a project, agencies involved and their methods of execution;

Unit 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, concept of productivities, estimating durations, sequence of activities, activity utility data; Techniques of planning- Bar charts, Gantt Charts. Networks: basic terminology, types of precedence relationships, preparation of CPM networks: activity on link and activity on node representation, computation of float values, critical and semi critical paths, calendaring networks. PERT- Assumptions underlying PERT analysis, determining three time estimates, analysis, slack computations, calculation of probability of completion. Updating, Resource Allocation, smoothing and levelling.

Unit 3: Construction Methods basics: Types of foundations and construction methods; Basics of Formwork and Staging; Common building construction methods (conventional walls and slabs; conventional framed structure with blockwork walls; Modular construction methods for repetitive works;

Unit4: Construction Equipment basics*:* Conventional construction methods Vs Mechanized methods and advantages of latter; Equipment for Earthmoving, Dewatering; Concrete mixing, transporting & placing; Cranes, Hoists and other equipment for lifting; Equipment for transportation of materials. Equipment Productivities

Unit 5:*Contracts Management basics:* Importance of contracts; Types of Contracts, parties to a contract; Common contract clauses (Notice to proceed, rights and duties of various parties, notices to be given, Contract Duration and Price. Performance parameters; Delays, penalties and liquidated damages; Force Majeure, Suspension and Termination. Changes & variations, Dispute Resolution methods.

Unit 6:*Construction Costs: Make-up of construction costs;* Classification of costs, timecost trade-off in construction projects, compression and decompression.

Text/Reference Books:

1. Varghese, P.C., "*Building Construction"*, Prentice Hall India, 2007.
2. *National Building Code*, Bureau of Indian Standards, New Delhi, 2017.
3. Chudley, R., *Construction Technology*, ELBS Publishers, 2007.
4. Peurifoy, R.L. Construction Planning, Methods and Equipment, McGraw Hill, 2011
5. Nunnally, S.W. Construction Methods and Management, Prentice Hall, 2006
6. Jha, Kumar Neeraj., Construction Project management, Theory & Practice, Pearson Education India, 2015
7. Punmia, B.C., Khandelwal, K.K., Project Planning with PERT and CPM, Laxmi Publications, 2016.

Fifth Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
4	Professional Core courses	BTCE-504-18	**Environmental Engineering**	4	0	4	Professional Core

External Marks: 60, Internal Marks: 40, Total Marks: 100

Course Outcome

The course will enable the students to:

i. Understand the impact of humans on environment and environment on humans
ii. Be able to identify and value the effect of the pollutants on the environment: atmosphere, water and soil.
iii. Be able to plan strategies to control, reduce and monitor pollution.
iv. Be able to select the most appropriate technique for the treatment of water, wastewater ,solid waste and contaminated air.
v. Be conversant with basic environmental legislation.

Contents

Unit1: *Water:* -Sources of Water and quality issues, water quality requirement for different beneficial uses, Water quality standards, water quality indices, water safety plans, Water Supply systems, Need for planned water supply schemes, Water demand 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. *Water Treatment:* aeration, sedimentation, coagulation flocculation, filtration, disinfection, advanced treatments like adsorption, ion exchange, membrane processes

Unit 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. Small bore systems, Storm Water- Quantification and design of Storm water; Sewage and Sullage, Pollution due to improper disposal of sewage, Wastewater treatment, aerobic and anaerobic treatment systems, suspended and attached growth systems, recycling of sewage – quality requirements for various purposes.

Unit 3: *Air* - Composition and properties of air, Quantification of air pollutants, Monitoring of air pollutants, Air pollution-Occupational hazards, Urban air pollution automobile pollution, Air quality standards, Control measures for Air pollution

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

Unit 5:*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.

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

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Text/Reference Books:

1. Introduction to Environmental Engineering and Science by Gilbert Masters, PrenticeHall, New Jersey.
2. Introduction to Environmental Engineering by P. AarneVesilind, Susan M. Morgan,Thompson /Brooks/Cole; Second Edition 2008.
3. Peavy, H.s, Rowe, D.R, Tchobanoglous, G. *Environmental Engineering*, Mc-Graw -Hill International Editions, New York 1985.
4. MetCalf and Eddy. *Wastewater Engineering, Treatment, Disposal and Reuse*, TataMcGraw-Hill, New Delhi.
5. Manual on Water Supply and Treatment. Ministry of Urban Development, New Delhi.
6. Plumbing Engineering. Theory, Design and Practice, S.M. Patil, 1999
7. Integrated Solid Waste Management, Tchobanoglous, Theissen& Vigil. McGraw HillPublication
8. Manual on Sewerage and Sewage Treatment Systems, Part A, B and C. Central PublicHealth and Environmental Engineering Organization, Ministry of Urban Development

Fifth Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
5	Professional Core courses	BTCE-505-18	**Structural Engineering**	3/4	1	0	4

External Marks: 60, Internal Marks: 40, Total Marks: 100

Course Outcome

The course will enable the students to:

i. The students will be able to apply their knowledge of structural mechanics in addressing design problems of structural engineering
ii. Ability to understand difference between Working stress and Limit State Philosophy by calculating various design parameters.
iii. Design the reinforced concrete beams and slabs using limit state design guidelines of Indian standards.
iv. They will possess the skills to analyse and design steel structure members
v. They will have knowledge of structural engineering

Unit 1:Introduction

Structural Engineering,role of structural engineer, engineer, architect, builder; Objectives of designing a structure.

Unit 2: Structural Analysis

Concept of determinacy and indeterminacy, Analyses of indeterminate beams, framesand trusses using Slope deflection method, Moment distribution method, unit load method and castiglano's theorem, Concept of Influence line diagram.

Unit 3: Design of concrete Elements

Design Philosophies of Working Stress Method and Limit State Method, Design of Reinforced Concrete Beamsfor Flexure, Shear; Bond, Anchorage, development length and torsion; Reinforced Concrete Axially Loaded Columns,
Reinforced Concrete Slabs: One Way and Two Way.

Unit 4: Design of Steel Elements

Properties of structural steel, I.S. rolled sections, I.S. specifications; Connections-Bolted and welded connections for axial loads; Tension members: Design of members subjected to axial tension; Compression members: Design of axially loaded members, built-up columns, laced andbattened columns; Flexural members: Design of laterally restrained and un-restrained rolled sectionbeams.

Text/Reference Books:

1. Nilson, A. H. Design of Concrete Structures. 13th edition. McGraw Hill, 2004
2. McCormac, J.C., Nelson, J.K. Jr., Structural Steel Design. 3rd edition. Prentice Hall, N.J., 2003.
3. Intermediate Structural Analysis - C K Wang, McGraw hill publications.
4. Limit state design of steel structures: S K Duggal, Mc Graw Hill.
5. Design of Reinforced Concrete Structures: S. Ramamrutham, Dhanpat Rai Publications.
6. Smith, J. C., Structural Analysis, Harpor and Row, Publishers, New York.
7. NBC, National Building Code, BIS (2017).
8. Theory of structures - S Ramamurtham, Dhanpat Rai Publications.
9. Theory of structures - B.C. Punima, Laxmi Publications.
10. Reinforced concrete design - Pillai & Menon, Tata McGrawHill publications

BIS Codes of practice and Design Handbooks:

1. *IS 456-2000- Indian Standard. Plain and Reinforced concrete -Code of practice
2. *Design Aid SP 16
3. *IS 800: 2007 (General construction in steel-Code of practice)*
4. *SP: 6(1) (Handbook for structural engineers-Structural steel sections
5. Explanatory hand book SP24.
6. Detailing of Reinforcement SP 34

Note: The codes marked with * are permitted in examination.

Fifth Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
6	Professional Core courses#	BTCE-506-18	**Geotechnical Engineering#**	3	1	0	4

After studying this course, students shall be able to:

1. Comprehend the various geotechnical field challenges and understand their fundamental, index and engineering properties and then use (apply) the soil as an engineering material.
2. Investigate and write the laboratory reports for soil design properties and parameters by apply the concept of permeability, total and effective stress approaches in soil strength determination
3. Apply the various specifications of compaction of soils in the construction of highways and earthen dams.
4. Able to apply the knowledge of consolidation, soil deformation parameters, and calculate settlement magnitude and rate of settlement.
5. Design the embankment slopes and check the stability of finite slopes.

Unit-I:*Basic Concepts*- Definition of soil, Comparison between soil mechanics, rock mechanics and geotechnical engineering, Scope of soil mechanics problems in Civil Engineering. Principal types of soils in India. Characteristics of main Clay mineral groups. Soil as three phase system: weight volume relationship and determination of moisture content from nuclear method, alcohol method and sensors. Determination of Specific gravity by density bottle method, pycnometer method. Field density from sand replacement method and other methods.

Index Properties: Grain size analysis. Stokes's law and Hydrometer analysis. Consistency and sensitivity of Clay, Atterbeg Limits, Flow Index and Toughness Index. Underlying theory of shrinkage limit determination. Classification of coarse and fine grained soils as per Indian Standard.

Unit-II :*Permeability of Soil*- 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.

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.

Unit-III:*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.

Consolidation of Soil - Introduction, comparison between compaction and consolidation, initial, primary & secondary consolidation, spring analogy for primary consolidation, interpretation of consolidation test results, Terzaghi's theory of consolidation, Concept of various consolidation characteristics i.e. av, mv and cv, primary and secondary consolidation concept of cv, tv& U. Consolidation test: determination of cv from curve fitting methods, Pre consolidation pressure determination. Normally consolidated and over consolidated clays. Causes of over-consolidation. Effect disturbance on e-Log σ curves of normally consolidated clays, importance of consolidation settlement in the design of structures. final settlement of soil deposits, computation of consolidation settlement and secondary consolidation.

Unit-IV: *Shear Strength*- Mohr circle and its characteristics, principal planes, relation between major and minor principal stresses, Mohr-Coulomb theory, types of shear tests: direct shear test, merits of direct shear test, triaxial compression tests, test behaviour of UU, CU and CD tests, pore-pressure measurement, computation of effective shear strength parameters. unconfined compression test, vane shear test

Stability of Slopes- Introduction, types of slopes and their failure mechanisms, factor of safety, analysis of finite and infinite slopes, wedge failure Swedish circle method, friction circle method, stability numbers and charts

Text/Reference Books:

1. Soil Mechanics by Craig R.F., Chapman & Hall
2. Fundamentals of Soil Engineering by Taylor, John Wiley & Sons
3. Soil Mech. & Foundation Engg, by K.R.Arora Standard *Publishers* Distributors
4. Geotechnical Engineering, by P. Purshotama Raj *Tata Mcgraw Hill*
5. Soil Mech. & Foundation Engg., by V.N.S.Murthy CBS *Publishers* & Distributors.
6. Principle of Geotechnical Engineering by B.M.Das Cengage Publisher
7. Basic and applied Soil Mechanics by Gopal Ranjan and A.S. R. Rao New Age International Publishers
8. Geotechnical Engineering by Gulati and Datta, Tata McGraw Hill
9. Problems in Soil mechanics and Foundation Engineering by B.P.Verma, Khanna Publishers.

S. No.	Category	Code	Course Title	Hours per week			Credits
				L	T	P	
7	Professional Core courses	BTCE-507-18	**Geotechnical Lab**	0	0	2	1

External Marks: 20, Internal Marks: 30, Total Marks: 50

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1. Determination of in-situ density by core cutter method and Sand replacement method.
2. Determination of Liquid Limit & Plastic Limit.
3. Determination of specific gravity of soil solids by Pycnometer method.
4. Grain size analysis of sand and determination of uniformity coefficient (Cu) and coefficient of curvature (Cc).
5. Compaction test of soil.
6. Determination of Relative Density of soil.
7. Determination of permeability by Constant Head Method.
8. Determination of permeability by Variable Head method.
9. Unconfined Compression Test for fine grained soil.
10. Direct Shear Test
11. Triaxial Test
12. Swell Pressure Test

Books Recommended:-

Soil Testing Engineering, Manual By Shamsher Prakash and P.K. Jain. Nem Chand & Brothers

S. No.	Category	Code	Course Title	Hours per week			Credits
				L	T	P	
8	Professional Core courses	BTCE-508-18	**Environmental Engineering Lab**	0	0	2	1

External Marks: 20, Internal Marks: 30, Total Marks: 50

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1. To measure the pH value of a water/waste water sample.
2. To determine optimum Alum dose for Coagulation.
3. To find MPN for the bacteriological examination of water.
4. To find the turbidity of a given waste water/water sample
5. To find B.O.D. of a given waste water sample.
6. To measure D.O. of a given sample of water.
7. Determination of Hardness of a given water sample
8. Determination of total solids, dissolved solids, suspended solids of a given water sample.
9. To determine the concentration of sulphates in water/wastewater sample.
10. To find chlorides in a given sample of water/waste water.
11. To find acidity/alkalinity of a given water sample
12. To determine the COD of a wastewater sample.

Books Recommended:

1. Chemistry for EnviromentalEngg. and Science by Sawyer & McCarty, TMH, New Delhi
2. Standard Methods for the examination of water & wastewater, APHA, AWWA, WE

S. No.	Category	Code	Course Title	Hours per week			Credits
				L	T	P	
9	Professional Core courses	BTCE-509-18	**Structural Lab**	0	0	2	1

External Marks: 20, Internal Marks: 30, Total Marks: 50

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1. Deflection of a simply supported beam and verification of Clark-Maxwell's theorem.
2. To determine the Flexural Rigidity of a given beam.
3. Deflection of a fixed beam and influence line for reactions.
4. Deflection studies for a overhang beam and influence line for reactions.
5. Structural Drawings of Reinforced Concrete Elements such as Beams, Slabs.
6. Structural Drawings of Steel Elements such as Connections, Tension Members, Compression Members, Beams,

S. No.	Category	Code	Course Title	Hours per week			Credits
				L	T	P	
10	Professional core	BMPD-501-18	**Mentoring and professional development**	-	-	2	0

Guidelines regarding Mentoring and Professional Development

The objective of mentoring will be development of:

- Overall Personality
- Aptitude (Technical and General)
- General Awareness (Current Affairs and GK)
- Communication Skills
- Presentation Skills

The course shall be split in two sections i.e. outdoor activities and class activities. For achieving the above, suggestive list of activities to be conducted are:

Part – A (Class Activities)

1. Expert and video lectures
2. Aptitude Test
3. Group Discussion
4. Quiz (General/Technical)
5. Presentations by the students
6. Team building Exercises

Part – B (Outdoor Activities)

1. Sports/NSS/NCC
2. Society Activities of various students chapter i.e. ISTE, SCIE, SAE, CSI, Cultural Club, etc.

Evaluation shall be based on rubrics for Part – A & B.
Mentors/Faculty incharges shall maintain proper record student wise of each activity conducted and the same shall be submitted to the department.

6th semester Syllabus

Sixth Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
	Professional Core courses[#]	BTCE-601-18	Engineering Economics, Estimation & Costing	3	1	0	4

Course outcomes: On completion of the course, the students will:

1. Have an idea of basic principles and elements of economics in general.
2. Be able to carry out and evaluate benefit/cost, life cycle and breakeven analyses on one or more economic alternatives.
3. Be able to understand the technical specifications for various works to be performed for a project and how they impact the cost of a structure.
4. Be able to quantify the worth of a structure by evaluating quantities of constituents, derive their cost rates and build up the overall cost of the structure.
5. Be able to understand how competitive bidding works and how to submit a competitive bid proposal.

Unit-1: **Basic Principles of Economics**

Demand/Supply – elasticity – Basic Macroeconomic Concepts (including GDP/GNP/NI/ Disposable Income), Aggregate demand and Supply (IS/LM), Price Indices (WPI/CPI), Interest rates, Direct and Indirect Taxes.

Unit-2: Elements of Business/Managerial Economics

Cost & Cost Control -Techniques, Types of Costs, Lifecycle costs, Budgets, Break even Analysis, Capital Budgeting, Application of Linear Programming. Investment Analysis – NPV, ROI, IRR, Payback Period, Depreciation, Time value of money.

Unit-3: Estimation / Measurements for various items

Introduction to the process of Estimation; 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, Estimating Earthwork and Foundations, Estimating Concrete and Masonry, Finishes, Interiors, MEP works; BIM and quantity take-offs; adding equipment costs; labour costs; rate analysis; 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. Use of Computers in quantity surveying.

Unit-4: Specifications

Types, requirements and importance, detailed specifications for buildings, roads, minor bridges and industrial structures.

Unit-5: Rate analysis:

Purpose, importance and necessity of the same, factors affecting, task work, daily output from different equipment/ productivity.

Unit-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 Changes, penalty and liquidated charges, Settlement of disputes, R.A. Bill & Final Bill, Payment of advance, insurance, claims, price variation, etc. Preparing Bids- Bid Price build-up: Material, Labour, Equipment costs, Risks, Direct & Indirect Overheads, Profits; Bid conditions, alternative specifications; Alternative Bids. Bid process management.

Unit-7: Introduction to Acts:

Acts pertaining to-Minimum wages, Workman's compensation, Contracts, Arbitration, Easement rights.

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. Pareek Saroj (2003), *Textbook of Business Economics,* Sunrise Publishers
4. M Chakravarty, Estimating, Costing Specifications & Valuation
5. Joy P K, Handbook of Construction Management, Macmillan
6. B.S. Patil, Building & Engineering Contracts
7. Relevant Indian Standard Specifications.
8. World Bank Approved Contract Documents.

9. FIDIC Contract Conditions.
10. Acts Related to Minimum Wages, Workmen's Compensation, Contract, and Arbitration
11. Typical PWD Rate Analysis documents.
12. UBS Publishers & Distributors, Estimating and Costing in Civil Engineering: Theory and Practice including Specification and Valuations,2016
13. Dutta, B.N., Estimating and Costing in Civil Engineering (Theory & Practice), UBS Publishers, 2016

Non-Credit Mandatory Course

Sixth Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
	Mandatory Course (Non-Credit)	BTMC-101-18	Constitution of India	3	0	0	S/US

The Constitution of India is the supreme law of India. Parliament of India can not make any law which violates the Fundamental Rights enumerated under the Part III of the Constitution. The Parliament of India has been empowered to amend the Constitution under Article 368, however, it cannot use this power to change the "basic structure" of the constitution, which has been ruled and explained by the Supreme Court of India in its historical judgments. The Constitution of India reflects the idea of "Constitutionalism" – a modern and progressive concept historically developed by the thinkers of "liberalism" – an ideology which has been recognized as one of the most popular political ideology and result of historical struggles against arbitrary use of sovereign power by state. The historic revolutions in France, England, America and particularly European Renaissance and Reformation movement have resulted into progressive legal reforms in the form of "constitutionalism" in many countries. The Constitution of India was made by borrowing models and principles from many countries including United Kingdom and America.

Course content

- Meaning of the constitution law and constitutionalism
- Historical perspective of the Constitution of India
- Salient features and characteristics of the Constitution of India
- Scheme of the fundamental rights
- The scheme of the Fundamental Duties and its legal status
- The Directive Principles of State Policy – Its importance and implementation
- Federal structure and distribution of legislative and financial powers between the Union and the States
- Parliamentary Form of Government in India – The constitution powers and status of the President of India
- Amendment of the Constitutional Powers and Procedure
- The historical perspectives of the constitutional amendments in India
- Emergency Provisions : National Emergency, President Rule, Financial Emergency
- Local Self Government – Constitutional Scheme in India
- Scheme of the Fundamental Right to Equality
- Scheme of the Fundamental Right to certain Freedom under Article 19
- Scope of the Right to Life and Personal Liberty under Article 21

S. No.	Category	Code	Course Title	Hours per week			Credits
				L	T	P	
		BMPD-601-18	**Mentoring and professional development**	-	-	2	0

Guidelines regarding Mentoring and Professional Development

The objective of mentoring will be development of:

- Overall Personality
- Aptitude (Technical and General)
- General Awareness (Current Affairs and GK)
- Communication Skills
- Presentation Skills

The course shall be split in two sections i.e. outdoor activities and class activities. For achieving the above, suggestive list of activities to be conducted are:

Part – A (Class Activities)

1. Expert and video lectures
2. Aptitude Test
3. Group Discussion
4. Quiz (General/Technical)
5. Presentations by the students
6. Team building Exercises

Part – B (Outdoor Activities)

1. Sports/NSS/NCC
2. Society Activities of various students chapter i.e. ISTE, SCIE, SAE, CSI, Cultural Club, etc.

Evaluation shall be based on rubrics for Part – A & B.

Mentors/Faculty incharges shall maintain proper record student wise of each activity conducted and the same shall be submitted to the department.

SYLLABUS FOR BASKET OF ELECTIVE COURSES OF ELECTED TRACKS

Track-1: Geotechnical Engineering

Sixth Semester							
S. No.	Category	Code	Course Title	Hours per week			Credits
				L	T	P	
	Professional Elective courses	PECE-602A-18	Foundation Engineering	3	1	0	4

Course Outcome: On completion of this course, the students will be able to
1 - Understand the methods of surface and subsoil exploration and to prepare investigation report.
2 - Estimate the stresses in soils and bearing capacity of soil for shallow foundation.
3 - Design various types of shallow foundation and to estimate settlement. 4
4 - Apply the concepts of deep foundation and solve problems related with pile foundation.

Unit-I :Soil Exploration
Object of soil investigation for new and existing structures. Depth of exploration for different structures. Spacing of bore Holes. Methods of soil exploration and relative merits and demerits. Types of soil sample. Design features of sampler affecting sample disturbance. Essential features and application of the following types of samples- Open Drive samples, Stationery piston sampler,. Rotary sampler,.- standard penetration test - static and dynamic cone penetration test ,Bore Hole log for S.P.T. Geophysical exploration by seismic and resistivity methods
Stresses Distribution: Bosussinesq equation for a point load, uniformly loaded circular and rectangular area, Newmark'ss chart and its construction. 2:1 method of load distribution. Comparison of Bosussinesq and Westerguard analysis for a point load. Pressure Bulb and Isobar. Related Numerical Problems

Unit-II: Earth Pressure
Terms and symbols used for a retaining wall. Movement of all and the lateral earth pressure. Earth pressure at rest. Rankine states of plastic equilibrium, Ka and Kp for horizontal backfills. Rankine's theory both for active and passive earth pressure for Cohesionless backfill with surcharge and fully submerged case. Cohesive backfill condition. Coulomb's method for cohesion less backfill. Merits and demerits of Ranking and Coulomb's theories, Culmann's graphical construction (without surcharge load).

Unit-III: Shallow Foundation
Type of shallow foundations, Depth and factors affecting it.Definitionof ultimate bearing capacity, safe bearing capacity and allowable bearing capacity. Rankine'sanalysis and Terzaghi's analysis.Types of Shear failures. Factors affecting bearing capacity. B.I.S.recommendations for shape, depth and inclination factors. Plate Load test and standard penetrationTest. Causes of settlement of structures, Comparison of immediate and consolidation settlement, calculation of settlement by Plate load Test and Static Cone penetration test data. Allowable settlement of various structures according to I.S. Code.

Unit-IV: Pile Foundations
Types and function of pile - factors influencing the selection of pile - carrying capacity of single pile in cohesionless and cohesive soil by static formula.Determination of point resistance and frictional resistance of a single pile by Static formulas. Piles in Clay, Safe load on a Friction and point Bearing pile- dynamic formulae (Engineering News and Hileys) Types of pile driving hammers & their comparison.Limitations of pile driving formulae. Negative skin friction - Carrying capacity of Pile group - Pile load test Cyclic Pile Load Test, Separation of skin friction and point resistance using cyclic pile load test.
Pile in sand, Spacing of piles in a group, Factors affecting capacity of a pile group, Efficiency of pile group by converse – Labare formula and feeds formulas. Bearing capacity of a pile group in clay by block failure and individual action approach. Calculation of settlement of friction pile group in clay. Settlement of pile groups in sand, Negative skin friction. Related Numerical problems
Unit-V: Well foundations-shapes, depth of well foundations, components, factors affecting well foundation design, Scour Depth, construction procedure, sinking of wells, rectification of tilts and shifts, recommended values of tilts & shifts as per I.S.3955.

Text/Reference Books:
1. Soil Mechanics by Craig R.F., Chapman & Hall

2. Fundamentals of Soil Engineering by Taylor, John Wiley & Sons
3. Soil Mech. & Foundation Engg, by K.R.Arora Standard *Publishers* Distributors
4. Geotechnical Engineering, by P. Purshotama Raj *Tata Mcgraw Hill*
5. Soil Mech. & Foundation Engg., by V.N.S.Murthy CBS *Publishers* & Distributors.
6. Principle of Geotechnical Engineering by B.M.Das Cengage Publisher
7. Basic and applied Soil Mechanics by Gopal Ranjan and A.S. R. Rao New Age International Publishers
8. Geotechnical Engineering by Gulati and Datta, Tata McGraw Hill
9. Problems in Soil mechanics and Foundation Engineering by B.P.Verma, Khanna Publishers.

Sixth Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
	Professional Elective courses #	PECE -602B-18	Ground Improvement Techniques	3#	1	0	4

UNIT I: Introduction
Role of ground improvement in foundation engineering– Geotechnical problems in alluvial, lateritic and black cotton soils, Methods of ground improvement Selection of suitable ground improvement techniques based on soil conditions.

UNIT II: Insitu densification of cohesion
less soils and consolidation of cohesive soils: Dynamic compaction Vibroflotation, Sand compaction piles and deep compaction. Consolidation: Preloading with sand drains, and fabric drains, Stone columns and Lime piles-installation techniques – simple design – relative merits of above methods and their limitations.

UNIT III: Soil improvement with the addition of materials
lime stabilization - lime column method - stabilization of soft clay or silt with lime - bearing capacity of lime treated soils – settlement of lime treated soils - improvement in slope stability - control methods - chemical grouting – commonly used chemicals - grouting systems - grouting operations - applications - compaction grouting - introduction - application and limitations - plant for preparing grouting materials - jet grouting – jet grouting process - geometry and properties of treated soils - applications - slab jacking - gravel - sand - stone columns

UNIT IV: Soil improvement using reinforcing elements
introduction to reinforced earth - load transfer mechanism and strength development - soil types and reinforced earth - anchored earth nailing reticulated micro piles - soil dowels - soil anchors - reinforced earth retaining walls.

UNIT V: Geotextiles
Behaviour of soils on reinforcing with geotextiles - effect on strength, bearing capacity, compaction and permeability - design aspects - slopes - clay embankments - retaining walls – pavements

Reference books:
1. Moseley, Text Book on Ground Improvement, Blackie Academic Professional, Chapman & Hall
2. Boweven R., Text Book on Grouting in Engineering Practice, Applied Science Publishers Ltd
3. Jewell R.A., Text Book on Soil Reinforcement with Geotextiles, CIRIA Special Publication, Thomas Telford
4. Van Impe W.E., Text Book On Soil Improvement Technique & Their Evolution, Balkema Publishers
5. Donald .H. Gray& Robbin B. Sotir, Text Book On Bio Technical & Soil Engineering Slope Stabilization, John Wiley
6. Rao G.V. & Rao G.V.S., Text Book On Engineering With Geotextiles, Tata McGraw Hill
7. Korener, Construction & Geotechnical Methods In Foundation Engineering, McGraw Hill
8. Shukla, S.K. and Yin, J.H. Fundamental of Geosynthetic Engineering, Taylor & Francis
9. Swamisaran, Reinforced Soil and its Engineering Application, New Age Publication
10. Gulati, S.K. and Datta, M., Geotechnical Engineering, TMH

Sixth Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
	Professional Elective courses #	PECE-602C-18	Advance Soil Mechanics	3#	1	0	4

Course Outcome: On completion of this course, the students will be able to:
1. Do earth dam design and stability analysis for all kind of drainage conditions
2. Do stability analysis of any kind of slope and its protection
3. Understand the earth pressure theories and able to calculate lateral earth pressure for different conditions
4. Evaluate depth of embedment for cantilever as well as anchored sheet piles.
5. Learn the concept of machine foundation

Unit-I

Drainage & Dewatering: Introduction, ditches and sumps, well point systems, shallow well system, deep well drainage, vacuum method, Electro-osmosis, consolidation by sand piles.

Drilled Piers and Caisson Foundations: Drilled piers-types, uses, bearing capacity, settlement, construction procedure. Caissons-Types, bearing capacity and settlement, construction procedure.

Unit-II

Braced Cuts Depth of unsupported vertical cut, sheeting and bracing for deep excavation, movements associated with sheeting and bracing, modes of failure of braced cuts, pressure distribution behind sheeting.

Cofferdams Introduction, types of cofferdams, design and lateral stability of braced cofferdams, design data for Cellular cofferdams, stability analysis of cellular cofferdams on soil and rock, interlocking stresses.

Unit -III

Cantilever Sheet Piles Purpose of sheet piles, cantilever sheet piles, depth of embedment in granular soils-rigorous method, simplified procedure, cantilever sheet pile penetrating clay.

Anchored Bulkheads Methods of design, free earth support method in cohesionless and cohesive soils, fixed earth support method in cohesionless soils.

Unit-IV

Basics of Machine Foundations Terminology, characteristics elements of vibratory systems, analysis of vibratory motions of single degree freedom system-undamped free vibrations, undamped forced vibrations, criteria for satisfactory action of a machine foundation, degrees of a freedom of a block foundation, Barken's soil spring constant, Barken's method of a determining natural frequency of a block foundation subjected to vertical oscillations.

Reference Books:

1 S.Prakash, Gopal Ranjan&S.Saran, Analysis and Design of Foundation and Retaining Structures, SaritaPrakashan Meerut, 1977.

2 Swami Saran, Analysis and Design of Sub Structures, IBH Oxford

3 Gopal Ranjan, ASR Rao, Basic and Applied Soil Mechanics, New Age Intetrnational (P) Ltd. Publishers-N.Delhi, Edition No. - 3 rd, 2016.

4 Shamsher Prakash, Soil Dynamic, McGraw Hill, 1981.

5 Teng, Foundation Design, Prentice Hall, Edition No. - 10th, 1984.

6 P.Purshotam Raj, Geotechnical Engg, Tata Mcgraw Hill, N.Delhi, Edition No.- I, 1995 7 DebashisMoitra, Geotechnical Engineering, Universities Press, Edition No. - I, 2016

Sixth Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
	Professional Elective courses #	PECE -602D-18	Geosynthetics Engineering	3#	1	0	4

Course Outcome: On completion of this course, the students will be able to:

1 Identify the functions of geosynthetics
2 Select the geosynthetic products
3 Identify the testing methods for geosynthetics
4 Design withgeosynthetic products

Contents

UNIT I:

Basic Description of Geosynthetics Historical Development, the Nomenclature, Function, Use Around the World, Applications, Development in India.

UNIT II:

Raw Materials – Their Durability and Ageing Raw Materials, Durability, Degrading Agencies, Polymers, Biological Resistance, Chemical Resistance, Weathering Resistance.

UNIT III:

Manufacturing Methods Fibers, Yarn, Nonwoven Geotextiles, Woven geotextiles, D.S.F. Fabrics.

UNIT IV:

Geogrids – Testing And Evaluation Factors Influencing Testing, Sampling, Physical Properties, Mechanical Properties under Uniaxial loading, Creep Testing.

UNIT V:

Erosion Control WithGeogrids: Wind Erosion, Rain Water Erosion, Erosion Control Measures, Placement of Geogrid.

UNIT VI:

Bearing Capacity Improvement with Geogrids Advantages, Mechanism. Modes of Failure, Friction Coefficient, Experimental Studies.

UNIT VII

Application of Geosynthetics in Water Resources Projects Case Studies: Dharoidam, Hiran II Dam, Meda Creek Irrigation Scheme, Lining of Kakarapar Canal.

Reference Books:

1. Robert M. Koerner, Designing with Geosynthetics, Prentice-Hall
2. G.V. Rao & G.V.S. Raju, Engineering with Geosynthetics, Tata McGraw-Hill
3. DebashisMoitra, Geotechnical Engineering, Universities Press, Edition No. - I, 2016.

Sixth Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
	Professional Elective courses [#]	PECE-602E-18	Geo Environmental engineering	3[#]	1	0	4

UNIT I

Soil Contamination: Introduction to Geo environmental engineering, Development of environmental geotechnology sources, Environmental cycles production and classification of waste, Waste Containment.

Contaminant's movements in soil, Contaminant transport in sub surface: advection, diffusion, dispersion, governing equations.

UNIT II

Groundwater contamination, Water quality standards, Sources of contamination, Hydro chemical behavior of contaminants - Trace metals - Trace nonmetals - Nitrogen, organic substances - Measurement of parameters - Velocity - Dispersity - chemical partitioning

UNIT III

Remediation of contaminants from soil and Ground water: contaminant transformation: sorption, biodegradation, ion exchange, precipitation: ex-situ and in-situ remediation – solidification, bio–remediation, soil washing, electro kinetics, soil heating, verification, bio venting, Ground water remediation – pump and treat, air spraying, reactive well.

UNIT IV

Solid waste disposal and stabilization: Hazardous waste control and storage system 3 mechanism of Stabilization, incineration, organic and inorganic stabilization reutilization of solid waste for soil improvement.

UNIT V

Engineered landfill: Site selection, dumping, Design of landfill: CNS layer, leachate and air collection units, Case studies. CPCB rules and regulations on waste handling and management - Criteria for selection of sites for waste disposal - Disposal techniques -Disposal systems for typical wastes.

Sixth Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
	Professional Elective courses #	PECE -602F-18	Rock Mechanics	3	1	0	4

Course Outcome: On completion of this course, the students will be able to:
1 Identify the problems associated with underground excavations
2 Classify the rock mass using the reference data
3 Understand the failure criteria of rock
4 Determine in-situ stresses from field test data

UNIT I: Introduction
Importance of rock mechanics, composition of rocks, geological and lithological classification of rocks, classification of rocks for engineering purposes, R.Q.D. method of classification of rocks. Theories of Brittle failure.

UNIT II: Laboratory Testing of Rocks
Various methods of obtaining rock cores, methods of sample preparation, methods of removing end friction of the rock samples. Compression testing machine, uniaxial compression strength of rock samples, methods of finding tensile strength-direct and indirect methods, Brazilian test, shear box test, triaxial shear test, punch shear test

UNIT III: In-situ Testing of Rocks
Field direct shear test on rock blocks, field triaxial strength, use of flat jacks, chamber test, plate load test, cable jacking test.

UNIT IV: Stress Evaluation in Field Stress-
relief technique(over coring), use of strain gauges, bore hole, deformation cell, photoelastic stress meter, stress measurement with flat jack. Hydraulics Fracturing Techniques.

UNIT V: Stabilization of Rocks
Rock bolting, principle of rock bolting, various types of rock bolts, application of rock bolting. Field testing of rock bolts and cable anchors.

UNIT VI: Elastic and Dynamic
Properties of Rocks Stress-strain behaviour dynamic properties, resonance method and ultra-sonic pulse method.

UNIT VII: Pressure on Roof of Tunnels
Trap door experiment, Terzaghi's theory, Bieraumer, kommerel, Protodyakanov theory.

UNIT VIII: Stress Around the Tunnels
Basic design and Principles of tunnels in rocks, design of pressure tunnels in rocks.

Reference Books
1 Lama,et.al Rock Mechanics, Vol.I,II,III,IV
2 Jaeger and Cook, Fundamentals of Rock Mechanics
3 Stagg &Zienkiewiez, Rock Mechanics
4 Obert&Duvell, Rock Mechanics & Design of Structures in Rocks
5 Jaeger, Rock Mechanics & Engineering
6 Schzy, Art of Tunneling

SYLLABUS FOR BASKET OF ELECTIVE COURSES OF ELECTED TRACKS

Track-II: Structural Engineering

Sixth Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
	Professional Elective courses #	PECE - 603A-18	Design of Concrete Structures	3#	1	0	4

Course outcomes: On completion of this course the students will be able:
1. To apply the loads on building frames and analyse them using direct and indirect methods.
2. To analyse the concrete components i.e. continuous beams, flat slabs, tanks and retaining walls, etc
3. To design and detail the concrete components i.e. curved beams, flat slabs, tanks and retaining walls, etc
4. To analyse and design the special foundations i.e. raft, pile and machine foundations.

Unit-I: Building frames:
Types, Analysis for vertical loads (Kani's method, Substitute frame method), Analysis for lateral loads (Portal and Cantilever), concept of redistribution of moments, design and detailing of various components (continuous beams and columns with uni or bi-axial bending)

Unit-II: Liquid retaining structures:
Introduction, Design criteria, Design of rectangular and circular concrete water tank resting on ground, Design of Intze tank, Staging for overhead tank.

Unit-III: Flat slabs:
Advantages and disadvantages of flat Slabs, basic action of Flat Slabs, Direct Design Method, Equivalent frame method, Codal provisions

Unit-IV: Design of special structures:
Retaining walls- cantilever and counter-fort type, curved beams (IS code method).

Unit-V: Foundations:
Design of raft foundation, pile foundation; Introduction to machine foundation, vibration characteristics, design consideration of foundation to rotary machine and impact machine.
 # Note: Design as per the relevant IS codes.

Reference Books:
1. Reinforced Concrete Design; Pillai & Menon; Tata McGraw-Hill Education
2. Advanced Reinforced Concrete design; Varghese P C; PHI Pvt.Ltd.
3. Advanced Reinforced concrete design, Krishnaraju
4. Jain, A.K., Reinforced Concrete-Limit State Design, Nem Chand & Bros
5. Advanced RCC Design, SS Bhavikatti.
6. Design of concrete structures, B C Punmia
7. Prestressed concrete by Krishna Raju, TMH

BIS Codes of practice and Design Handbooks:
1. *IS 456-2000*- Indian Standard. Plain and Reinforced concrete -Code of practice
2. *IS 3370- Code of practice for concrete structures for storage of liquids
3. *IS1343-2012- Code of practice for Prestressed concrete
4. *Design Aid SP 16

Note: The codes marked with * are permitted in examination.

Sixth Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
	Professional Elective courses #	PECE-603B-18	Design of Steel Structures	3#	1	0	4

Course outcomes: On completion of this course student will be able :
1. To apply the knowledge for analysis and design of various components of a plate girder.
2. To analyse , evaluate and design the different types of beam-column connections.
3. To design the column bases and footings for a steel structure under various loading conditions.
4. To analyse the loads and design various elements of industrial buildings.
5. To demonstrate the basic knowledge of plastic analysis of simple steel elements.

Unit-I: Design of Plate girders:
Elements of a plate girder, design of plate girder, curtailment of flanges, various type of stiffeners.

Unit-II: Beam-column connections:
Types of beam-column connections, Design of shear resistant connections - Design of bracket connections, seat connections and framed connections.

Unit-III: Column bases and footings
Types, slab base, gusseted base, bases for eccentrically loaded columns, Grillage footing.

Unit-IV: Industrial Buildings:
Types, elements of industrial buildings/sheds, structural planning, analysis and design of trussed roof/bents, crane/gantry girders, column brackets, transverse and longitudinal bracings.

Unit-V: Plastic analysis:
Introduction to Plastic analysis; plastic hinge mechanism, collapse load, analysis of simple beams and frames.

 # Note: Design procedure as per the relevant IS codes and guidelines.

Reference Books:
1. Limit state design of steel structures: S K Duggal, TMH
2. Design of steel structures (Vol. 2): Ram Chandra
3. Design of steel structures by BC Punmia
4. Design of steel structures, Vazirani and Ratwani
5. Planning of Industrial Structures, Dunham, C.W., John Wiley and Sons
6. Design of steel structures, Arya and Azmani.

BIS Codes of practice and Design Handbooks:
1) IS 800: 2007 (General construction in steel-Code of practice)*
2) IS 875-2015 Part -3 [Design loads (other than earthquake) for buildings and structures — code of practice-wind loads]*
3) SP: 6(1) (Handbook for structural engineers-Structural steel sections)*

Note: The codes marked with * are permitted in examination.

Sixth Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
	Professional Elective courses ##	PECE-603C-18	Advanced Structural Analysis	3#	1		4#

Course Outcomes: On completion of this course students will be able:
1. To evaluate the indeterminacy of different types of building frames.
2. To develop and relate stiffness and flexibility matrices for beams and frames.
3. To analyse beams and fames using flexibility and stiffness matrix method.
4. To apply the concept of finite element method to basic civil engineering structures.

Unit-I: Analysis of building frames
Static and kinematic indeterminacies of rigid and pin-jointed frames, action and displacement equations, generalized system of coordinates, Kani's method, and other approximate methods-Portal, cantilever and substitute frame method.

Unit-II: Flexibility matrix method
Development of flexibility matrices for statically determinate and in determinate beams, rigid-jointed and pin-jointed plane frames using physical approach. Analysis of simple problems of beams and frames and its computer applications.

Unit-III: Stiffness matrix method
Relation between flexibility and stiffness matrices, transformation of element stiffness matrices to system stiffness matrix, development of stiffness matrices for statically determinate and indeterminate structures using physical and element approach, Analysis of simple problems of beams and frames and its computer applications

Unit-IV: Finite element method:
Review of principle of virtual work, Ritz method, Basic concept, elementary applications of principles and formulation of problems, the element characteristic matrix - element assembly
and solution for unknowns, basic equations of elasticity, strain displacement relations, steps of FEM, Basic element shape, Discretization process; Application of finite element method to one and two dimensional plane stress strain elements.

Unit-V: Model analysis:
Structural similitude, Direct and indirect model analysis, Model material and model making, Measurement for forces and deformations.

Reference Books:
1 Basic structural analysis - C.S. Reddy Tata McGraw-Hill
2. Intermediate structural analysis - C . K. Wang. McGraw Hill
3. Structural Analysis, Devdas Menon, Narosa Publishers.
4. Structural analysis- A matrix approach - GS Pandit and SP Gupta
5. Matrix analysis of framed structures - William weaver, Jr. James M. Gere
6. Finite element analysis - C.S. Krishnamurthy
7. Finite element methods - O.C. Zeincwicz

Sixth Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
	Professional Elective courses #	PECE-603D-18	Structural Analysis and Design	3#	1		4#

Course Outcomes: On completion of this course the students will be able:
1. To understand and determine the indeterminacy of different types of structures.
2. To calculate forces and moments in indeterminate structures due to static as well as moving loads.
3. To analyse and design concrete structures i.e. column subjected to moments, foundations, retaining walls, etc.
4. To analyse and design the steel structures i.e. column bases, beam-column joints, plate girders and roof trusses.

Unit-I: Review of indeterminacy:
Static and kinematic indeterminacies of beams, rigid-jointed and pin-jointed plane frames.

Unit-II: Analysis of indeterminate structures:
Analysis indeterminate beams and frames by Kani's method, Theorem of three moments and other approximate methods-Portal, Cantilever and Substitute frame method.

Unit-III: Moving loads and influence lines:
Analysis of moving Loads for determinate beams, Influence lines for indeterminate beams, trusses and frames. Muller Breslau principle.

Unit-IV: Design of Concrete structures:
Columnswith moments: Design of short columns with uni-axial and bi-axial bending; Design of Long columns, use of design charts; **Foundations**: Isolated and combined footing for columns; **Staircases**, Introduction, types and design; **Retaining walls** - Cantilever and Counter-forte type retaining wall.

Unit-V: Design of Steel Structures:
Column bases: Slab base, Gusseted base; **Beam-column connections:** bracket connections, seated and framed connections.; **Plate girders:**Elements of a plate girder, design of plate girder section, intermediate and bearing stiffeners, **Roof trusses:** Types, Design loads, design of members and joints.

Reference Books
1 Basic structural analysis - C.S. Reddy Tata McGraw-Hill
2. Intermediate structural analysis - C . K. Wang. McGraw Hill
3. Structural analysis - S Ramamurtham,
4. Reinforced Concrete Design; Pillai & Menon; Tata McGraw-Hill Education
5. Limit state Design of Reinforced Concrete; Varghese P C; PHI Pvt.Ltd.
6. Design of concrete structures, B C Punmia
7. Limit state design of steel structures: S K Duggal, TMH
8. Design of steel structures: N Subramanian, Oxford publications
9. Design of steel structures (by limit state method as per IS: 800-2007), S SBhavikatti

BIS Codes of practice and Design Handbooks:
1. *IS 456-2000- Indian Standard. Plain and Reinforced concrete -Code of practice
2. *Design Aid SP 16.
4. *IS 800: 2007 (General construction in steel-Code of practice)
5.* IS 875-2015 Part -3 [Design loads (other than earthquake) for buildings and structures — code of practice- wind loads]
6. *SP: 6(1) (Handbook for structural engineers-Structural steel sections)

Note: The codes marked with * are permitted in examination.

Sixth Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
	Professional Elective courses #	PECE-603D-18	Structural Analysis and Design	3#	1	0	4

Course Outcomes: On completion of this course the students will be able:
1. To understand and determine the indeterminacy of different types of structures.
2. To calculate forces and moments in indeterminate structures due to static as well as moving loads.
3. To analyse and design concrete structures i.e. column subjected to moments, foundations, retaining walls, etc.
4. To analyse and design the steel structures i.e. column bases, beam-column joints, plate girders and roof trusses.

Unit-I: Review of indeterminacy:
Static and kinematic indeterminacies of beams, rigid-jointed and pin-jointed plane frames.

Unit-II: Analysis of indeterminate structures:
Analysis indeterminate beams and frames by Kani's method, Theorem of three moments and other approximate methods-Portal, Cantilever and Substitute frame method.

Unit-III: Moving loads and influence lines:
Analysis of moving Loads for determinate beams, Influence lines for indeterminate beams, trusses and frames. Muller Breslau principle.

Unit-IV: Design of Concrete structures:
Columnswith moments: Design of short columns with uni-axial and bi-axial bending; Design of Long columns, use of design charts; **Foundations**: Isolated and combined footing for columns; **Staircases**, Introduction, types and design; **Retaining walls** - Cantilever and Counter-forte type retaining wall.

Unit-V: Design of Steel Structures:
Column bases: Slab base, Gusseted base; **Beam-column connections:** bracket connections, seated and framed connections.; **Plate girders:**Elements of a plate girder, design of plate girder section, intermediate and bearing stiffeners, **Roof trusses:** Types, Design loads, design of members and joints.

Reference Books
1 Basic structural analysis - C.S. Reddy Tata McGraw-Hill
2. Intermediate structural analysis - C . K. Wang. McGraw Hill
3. Structural analysis - S Ramamurtham,
4. Reinforced Concrete Design; Pillai & Menon; Tata McGraw-Hill Education
5. Limit state Design of Reinforced Concrete; Varghese P C; PHI Pvt.Ltd.
6. Design of concrete structures, B C Punmia
7. Limit state design of steel structures: S K Duggal, TMH
8. Design of steel structures: N Subramanian, Oxford publications
9. Design of steel structures (by limit state method as per IS: 800-2007), S SBhavikatti

BIS Codes of practice and Design Handbooks:
1. *IS 456-2000- Indian Standard. Plain and Reinforced concrete -Code of practice
2. *Design Aid SP 16.
4. *IS 800: 2007 (General construction in steel-Code of practice)
5.* IS 875-2015 Part -3 [Design loads (other than earthquake) for buildings and structures — code of practice- wind loads]
6. *SP: 6(1) (Handbook for structural engineers-Structural steel sections)

Note: The codes marked with * are permitted in examination.

Sixth Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
	Professional Elective courses [#]	PECE-603E-18	Prestressed Concrete	3[#]	1	0	4

Course outcome: On completion of this course the student will be able to:

1. Recognize the materials for prestressed concrete and its properties, advantages and applications in contrast to normally reinforced concrete.
2. Comprehend the concept of pre-tensioning and post-tensioning of prestressed concrete, types of prestressed members, prestressing systems and its components.
3. Analyse the prestress, its losses, and determine the strength of a prestressed concrete sections using Indian Standards (IS) guidelines under flexure, shear and torsion.
4. Evaluate the strength and serviceability requirements of different prestresed concrete members i.e. beams, slab and anchor blocks.
5. Design the sections and the reinforcement for prestressed concrete beams, prestressed slabs and anchorage zones as per the IS specifications.

Unit-I: Materials for prestressed concrete

Introduction to prestressing concrete; High strength concrete- strength, creep and shrinkage, permissible stresses; High tensile prestressing steel –treatments, forms of prestressing steel, strength, relaxation of steel, permissible stresses.

Unit-II: Prestressing devices and systems

Types of prestressing, tensioning devices and equipments, pre-tensioning systems, post- tensioning systems (advantages and disadvantages, procedure, applications)

Unit-III: Analysis of prestress and bending stresses

Analysis of prestress, resultant stresses at a section, pressure line or thrust line concept and internal resisting couple, concept of load balancing, losses of prestress, deflection of beams.

Unit-IV: Strength of prestressed concrete sections

Types of flexural failure, strain compatibility method, IS:1343 code procedure for flexural strength, design for limit state of shear and torsion and codal provisions for detailing.

Unit-V: Design of prestressed concrete beams and slabs

Transfer of prestress in pre tensioned and post tensioned members, design of anchorage zone reinforcement, design of simple beams/gorders, cable profiles, design of slabs.

Reference Books

1. N. Krishna Raju, Prestressed concrete, Tata McGraw Hill
2. T.Y. Lin, Ned H. Burns, Design of Prestressed Concrete Structures, John Wiley & Sons.
3. P. Dayaratnam, Prestressed Concrete, Oxford & IBH
4. R. Rajagopalan, Prestressed Concrete.

BIS Codes of practice

1. * IS 1343 2012, Code of Practice for Prestressed Concrete
2. * IS 456-2000, Code of practice for design of reinforced concrete

Note: The codes marked with * are permitted in examination.

Sixth Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	P	
	Professional Elective courses #	PECE-603F-18	Bridge Engineering	3#	1	0	4

Course Outcomes: On completion of this course the student will be able:
1. To evaluate the basic design considerations for different types of bridge structure.
2. To analyse the concrete and steel bridges as per the various loading standards of India.
3. To design the main structure of the concrete and steel bridges.
4. To design the various types sub-structure and bearings for a bridge.
5. To demonstrate the various construction and maintenance methods for a bridge structure.

Unit-I: Planning and General design consideration
Classification of bridges, Factors considered for planning of Concrete and Steel Bridges site selection; Design consideration - geometric and hydraulic considerations, optimum spans; Design aids andCodes of practice, loading standards for highway and railway bridges (IS, IRC, RDSO, AASHTO).

Unit-II: Concrete Bridges
Culverts; Slab, T-beam, box girder bridges, balanced cantilever bridge, arch bridge; Bridge deck and approach slabs - Slab design methods - bridge deck systems - Slab-beam systems - Box girder systems - Detailing of box girder systems. (not design), Special requirements for Prestressed Concrete bridges.

Unit-III: Steel Bridges
Plate girder bridge, truss bridge, suspension cable bridge, cable stayed bridge; Analysis and design of Truss bridge and plate girder bridge

Unit-IV: Substructures:
Design of Piers - Columns and towers; Caissons, pile and well foundations; abutments and retaining walls.

Unit-V: Bearings and expansion joints
Types and functions of bearings, design of elastomeric bearings, rocker and roller type bearings, general requirements for provisions of expansion joints.

Unit-VI: Construction techniques and maintenance
Construction techniques: Cast in-situ, Prefabricated, Incremental launching, Free cantilever construction, provisions for inspection and maintenance.

 # Note: Design as per the relevant IS, IRC codes and guidelines for bridges.

Reference Books
1. Krishna Raju N., "Design of Bridges", 4th Edition, Oxford and IBH Publishing Co., Ltd., 2008
2. Ponnu Swamy, "Bridge Engineering", 4th Edition, McGraw-Hill Publication, 2008.
3. Swami Saran, "Analysis and Design of sub-structures",2nd Edition, Oxford IBH Publishing co ltd., 2006.
4. Vazirani, Ratvani&Aswani, "Design of Concrete Bridges",5th Edition, Khanna Publishers,2006.
5. D.J. Victor, "Essentials of Bridge Engineering," Oxford & IBH Publishing, New Delhi, 2001.

BIS Codes of practice and Design Handbooks:
1) IS 800: 2007 (General construction in steel-Code of practice)*
2) SP: 6(1) (Handbook for structural engineers-Structural steel sections)*
3) IS 456:2000 Code of practice for design of concrete structures*
3) Relevant IRC and IS guidelines for bridge design.

Note: The codes marked with * are permitted in examination.

SYLLABUS FOR BASKET OF ELECTIVE COURSES OF ELECTED TRACKS

Track-III: Construction Engg.

Sixth Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
	Professional Elective courses #	PECE-604A-18	Construction Equipment & Automation	3	1	0	4

External Marks: 60, Internal Marks: 40, Total Marks: 100

Course Outcomes

1. Understand Equipments& Automation and key features of its performance
2. Know automation systems in detail, including its evolution, objectives, criteria, levels of benefits, and shortcomings
3. Know a series of case studies representing diverse project types, sizes, certification levels, and climate regions
4. Know what are innovations in construction equipments

Content

UNIT-I :Construction Equipment

Introduction, significance of equipment in construction industry - laboratory setting including plan reading, specification reading, construction scheduling and estimating, Job layout and its importance. Study of equipments with reference to available types and their types and their capacities, factors affecting their performance.

UNIT – II: Construction Equipment Management

Equipment Management- Introduction, Differences between men and manpower, Extent of Mechanisation, Equipment planning, Selection of equipment, Forward planning, Purchase of Equipment, Specifications for ordering equipment

Unit –III: Equipment for Earthwork

Fundamentals of Earth Work Operations - Earth Moving Operations - Types–Excavation equipment- Power Shovels, Back Hoe, Drag line, Clamshell – Scrapers, Bull Dozers, Tractors, Hauling Equipment – Dump trucks, Dumpers Loaders, trucks, Earth Compaction Equipment-Tamping Rollers, Smooth Wheel Rollers, Sheepsfoot Roller, Pneumatic-tyred Roller, Vibrating Compactors, Vibrocompaction methods.

UNIT-IV: Other Construction Equipment

:Pile driving Equipment - Erection Equipment – Cranes, Derrick Cranes, Mobile cranes, Overhead cranes, Traveller cranes, Tower cranes - Types of pumps used in Construction - Grouting - Material Handling Conveyors –Industrial Trucks, Forklifts and related equipment.

Unit-V: Equipment for Concrete and Road laying

Aggregate production equipment- Different Crushers – Feeders - Screening Equipment -Handling Equipment - Batching and Aggregate Mixing Equipment - Asphalt Plant, Asphalt Pavers, Asphalt compacting Equipment – Ready mix concrete equipment, Concrete mixers, Concrete batching and mixing plant, Transportation of concrete mix, Concrete pouring and pumps, concrete compaction equipment.

UNIT-VI: Automation:

Introduction & Technical terms of Automation and robotics; advantages & disadvantages, Need for construction automation, Applications, Automation in precast construction industry, Autonomous Machines on the Construction Site, Drones to Survey Working Areas , Robotics in Concrete Works, IoT Sensors to Collect and Process Data, Virtual Reality During Project Planning and Training **,** Automatic Concrete Screeding Machine, Concrete Surface Finishing Robot, Automation in High Rise Building Construction, Automation in prefabrication of masonry and on site masonry construction, partially automated masonry element prefabrication, automated manufacture of brick wall masonry blocks, Automation in timber construction, Automation in production of steel components, Transformable welding robot.

Reference Books

1Peurifoy, R.L., Ledbetter, W.B. and Schexnayder, C., "Construction Planning, Equipment and Methods", McGraw Hill, Singapore, 2006.
2. Sharma S.C. "Construction Equipment and Management", Khanna Publishers, New Delhi, 1988.
3. Deodhar, S.V. "Construction Equipment and Job Planning", Khanna Publishers, New Delhi, 1988.
4. Dr.MaheshVarma, "Construction Equipment and its planning and Application", Metropolitan Book Company, New Delhi. 1983.

Sixth Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
	Professional Elective courses #	PECE-604B-18	Sustainable Construction Methods	3#	1	0	4

External Marks: 60, Internal Marks: 40, Total Marks: 100

Course Outcomes:

1. Create new engineering materials to improve the performance of infrastructure
2. Characterize and mitigate natural and man-made hazards
3. Improve fundamental knowledge of the inter-relationships between the built environment and natural systems.
4. Develop the technological innovations needed to safeguard, improve, and economize infrastructure

Content

UNIT-I : INTRODUCTION

Definitions- Various types - Pillars of Sustainability - Circle of Sustainability - Need - systems and their sustainability - Green Buildings -Difference between Green and Sustainability - Climate Change, Global warming - National and International policies and Regulations. Identification of cutting edge sustainable construction materials, technologies, and project management strategies for use in the construction industry and evaluation of their potential to reduce the negative environmental impacts of construction activity.

UNIT – II: BUILDING CONSTRUCTION METHODS

Conventional vs modular construction methods, development , Engineering principles, benefits**,** Modular construction methods for repetitive works, Green Roofs, Cool Roofs, Passive House, Rammed Earth Brick**,** Passive Solar, Greywater Plumbing Systems, Solar Thermal Cladding, Solar Power, Water Efficiency Technologies, Sustainable Indoor Environment Technologies.

UNIT –**III: PRECAST CONSTRUCTION METHODS**

Modular construction methods for repetitive works; Precast concrete construction methods; Benefits , Sustainability in Concrete Mix Design, Greener, Faster and Sustainable Construction Practices Through Precast Solutions, Use of secondary cementitious material (SCM's) like GGBS, fly ash, ultra-fine GGBS in the production of the concrete, Basics of Slip forming for tall structures, Structural 3D Printing, Self-healing Concrete**,** Green Insulation, Sustainable Resource Sourcing, Environmental Sustainability Benefits From Precast Concrete.

UNIT-IV: CONSTRUCTION METHODS OF BRIDGES

Types of foundations and construction methods; Basics of Formwork and Staging;Proactive Maintenance**,** Prefabrication/Modular Construction, balance between environment and construction activities, reducing problems at site with minimal staging, increasing safety etc, Constructions are sustainable with reduced use of natural resources, Costs of Construction/Assembly and Transportation, Lifespan, Environmental Impact, harmful emissions during bridge construction, Reducing waste, solar panels to power LED lights to illuminate its deck, water-powered light system powered by the currents of the river, development that meets the needs of the present.

UNIT-V: NEW CONSTRUCTION MATERIALS TECHNOLOGIES Introduction to new construction materials & technologies, Synthetic Roof Underlayment, Electro chromic Glass, Biodegradable Materials, Reduction of water consumption, Impact on environment, Concepts of climate responsive building,Sustainability assessment using standard approaches- LEED/GRIHA rating evaluation process

Text/Reference Books

1. Margaret Robertson, Sustainability Principles and Practice, Routledge, 2014
2. Martin A. A. Abraham, Sustainability Science and Engineering: Defining Principles, Elsevier Science, 2005
3. Tony Clayton, Nicholas J. Radcliffe, Anthony M. H. Clayton, Sustainability: A Systems Approach, Routledge, 1996
4. Stephen M. Stephen, Stephen M. Wheeler, Climate Change and Social Ecology: A New Perspective on the Climate Challenge, Routledge, 2012
5. Gursharan Singh Kainth, Climate Change, Sustainable Development and India, LAP Lambert Academic

Publishing, 2011

Sixth Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
	Professional Elective courses #	PECE-604C-18	Repair and Rehabilitation of Structures Methods	3#	1	0	4

Objectives:-

To understand the knowledge on quality of concrete, durability aspects, causes of deterioration, repairing of structures and demolition procedures.

Course Outcomes After studying this course, students will be able to

1. Understand the cause of deterioration of concrete structures.
2. Able to assess the damage for different types of structure.
3. Summarize the principles of repair and rehabilitation of structures.
4. Recognize the ideal material for different repair and retrofitting techniques.

Content

Unit-I: Introduction to Rehabilitation of Structures

Aging of Structures, Performance of Structures, Need for rehabilitation of structural members, Maintenance, Facets of Maintenance, Importance of Maintenance, Various aspects of Inspection, Assessment procedure for evaluating a damaged structure, Causes of deterioration.

Unit-II: Evaluation and Deterioration of Concrete Buildings

Visual Integration, Destructive Testing Systems, Non-Destructive Testing Techniques, Semi Destructive Testing Techniques, Chemical Testing, Embedded Metal Corrosion, Disintegration Mechanisms, Moisture Effects, Thermal effects, Structural effects, Faulty construction, Distress in structure due to corrosion, fire, leakage, earthquake and effects, case studies, damage assessment and evaluation models.

Unit III: Strength and Durability of Concrete

Quality assurance for concrete – Strength, Durability and Thermal properties of concrete – Cracks, different types, causes – Effects due to climate, temperature, Sustained elevated temperature, Corrosion – Effects of cover thickness and cracking, Methods of corrosion protection, Corrosion inhibitors, corrosion resistant steels, coatings, and cathodic protection, Special concretes -- Polymer concrete, Sulphur infiltrated concrete, Fibre reinforced concrete, High strength concrete, High performance concrete, Vacuum concrete, Self-compacting concrete, Geopolymer concrete, Reactive powder concrete, Concrete made with industrial wastes.

Unit IV: Surface Repair and Retrofitting

Strategy and Design, Selection of Repair Materials, Surface Preparation, Bonding Repair Materials to existing concrete, Placement methods, Epoxy bonded replacement concrete, Preplaced aggregate concrete, Shotcrete/Gunite, Grouting, Injection Grouting, Micro concrete, Mortar repair for cracks, shoring and underpinning.

Unit V: Strengthening Techniques and Seismic Rehabilitation

Beam Shear capacity Strengthening, Shear Transfer Strengthening between members, Column Strengthening, Flexural Strengthening and Crack Stabilization, Seismic strengthening of structures, Guidelines for Seismic Rehabilitation, Seismic Vulnerability and Strategies for Seismic Retrofit.

Reference's Books

1. R.T. Allen and SC Edwards, "Repair of Concrete Structures", Blakie and Sons, 1987
2. FEMA273, NEHRP Guidelines for Seismic Rehabilitation of Buildings, 1997
3. DovKominetzky.M.S., "Design and Construction Failures", Galgotia Publications Pvt. Ltd., 2001
4. Emmons, P.H., "Concrete Repair and Maintenance", Galgotia Publication,2001
5. Ravishankar.K, Krishnamoorthy.T.S, "Structural Health Monitoring, Repair and Rehabilitation of Concrete Structures", Allied Publishers, 2004.

6. Malhotra, V.M. and Carino, N.J., " Handbook on Non Destructive Testing of Concrete", CRC press, 2004
7. Bohni, H., "Corrosion in Concrete Structures", CRC Press., 2005
8. ShettyM.S., "Concrete Technology – Theory and Practice", S.Chand and Company, 2008.
9. CPWD and Indian Buildings Congress, Hand book on Seismic Retrofit of Buildings, Narosa Publishers, 2008.
10. P.C. Varghese , "Maintenance Repair and Rehabilitation and Minor Works of Bridges", PHI learning Pvt.Ltd, 2014.

Sixth Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
	Professional Elective courses #	PECE-604D-18	Construction Cost Analysis **Methods**	3	1	0	4

Course Outcomes: Student shall be able to

1. To Prepare Capital budgeting of a Construction site.
2. To Prepare a Performance statement of a company'
3. To estimate various financial instrumental such as IRR, Break even analysis
4. To prepare a Job Cost report of a Construction Site.

Unit-I: Project Appraisal

Project appraisal, government and private project evaluators, significance of social benefit – cost analysis, commercial profitability, national economic profitability, measurement of direct and indirect benefit and costs. Calculation of benefit cost ratio.

Unit-II : Engineering economics

Time value of money, discounted cash flow, decision making among the alternatives, replacement analysis, break even analysis.

Project capital: Cash flow of a project, estimation of minimum capital required, internal rate of return (IRR), Multiple IRR, estimation of annualized cost.

Unit-III: Depreciation

Importance, classification, types – straight line, sum of year method, double rate declining balance method.

Capital Budgeting: Element of budgeting – men, materials, equipment, overhead, profits – preparation of capital budget.

Unit-IV: Cost Control:

Understanding control, operating cycles, cost account codes, Job cost report, Projected Cost Estimates, status reporting, variance and earned value.

Unit-V: Performance statement

Capital gearing ratio, shares, debentures, PBT, PAT, PBIT, Earning per share, preparation of company's performance statement, Inflation.

REFERRENCE BOOKS:

1. M Pandey, Financial Management, Vikas Publishing house pvt ltd9th Edition.
2. Donald Newnan, Engineering Economics analysis, Oxford University Press
3. R Panneerselvam, Engineering Economics, PHI Learning Pvt. Ltd.
4.Frank Harris & Ronald Mc CafferModern Construction ManagementBlackwell science4th Edition.
5. Roy PilcherPrinciples of Construction Management, Mc Graw Hill London.
6. United Nations Guidelines for Project Evaluation Oxford & IBH Publishing Co. Pvt. Ltd.
7. A.H. Taylor & H Shearing, Financial & Cost Accounting for Management Mac Donald & Evans

Sixth Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
	Professional Elective courses #	PECE-604E-18	Contract Management	3	1	0	4

Course Outcomes:

To make Civil Engineering students able to analyze, evaluate and design construction contract documents.

UNIT I: Construction Contract:
Terminology, Importance, Agreement, Contract, essential conditions, Elements, nature, Features, Suitability. Subcontracts and supply contracts, Indian Contracts Act. Types of contract: Lump sum contract, Item rate contract, Cost plus fixed fee contract, Cost plus percentage contract, Special contracts.
Execution of Works: Direct execution by Department, Muster Roll, Piece work Agreement, Work Order.

UNIT II: Construction Specifications
Standard specifications, general specification, development, interpretation. Tender and tender documents: tender form, Types of bidding, tender notice, tendering procedure, submission and opening of tender.

UNIT III: Contract document
Design of Contract Documents –Contract document: Drafting of clauses, development, and interpretation, CPWD conditions of contract, FIDIC conditions of contract. International Contract Document, Standard Contract Document.

UNIT IV: Construction claims
Extra item, excess quantity, deficit quantity, price escalation. Dispute resolution mechanism: litigation, arbitration, conciliation, mediation, dispute resolution board. Contractual Problems: Possible contractual problems, creation of claims, development of disputes.
BOT contract: Types of contract, PPP framework, types of risk, concession agreement, drafting of clauses, development, and interpretation.

UNIT V: Legal requirements
Labour Laws, Child Labour Act, Sales Tax, VAT, Service Tax, Excise Duty, Laws relating to Wages, Bonus and Industrial Disputes, Labour Administration, Insurance and Bonding, Insurance and Safety Regulations.

REFERRENCE BOOKS:
1. L.S. Ranaga Rao Contract Management and Dispute Resolutions Engineering staff College of India January 2008.
2. C. J. Schexnayder and R. E. Mayo,Construction Management Fundamentals,McGraw Hill, New Delhi.2003
3. General Conditions of Contract,Central Public Works Department, New Delhi,2010
4. S. RanagaRao,Contract Management & Dispute Resolutions,Engineering staff College of India,January 2008
5. D.S. Berrie and B.c.Paulson,Professional construction management including C.M.,Design construct and general contracting,McGraw Hill InternationaL,Third Edition 1992..
6. V. K. Raina,Construction& Contract Management Practices,SPD, New Delhi

Sixth Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
	Professional Elective courses #	PECE-604F-18	Construction Engineering Materials	3	1	0	4

Course Outcomes: On completion of this course the student will be able

•To Provides a broad understanding of the composition, microstructure, and engineering behavior of various materials used in civil engineering applications.

•To Introduces various modifications possibilities in construction materials.

•To Understand and Explain Special Concrete.

Unit-I: Construction Materials

Classifications of Construction Materials. Consideration of physical, Mechanical, thermo-physical Properties, characteristics behaviour under stress, Selection criteria for construction materials, green building materials.

Unit-II: Materials for making Mortar and concrete

Lime manufacture, properties, hardening of lime, types of lime, lime concrete uses. Cement, pozzolanic material, aggregates, water, admixtures - characteristics, properties and uses. Types of mortars, special mortars,their properties and applications.

Ceramic Materials: Classification, Refractories, glass, glass wool, mechanical, thermal and electrical properties, fire resistance materials, Uses and application.

Unit-III: Polymers in civil engineering

Rubber and plastics, properties, effect of temperature on mechanical properties. Uses and application.Polymers, fibres and composites, Fibre reinforced plastic. Architectural use and aesthetics of composites. Adhesives and sealants. Structural elastomeric bearings and resilient seating. Moisture barriers, Polymer foams and polymers in Building Physics. Polymer concrete composites.

Unit IV: Metals

Types of structural steels, special steel, alloy steel, stainless steel, light gauge steel, Corrosion of concrete and reinforcing steel in various environments. Electro-chemical process and measures of protection during construction. Ferro-cement, composition and properties.

Unit V: Modified Materials

Modified bitumen using plastic or polymers, Modified cement concrete using various industrial ashes, soil stabilised using slag, polymers - their properties, advantages and applications as per Indian conditions.

Unit-VI: Special concretes

Concretes, Behaviour of concretes – Properties and Advantages of High Strength and High-Performance Concrete – Properties and Applications of Fibre Reinforced Concrete, Self- compacting concrete, Alternate Materials to concrete on high performance & high Strength concrete.

REFERENCES BOOKS:

1. Rangawala S.C. Engineering Materials Chortor Publications 1991.
2. S.K. Duggal Building Materials, New Age International Publications 2006.
3. Bruntley L.R Building Materials Technology Structural Performance & Environmental Impact McGraw Hill Inc 1995.
4. R Chudley Construction Technology, Vol I - IV Longman Group Construction Ltd. 1973.

Open Elective Course

Sixth Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours per week**			**Credit**
				L	**T**	**P**	
1	Open Elective	OECE-609	Remote Sensing and GIS	3	0	0	3

External Marks: 60, Internal Marks: 40, Total Marks: 100

Course Objectives

- To introduce the concepts of remote sensing, satellite image characteristics and its components.
- To expose the various remote sensing platforms and sensors and to introduce the concepts of GIS, GPS and GNSS.

Course Outcome

The course will enable the students understand:

- The characteristics of Remote sensing satellites and Applications of remote sensing.
- The GIS and its Data models.
- The Global Navigation Satellite System.

Content

Unit-I: Remote Sensing: Physics of remote sensing, Remote sensing satellites, and their data products, Sensors and orbital characteristics, Spectral reflectance curves, resolution and multi-concept, FCC

UNIT – II: Satellite Image - Characteristics and formats, Image histogram, Introduction to Image rectification, Image Enhancement, Elements of interpretation, Land use and land cover classification system, Unsupervised and Supervised Classification, Applications of remote sensing

UNIT - III Basic concepts of geographic data, GIS and its components, Data models, Topology, Process in GIS: Data capture, data sources, data encoding, geospatial analysis, GIS Applications

UNIT - IV Global Navigation Satellite System (GNSS), GPS, GLONASS, GALILEO, GPS: Space segment, Control segment, User segment, GPS satellite signals, Static, Kinematic and Differential GPS, GPS Applications

Text/Reference Books:

1. T M Lillesand et al: Remote Sensing & Image Interpretation
2. Higher Surveying by A M Chandra New Age International Publisher
3. Remote Sensing & GIS by B. Bhatta Oxford University Press
4. Introduction to GPS by A. E Rabbany Library of congress cataloging in Publication data
5. Geomatics Engineering - Modern Surveying, GPS, Astronomy, Photogrammetry, Remote Sensing & GIS by: Dr. Manoj K.Arora& Prof. R.C.Badjatia

7th & 8th Semester Syllabus

B. Tech Civil Engineering

SYLLABUS FOR BASKET OF ELECTIVE COURSE

Track-1V

Transportation Engineering

Seventh/Eight Semester							
S. No.	Category	Code	Course Title	Hours per week			Credits
				L	T	P	
1	Professional Core courses	PECE -701A-18	**Pavement and geometric design of Highways**	3	1	0	4

Course Outcome: On the completion of this course the student will be able to

1. Understand patterns of Traffic and its behaviour.
2. Develop an understanding for various sight distances and its affects
3. Analyse and design Horizontal and vertical curves
4. Design the cross-sectional elements for different types of highways.
5. Develop and appreciate the concept of intersections

Suggest the required facilities for pedestrians, bicycles, buses and parking

Unit 1 : Introduction to Design Elements: Objectives and requirements of highway geometric design, Sight distances - types, analysis, PIEV theory, factors affecting, measurements, Horizontal alignment – design considerations, stability at curves, super-elevation, widening, transition curves; curvature at intersections, vertical alignment - grades, ramps, design of summit and valley curves, combination of vertical and horizontal alignment including design of hair pin bends, IRC standards and guidelines for design problems.

Unit 2 : Cross Section Elements: Right of way and width considerations, roadway, shoulders, kerbs traffic barriers, medians, frontage roads; Facilities for pedestrians, bicycles, buses and trucks, Pavement surface characteristics - types, cross slope, skid resistance, unevenness.

Unit 3 : Design of Intersections: Types of Intersections; Design Principles for Intersections; Design of At-grade Intersections –Channelization, Objectives; Traffic Islands and Design standards; Rotary Intersection – Concept, Advantages and Disadvantages; Grade separated Interchanges – Types, warrants and Design standards.

Unit 4: Miscellaneous Elements: Traffic Signs and Markings. Requirements of Pedestrians; Pedestrian facilities on Urban Roads; Cycle Tracks – Guidelines and Design standards; Bus bays –Types and Guide lines; Design of On-street and Off-street Parking facilities – Guidelines for lay out Design,

Books Recommended:

1. Khanna S.K. and C.E.G. Justo, "**Highway Engineering"**, Nemchand Bros(2012).
2. Kadyali L. R.; "**Highway Engineering"**, Nem Chand & Brothers, Roorkee (2004).
3. Rao G. V.; "**Transportation Engineering**", Tata McGraw Hill Publisher, New Delhi (1999).
4. Yoder E. J.; "**Principles of Pavement Design",** John Wiley & Sons (1975).

Seventh/Eight Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
2	Professional Core courses	PECE -701B-18	**Airport planning and Design**	3	1	0	4

Course outcome: On the completion of this course the student will be able to

1. Understand the detail concepts of the airport engineering.
2. Able to design runway, taxiway and apron pavements.
3. Suggest the runway orientation and the runway length as per FAA & ICAO guidelines.
4. Conceptualise Pavement management system for maintenance

Unit 1. Airport Engineering: Components of airport: Classifications of obstructions, Imaginary surfaces, Approach zone and turning zone. Runway orientation, basic runway length, corrections for elevation, temperature & gradient, airport classification.

Unit 2. Runway & Taxiway Design: Wind-rose diagram, Geometric design of runway, airport capacity, factors controlling taxiway layout, geometric design standards for taxiway holding aprons,

Unit 3. Structural design of runway pavements LCN/PCN method of rigid pavement design, different LCN/PCN of aircrafts using runway. Pavement Evaluation for runway & taxiway, design of overlay, Terminal area, building area, parking area, apron, hanger typical airport layouts.

Unit 4. Design of flexible and rigid runways as per FAA procedure, Specifications for the different layers of runway and taxiway pavements, Pavement management systems for runway pavements. Benkelman Beam method for maintenance.

Books Recommended:

1. Khanna, Arora & Jain, **Airport Planning and Design**, Nem Chand & Brothers, Roorkee (1999).
2. Rangwala, **Airport Engineering**, Charotar Publishing House (2019).
3. Horenjeff Robert, **Airport Engineering**, McGraw Hill International Publisher (2010).

S. No.	Category	Code	Course Title	Hours per week			Credits
				L	T	P	
3	Professional Core courses	PECE -701C-18	**Intelligent Transportation systems**	3	1	0	4

Course outcome: On the completion of this course the student will be able to:

1. Understand the concept of Intelligent Transportation system.
2. Analyse ITS's relevance with Smart growth and energy based planning.
3. Conceptualise the urban transportation systems using different models.
4. Explore methodology for smart city based Transit planning
5. Suggest road safety using ITS.

Unit 1. Overview of Intelligent Transportation Systems: Introduction to ITS, its history and future, Framework for analysing ITS relationships- Information technology, GPS.

Unit 2. Advanced Transportation Planning Process and Problems: Terminology of Transportation Planning, Functional Components, Brief Overview of Models used in Transportation Planning, Environmental concerns, Smart growth and sustainable alternatives, Energy based planning, Global Positioning Systems. Transportation System Impacts: Travel Facilities, Origin and Destination, Transit Surveys, Decision making Process, Transportation Demand Management (TDM). Use of GIS in Transport planning.

Unit 3. Land Use Transportation System: Urban system components, Urban Spatial Structure, Location Theory, Land use planning, Land use Models, Land use transport models – (Lowry and Garin), Lowry Models, Transit Oriented Development(TOD).

Unit 4. Urban Public Transportation: Urban Growth and Public Transport needs, Transit mode characteristics, transit characteristics, Fleet size and capacity estimation, Smart cities based Transit Planning.
Road Safety: Highway safety using ITS.

Books recommended:

1) Joseph M. Sussman, Perspectives on Intelligent Transportation systems

2) Kadyali, Traffic Engineering and Transport planning, Khanna publishers

Seventh/Eight Semester					
S. No.	**Category**	**Code**	**Course Title**	**Hours per week**	**Credits**

				L	T	P	
4	Professional Core courses	PECE -701D18	**Highway Construction and Management**	3	1	0	4

Course outcome: On the completion of this course the student will be able to:

1. Understand various materials and techniques used to construct pavements.
2. Design the bituminous pavement as per standards.
3. Design thickness and joints including drainage of concrete pavements.
4. Suggest maintenance of pavement.
5. Conceptualise pavement management systems.

Unit 1. Bituminous pavement: Various types of bituminous constructions and their selection, Construction of earth, gravel, water bound macadam, surface dressing, premixed carpet, bituminous macadam, bituminous concrete, mastic asphalt, cement concrete pavements.
Design of bituminous mixes: Requirement of bitumen mixes, design of bituminous mixes as per Marshall Stability & flow method, I.R.C & MORTH recommendations for the design mix of various layers of flexible pavements.

Unit 2. Concrete pavement: Components of concrete pavement-PQC**,** various joints- construction joints, longitudinal joints, transverse joint, thermal joints, tie bars, dowels; Construction techniques- alternate bay method, continuous bay method, expansion joint and strip method; slip form paving.
Drainage: Introduction, Importance & Principles of Highway Drainage, Surface Drainage, Sub Surface drainage.

Unit 3. Highway Maintenance: Introduction, Maintenance of Earth, gravel, WBM Roads, Bituminous Roads, Cement Concrete pavements. Use of Benkelman Beam method, Falling weight deflector-meter.

Unit 4. Pavement Management Systems: Concepts of Pavement life cycle, Pavement performance assessment, evaluation of pavement structural capacity and safety, combined measures of pavement quality, development of models for pavement deterioration, rehabilitation and maintenance strategies.

Books recommended:

1. Khanna S.K. and C.E.G. Justo, "Highway Engineering", Nemchand Bros, (2002)
2. Kadyali L. R.; Highway Engineering, Nem Chand & Brothers, Roorkee(2002)
3. Haas R.C.G., Hudson W. Ronald., Zaniewski John P., Modern Pavement Management, Krieger Publishing Company, 1994.

Seventh/Eight Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
5	Professional Core courses	PECE -701E-18	**High Speed Rail Engineering**	3	1	0	4

Course Objective: On the completion of this course the student will be able to:

1. Develop an understanding for high-speed Rails.
2. Outline the requirements for design.
3. Design of points, crossing and turnouts.
4. Suggest techniques to mechanize tracks,
5. Analyse signals inter locking devices for high-speed rails.

Unit 1. High Speed Railway(HSR) Engineering: Introduction, Key elements of HSR technology, History and Development of HSR: world and India, High Speed Trains: Present & Future.

Unit 2. Feasibility Studies: Basic traffic and volume feasibility studies related to HSR, Design requirements and construction of aspects of high- speed rail (HSR) passenger transport systems engineering. Geotechnical and structural requirements for track, bridges, viaducts and tunnels.

Unit 3. Geometric design: Alignment, horizontal curves, super elevation, equilibrium, cant and cant deficiency, length of transition curve, gradients and grade compensation. Stations and yards, and their classification.
Points and crossings: introduction, necessity of points and crossings, turnouts, points and crossings, design of a simple turnout.

Unit 4. Track Recording: Requirements for track system, Basic design and construction of HSR stations and rolling stock maintenance facilities. Equipment, Mechanized Maintenance
Basic Signalling and interlocking: objects of signalling, engineering principle of signaling, classification of signalling, control of train movements, interlocking definition, necessity and function of interlocking, methods of interlocking, mechanical devices for inter locking. Traction and tractive resistance, stresses in track, modernization of railway track.

Books Recommended:

1. Arora and Saxena, **Railway Engineering**, Dhanpat Rai & Sons, New Delhi (2006)
2. Rangawala, **Railway Engineering**, Charotar Publishing House, Anan (1989).
3. Aggarwal M.M., and Satish Chandra **Railway Engineering**, Oxford University Press (2002).

Board of Studies – Civil and Environmental Science, IKGPTU Main & Constituent Campuses

Seventh/Eighth Semester

S. No.	Category	Code	Course Title	Hours per week			Credits
				L	T	P	
6	Professional Core courses	PECE -701F -18	**Traffic Engineering and Management**	3	1	0	4

Course Outcomes: On the completion of this course the student will be able to:

1. Understand the traffic flow parameters and measures related to traffic control and management.
2. Analyze the feasibility of different control devices for traffic management.
3. Create the solution of the problem related to traffic congestion and safety.
4. Outline the causes of road accidents and procedure to assess the road safety audit.
5. Apply the methods to identify the black spots and propose the solutions to improve road safety.
6. Assess the need of modernization in traffic management and road safety.

Unit 1. Fundamentals of Traffic Management: Principles of Traffic management; Highway capacity and Level of service; Mixed Traffic flow: PCU concept and its limitations; Traffic stream parameters: Interrupted and Uninterrupted flow

Unit 2. Traffic Regulation and Control: Road Signs and markings; Channelization; At-grade and Grade separated intersections; Traffic Rotary;
Design principles of traffic signals

Traffic Management techniques: Regulatory measures for Traffic management; Travel Demand Management; Role of ITS in traffic management.

Unit 3. Road accidents: Causes of road accidents: Vehicle design factors & Driver characteristics influencing road safety, Road condition, Parking and its influence on traffic safety.

Road safety measures: Accident data collection methods; Representation of accident data: Collision and condition diagram; Methods to Identify and Prioritize Black spots; Road safety: 3 E measures.

Unit 4. Road safety audits: Key elements in Road safety audit; Road safety audit procedure and investigations; Role of ITS in Road safety.

Books Recommended:

1. Fred L. Mannering, Scott S. Washburn. Principles of Highway Engineering and Traffic Analysis.7th Edition, Wiley, 2019.
2. Kadiyali, L. R., "**Traffic Engineering and Transport Planning"**, Khanna Publishers
3. Chakroborty Partha and Animesh Das, "**Principles of Transportation Engineering"**, Prentice hall
4. O'Flaherty C A**, "Transport Planning and Traffic Engineering",** Butterworth Heinemann, Elsevier, Burlington, MA

SYLLABUS FOR BASKET OF ELECTIVE COURSE

Track-V

Environment Engineering

Seventh/Eight Semester

S. No.	Category	Code	Course Title	Hours per week			Credits
				L	T	P	
1	Professional Core courses[#]	PECE-702A-18	**Environmental Law and Policy**	3[#]	1	0	4

Unit 1

Basic Concepts in Environmental Law. An introduction to the legal system; Constitution, Acts, Rules, Regulations; Indian Judiciary, Doctrine of precedents, judicial review, Writ petitions, PIL–liberalization of the rule of locus standi, Judicial activism. Introduction to environmental laws in India; Constitutional provisions, Bhopal gas tragedy; Rio conference. General principles in Environmental law: Precautionary principle; Polluter pays principle; Sustainable development; Public trust doctrine. Overview of legislations and basic concepts.

Unit 2

Forest, Wildlife and Biodiversity related laws Evolution and Jurisprudence of Forest and Wildlife laws; Colonial forest policies; Forest policies after independence 2 Statutory frame work on Forests, Wildlife and Biodiversity: IFA, 1927; WLPA, 1972; FCA, 1980; Biological Diversity Act, 2002; Forest Rights Act, 2006. Strategies for conservation–Project Tiger, Elephant, Rhino, Module leopard.

Unit 3

Air, Water and Marine Laws National Water Policy and some state policies Laws relating to prevention of pollution, access and management of water and institutional mechanism: Water Act, 1974; Water Cess Act, 1977, EPA, 1986. Pollution Control Boards Ground water and law Judicial remedies and procedures Marine laws of India; Coastal zone regulations. Legal framework on Air pollution: Air Act,1981; EPA, 1986

Unit 4

Environment protection laws and large Projects Legal framework on environment protection-Environment Protection Act as the framework legislation–strength and weaknesses; EIA; National Green tribunal The courts infrastructure projects

Unit 5

Hazardous Substances and Activities Legal framework: EPA and rules made thereunder; PLI Act, 199 Principles of strict and absolute liability

Reference Books:

1. Birnie P. (2009) et al., International Law and the Environment, 3rd ed., Oxford.
2. Desai A. (2002) Environmental Jurisprudence, 2nd ed., Modern Law House, Allahabad.
3. Gadgil M. and Guha R. (1995) Ecology and Equity, Oxford, New Delhi.
4. Gadgil M. and Guha R. (1997) This Fissured Land, Oxford, New Delhi.
5. Guha R. (2000) Environmentalism: A Global History, Oxford, New Delhi.
6. Kamala S. and Singh U.K. (eds.) (2008) Towards Legal Literacy: An Introduction to Law in India, Oxford, New Delhi.

Seventh/Eight Semester					
S. No.	**Category**	**Code**	**Course Title**	**Hours per week**	**Credits**

				L	T	P	
2	Professional Core courses#	PECE-702B-18	**Rural water Supply And onsite Sanitation Systems**	3#	1	0	4

Syllabus Content:

Unit 1

Rural Water Supply: Issues of rural water supply –Various techniques for rural water supply- merits-National rural drinking water program- rural water quality monitoring and surveillance- operation and maintenance of rural water supplies

Unit 2

Low Cost Water Treatment: Introduction – Epidemiological aspects of water quality- methods for low cost water treatment-Specific contaminant removal systems

Unit 3

Rural Sanitation: Introduction to rural sanitation-Community and sanitary latrines-planning of wastewater collection system in rural areas- Ecological sanitation approach – Grey water and storm water management-Compact and simple wastewater treatment systems in rural areas-catch basins-constructed wetlands- roughing filters- stabilization ponds - septic tanks – anaerobic baffled reactors-soak pits- low cost excreta disposal systems-Village ponds as sustainable wastewater treatment system-Wastewater disposal

Unit 4

Solid Waste Management: Disposal of Solid Wastes- Composting- land filling- incineration- Biogas plants-Other specific issues and problems encountered in rural sanitation.

ReferenceBooks:

1. Eulers,V.M.,andSteel,E.W.,MunicipalandRuralSanitation,6thEd.,McGrawHillBookCompany,.
2. Wright, F.B.,Rural water Supply and Sanitation,E.Robert Krieger Publishing Company,Huntington,NewYork.
3. Juuti, P., Tapio S. K.,and Vuorinen H.,Environmental History of Water: Global Viewson Community Water Supply and Sanitation, IWA Publishing(IntlWaterAssoc).
4. Winbald,U.,andSimpson-Hebert,M.,EcologicalSanitation,SEI,Stockholm,Sweden.
5. Kadlec R.H.andWallace S.D.,TreatmentWetlands, CRCPress, BocaRaton
6. WastewaterEngineering–TreatmentandReuse,MetcalfandEddy,TataMcGrawHill

Seventh/Eight Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
3	Professional Core courses[#]	PECE-702C-18	**Air and Water Quality Modeling**	3[#]	1	0	4

UNIT I
Modeling Concepts : Casual and statistical models-Characteristics- Steps in model development - Importance of model building.- conservation of mass and mass balance –calibration and verification of models; Transport phenomena – Advection, diffusion, dispersion, simple transport models; chemical reaction kinetics – Law of mass action, Rate constants, reaction order, types of reactions, equilibrium principles.

UNIT 2
Water Quality Modeling: Water quality models – Historical development – Mass balance equation – Streeter - Phelps Equation – Modification to Streeter – Phelps Equation – Waste load allocations – Dissolved oxygen in Rivers and estuaries; Lake Water Quality Models; Models for Nitrogen, Bacteria, Phosphate and toxicants - Ground Water Quality Modeling -Contaminant solute transport equation, Numerical methods.

UNIT 3
Air Pollution Modeling: Chemistry of air Pollutants - Atmospheric reactions, sinks for air pollution –Transport of air Pollutants - Meteorological settling for dispersal of air pollutants– Vertical structure of temperature and stability, atmospheric motions, Wind and shear, self-cleaning of atmosphere; transport and diffusion of stack emissions – atmospheric characteristics significant to transport and diffusion of stack emission – stack plume characteristics.

UNIT 4
Water Quality Index: Categories of water quality index. Determination of water quality index (WQI): Industrial and municipal effluent index, ambient water quality index, combined water quality index and Delphi method.

UNIT 5
Air Quality Index: Categories of air quality index. Determination of air quality index (AQI): National AQI, Extreme value indices, Regional indices.

Reference Books:
1. Steven C. Chapra, Surface Water Quality Modeling, Tata McGraw-Hill Companies,Inc., New Delhi, 1997.
2. J.L. Schnoor, Environmental Modeling Fate and Transport of Pollutants in Water, Air and Soil, John Wiley & Sons Inc., New York, 1996.
3. Arthur C. Stern, Air Pollution, Air Pollutants, their transformation and Transport,(Ed.), (Third Ed.) Volume I , Academic Press, 2006.
4. Deaton and Wine Brake, Dynamic Modeling of Environmental Systems, Wiley &Sons, 2002
5. E.V. Thomson, Principles of Surface Water Quality Modeling and Control, Happer and Row Publishers New York, 1987.
6. M.D. Palmer, Water Quality Modeling, the World Bank Washington DC.

Seventh/Eight Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
4	Professional Core courses[#]	PECE-702D-18	**Solid and Hazardous Waste Management**	3	1	0	4

Unit-1

Introduction: Definition of solid wastes and hazardous wastes, Nuisance potential and extent of solid waste problems, Objectives and scope of integrated solid waste management. **Collection, Storage and Transportation of Wastes:** Types of collection systems and their components, Concept of waste segregation at source and recycling and reuse of wastes.

Unit-2.

Solid Waste Processing and Treatment: Waste processing – processing technologies – biological and chemical conversion technologies–Composting-thermal conversion technologies-energy recovery.

Unit-3

Hazardous Waste Treatment and Disposal: Biological and chemical treatment of hazardous wastes; Solidification and stabilization of wastes; Incineration for the treatment and disposal of hazardous wastes; Land farming; Landfill disposal of hazardous waste; Bioremediation of hazardous waste disposal sites.

Unit-4

Sanitary Landfills: Design, development, operation and closure of landfills, Management of leachate and landfill gases, environmental monitoring of landfill sites.

Unit-5

Legal Requirements: Municipal solid waste rules; Hazardous waste rules; Biomedical waste rules; E-waste rules; Rules related to recycled plastics, used batteries, flyash, etc.

Reference Books:

1. Pichtel,J.,WasteManagementPractices–Municipal,HazardousandIndustrial,CRCPress
2. Vesilind, P.A., Solid Waste Engineering, Thomson Learning Inc.
3. Tchobanoglous,G.,Vigil,S.A.andTheisen,H.,IntegratedSolidWasteManagement:EngineeringPrinciple sand Management Issues, McGraw Hill
4. HowardS.Peavy,DonaldR.Rowe&GeorgeTchobanoglous,"EnvironmentalEngg.",McGrawHill
5. CPHEEO,*ManualonMunicipalSolidwastemanagement,CentralPublicHealthand Environmental Engineering Organization*, Government of India

Seventh/Eight Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours**			**Credits**
				L	**T**	**P**	
5	Professional Course Courses	PECE-702E-18	**EIA and LCA**	3	1	0	4

External Marks: 60, Internal Marks: 40, Total Marks: 100

Unit1

The Need for EIA, Indian Policies Requiring EIA, The EIA Cycle and Procedures, Screening, Scoping, Baseline Data, Impact Prediction, Assessment of Alternatives, Delineation of Mitigation Measure and EIA Report, Public Hearing, Decision Making, Monitoring the Clearance Conditions, Components of EIA, Roles in the EIA Process. Government of India Ministry of Environment and Forest Notification (2000),List of projects requiring Environmental clearance.

Unit2

Key Elements of an Initial Project Description and Scoping, Project Location(s), Risks to Environment and Human Health, Socio-Economic Impacts, Ecological Impacts, Global Environmental Issues. Criteria for the selection of EIA methodology, impact identification ,impact measurement, impact interpretation & Evaluation, Methods - Adhoc methods, Checklists methods, Matrices methods, Networks methods,

Unit3

Introduction: Life Cycle Assessment concepts, A brief history of Life-cycle Inventory analysis, overview of methodology, three components, identifying and setting boundaries for life-cycle stages, issues that apply to all stages, Applications of inventory analysis.

Unit 4

Procedural framework of Life-cycle inventory: Introduction, define the purpose and scope of inventory. General issues in Inventory analysis: Introduction, Using Templates, Data issues, special case boundary issues. Product design evaluation and analysis using LCA

Reference/TextBooks:

- Sadler,B.andMc Cabe M.,"Environmental Impact Assessment: Training Resource Manual",UNEP (2002).
- Wathern.P.,"Environmental Impact Assessment-Theory and Practice",Routledge Publishers, London(2004).
- Rau J.G.and Wooten D.C.,"Environmental Impact Analysis Handbook", TataMc Graw Hill (1980).
- CanterR.L.,"Environmental Impact Assessment",Tata McGraw-Hill (1981).
- Ciambrone D.F.,"Environmental Life Cycle Analysis",CRCPress (1997).

Ralph E Horne,Tim Grant,VergheeK,"Life Cycle Assessment: Principles, Practice and Prospects", CSIRO Publishers(2009).

S. No.	Category	Code	Course Title	Hours			Credits
				L	T	P	
6	Professional Course Courses	PECE-702F-18	**Sustainable Engg and Technologies**	3	1	0	4

External Marks: 60, Internal Marks: 40, Total Marks: 100

Unit-1

Introduction:

Sustainability - Introduction, Need and concept of sustainability, Social-environmental and economic sustainability concepts. Sustainable development, Nexus between Technology and Sustainable development, Challenges for Sustainable Development. Multilateral environmental agreements

Unit-2

Global Environmental Issue:

Resource degradation, Climate change, Regional and Local Environmental Issues. Carbon credits and carbon trading, carbon foot print Carbon sequestration – Carbon capture and storage (CCS). Environmental management standards, ISO 14000 series, Life Cycle Analysis (LCA) - Scope and Goal, Bio-mimicking and Protocols

Unit-3

Sustainable Design:

Basic concepts of sustainable habitat, Green buildings, green materials for building construction, material selection for sustainable design, green building certification- GRIHA & IGBC Certification for buildings, Energy efficient building design

Unit-4

Clean Technology and Energy

Energy sources: Basic concepts-Conventional and non-conventional, solar energy, Fuel cells, Wind energy, Small hydro plants, biofuels, Energy derived from oceans, Geothermal energy, Rainwater harvesting.

Unit-5

Green Engineering:

Green Engineering concepts, Sustainable Urbanization, industrialization and poverty reduction; Social and technological change, Industrial Processes: Material selection, Pollution Prevention, Industrial Ecology, Industrial symbiosis.

Text Books:

1. Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.

2. Bradley. A.S; Adebayo,A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning

Reference Books:

1. Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication

2. ECBC Code 2007, Bureau of Energy Efficiency, New Delhi Bureau of Energy Efficiency Publications-Rating System, TERI Publications - GRIHA Rating System

3. Ni bin Chang, Systems Analysis for Sustainable Engineering: Theory and Applications, McGraw-Hill Professional.

SYLLABUS FOR BASKET OF ELECTIVE COURSE

Track-VI

Water Resources

Seventh/Eight Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours**			**Credits**
				L	**T**	**P**	
1	Professional Course Courses	PECE-703A-18	Design of Hydraulic Structures	3	1	0	4

External Marks: 60, Internal Marks: 40, Total Marks: 100

Content

Unit 1:Design of Storage Structures – Planning and investigations of reservoir and damsite, choice of dams, Analysis and Design of dams: Gravity dams, Earthen dams, rockfill dams, buttress dams. Spillway and Non-overflow sections and their design, Types of spillways, Flow characteristics of gated/ungated spillways. Types of energy dissipators Influence of tail water rating curve on choice of energy Dissipater, Backwater curve analysis for reservoirs.

Unit 2: Diversion Structures- Barrages and weirs on permeable foundations, Design of different types of weirs: Sharp

crested weirs, broad crested weirs. Barrage components: Glacis, Rigid apron, Flexible (concrete block) apron, Design consideration of barrages for surface and sub-surface flows,causes of failure, Bligh's and Lane's creep theory,Khosla's theory and method of independent variables, standard profiles, corrections, exit gradient, plotting of HGL, Design of d/s and u/s protection works, length of pucca concrete floor.

Unit 3: Canal Structures- Head regulator, Cross regulator and Falls, Canal section design (unlined and lined); in cutting and filling, Aqueducts; Super passage; Syphon Aqueducts, Distribution structures for conveying water from canals to irrigation fields, Canal capacity determination from field water requirements. Design considerations for cross drainage works: hydraulic structures, including spillways, stilling basins, and embankment seepage; Design of canal falls, Canal Outlets**,** Essential requirements, classifications, criteria for outlet behaviours, flexibility, proportionality, sensitivity, sensitiveness, Fluming the canal. Design of Channel Transition, Operation and maintenance of canals.

Text/Reference Books

1. David A. Chin (2013), "water-Resources Engineering", PEARSON.
2. Edward Kuiper "Water Resources Development", Springer
3. Novak, P., Moffat, A.I.B., Nalluri, C. and Narayanan, R. Hydraulic Structures Unwin Hyman Ltd., London 1989.

Seventh/Eight Semester

S. No.	Category	Code	Course Title	Hours			Credits
				L	T	P	
2	Professional Course Courses	PECE-703B-18	River Engineering	3	1	0	4

External Marks: 60, Internal Marks: 40, Total Marks: 100

Content

Unit 1: Introduction to River Engineering- River classifications, Primary functions of rivers, Rivers in India, Himalaya andPeninsular.River flow kinematics

Flow resistance in rivers- Physical properties of sediments, sediment movement in rivers, shear stress, shields diagram, scouring around bridge piers and embankments,Bed load and suspended load transport for uniform and non-uniform bed material, Total load equations, sediment sampling, Reservoir sedimentation, river flow and sediment-duration curves.

Unit 2: River Hydrology- River morphology:thresholds in river morphology, steady river flow, steady non-uniform river flow, river continuity equations, river momentum equations, River gauging, river flood waves, river flood routing.

***River Mechanics*-** River Equilibrium: particle stability, Stability of Channel, regime relations, river bend equilibrium, downstream hydraulic geometry, meander plan form, geomorphic analysis of river channel responses; Fundamentals of alluvial channel flows, bars in alluvial rivers, Lateral river migration, River dynamics: degradation and aggradation of river bed,River Confluences and branches, River Database.

Unit 3: River Stabilization- River bank stability, Riverbank riprap revetment, river bank protection, Principles of stabilisation and rectification of rivers, River bank stability analysis, Design of river training works like Revetments, Dikesgroynes, guide banks, gabions, Hydraulic modelling of rivers,Diversion and Cofferdams; River regulations systems; Dredging and Disposal, River restoration

Unit 4: River Models- dimensional model studies for rivers, rigid bed models, mobile bed river models, finite difference approximations, one-dimensional and multi-dimensional river models.

Text/Reference Books

1. Garde, R.J., (2006), "*River Morphology*", New Age International Publishers
2. Garde, R.J. and Ranga Raju, K.G., (2006), "*Mechanics of Sediment Transportation and Alluvial Stream Problems*", Wiley Eastern Limited
3. Julien, Pierre, Y., (2002), "*River Mechanics*", Cambridge University Press
4. Mechanics of Sediment transportation and Alluvial stream problem by R.J. Garde and K.G RangaRaju – New Age Int. Publications.
5. Sahnaz Tigrek and Tuce Aras "Reservoir Sediments Management", CRC Press

Seventh/Eight Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours**			**Credits**
				L	**T**	**P**	
3	Professional Course Courses	PECE-703C-18	**Ground Water**	3	1	0	4

External Marks: 60, Internal Marks: 40, Total Marks: 100

Content

Unit 1: Introduction- Groundwater in Hydrologic Cycle, Occurrence of groundwater, Hydrogeology, Hydrometeorology, Groundwater Systems, Planning and Management of Groundwater, Groundwater Sustainability, Groundwater protection: Concerns and Acts

***Groundwater Properties*-** Vertical distribution of subsurface, characteristics and classification of aquifers, Determination of specific yield and permeability.Physical properties of groundwater and aquifers, principles and fundamental equations of porous media flow and mass transport, well hydraulics and pumping test analysis, role of groundwater in the hydrologic cycle, groundwater quality and contamination groundwater hydrology, well hydraulics and well construction, geo-physical explorations, Different types and procedures for analysis of geophysical studies, groundwater quality and management of

groundwater resources

Unit 2: Groundwater Hydraulics- Groundwater movement: Darcy's law and its limitations, Dupuit–Forchheimer Theory of Free-Surface Flow, Stream lines and Flow net analysis, Discharge and draw down for various condition of groundwater flow, Groundwater tracers, continuity equation, equation of motion in ground water,

Well hydraulics- steady/unsteady, uniform/radial flow to a well in a confined/unconfined/leaky aquifer, Well flow near aquifer boundaries/for special conditions, Evaluation of well loss parameters, Partial penetration of wells, Interference of wells, Collector wells and Infiltration galleries.Well Hydraulics: Steady and unsteady radial flows in aquifers; partially penetrating wells; multiple well systems; characteristic well losses; specific capacity, Surface and Subsurface investigations (Geologic methods; remote sensing; geophysical explorations; electrical resistivity and seismic refraction), Water Wells: design, Construction; completion, development, protection and rehabilitation of wells;

Unit 3: Groundwater Quality- Groundwater constituents and contaminants, Water quality standards, Groundwater solubility, Disequilibrium and Saturation Index, sources of groundwater contamination, Mass Transport of Dissolved Contaminants.Groundwater Management: Basin management, investigations, conjunctive use, modelling, artificial recharge; Saline water intrusion

Unit 4: Impact of Climate change – Climate change impact on hydrological cycle, Climate change impact on Groundwater, impact on groundwater quality, climate change simulation, impact on availability of water in aquifer.

Text/Reference Books

1. Groundwater Hydrology by Todd, D. K. and Mays, L. W., John Wiley & Sons, Inc.
2. Ground and Surface Water Hydrology by Mays, L. W., John Wiley & Sons, Inc.
3. Bear J., Hydraulics of Groundwater, McGraw-Hill, New York, 1979.
4. Bouwer H., Groundwater Hydrology, McGraw-Hill, New York, 1978.
5. Driscoll, Groundwater and Wells, Johnson Filtration Systems, Inc., 1986.

Seventh/Eight Semester

S. No.	Category	Code	Course Title	Hours			Credits
				L	T	P	
4	Professional Course Courses	PECE-703D-18	**Hydraulic Modelling**	3	1	0	4

External Marks: 60, Internal Marks: 40, Total Marks: 100

Content

Unit 1: Computational Methods- Basics of Hydraulic Modelling (similarity mechanics, model laws, distinction between numerical and hydraulic models, classification of hydraulic modelling, materials used in the model, scale effect, design, construction, operation and interpretation of the results), applications of computational methods for pipe flow, flow through porous media.

Unit 2: Groundwater Modelling-Role of instrumentation and data processing; Gravity dominated models (modelling of energy dissipaters, overflow spillways, siphon spillways, bridge piers, vortex formation, cavitation, flow induced vibrations); Gravity friction models: (pumped flow models, ship models, surge tank models); Friction dominated models; River models with fixed and mobile bed; Basin and reservoir models; Tidal models with fixed and mobile bed; estuarine models; harbor and breakwater models, models of offshore structures; Hybrid and Analogue models; Scope and limitations of hydraulic modelling,

complementary aspects of numerical and hydraulic modellingGeophysical Subsurface Explorations, Well Hydraulics- Image well theory. Groundwater Modelling, Artificial Recharge of Groundwater, Groundwater Quality Modelling, contaminant transport model, Soil moisture simulation models.

***Water Supply Networks*:** Design and optimization of water distribution system- trial error method, cost-head loss ratio method. Optimization using linear programming techniques, surge analysis in water distribution system,Hybrid and Analogue models; Scope and limitations of hydraulic modelling, complementary aspects of numerical and hydraulic modelling.

Unit 3: RS and GIS: Ideal Remote Sensing System, Spectral Signatures of Earth features, Principles of Interpretation, Use of Remote Sensing and GIS in Water Quality Modelling, vegetation mapping, runoff modelling, Drought and Flood Monitoring, water resource mapping.

Unit 4: Simulation Software in Water Resources:Introduction to Surface water models (HMS) - Storm Water Management Models (SWMM) -Water CAD, STORM CAD - Ground Water Flow models - Visual Modflow.

Text/Reference Books

1. Schilling, R.J., and S.L. Harris, (2007), *"Applied Numerical Methods for Engineering*", CENGAGE Learning, India Edition.
2. Abbot, M.A. and Vervey (1996), *"Computational Hydraulics",* Elsevier Publications.
3. Domenico (1972), "Concepts and Models in Groundwater Hydrology", McGraw Hill Inc. N York
4. Anderson M.P., and Woessner W.W., Applied Groundwater Modelling : Simulation of flow and advective transport, Academic Press, Inc., 1992
5. Lynn E. Johnson, (2008), "*Geographical Information Systems in Water Resources Engineering*" CRC Press.

Seventh/Eight Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours**			**Credits**
				L	**T**	**P**	
5	Professional Course Courses	PECE-703E-18	**Transient in Closed Conduits**	3	1	0	4

External Marks: 60, Internal Marks: 40, Total Marks: 100

Content

Unit 1: Transient Flow Equations- Wave propagations, wave reflection and transmission, Reynold Transport Theorem, Continuity equation, momentum equation, wave velocity, solution of governing equations, Unsteady friction, basic water hammer equations, causes of transient in closed conduits.Analysis of flow in water transmission and water distribution systems (pump & gravity); optimal design and operation of systems for achieving different goals (including latest tools available for optimization); Extended period simulations, Software for WDN analysis and design,

Unit 2: Causes of Transients- Transients caused by opening and closing of valves, Transient caused by power failure of pumps.Rehabilitation of pipeline systems; Water auditing, online monitoring and control, leak and burst detection; transient analysis and surge protection; Appurtenances (valves / flow meters etc.); Selection of pipe material; Jointing details; Pipe

laying and testing; Structural design for buried and surface mounted pipes unsteady flow in pipes (water hammer) and designing for surge protection**;** Differential equations for unsteady pipe flow.

Unit 3: Transient Control- Surge Tanks: Types of surge tanks, analysis of surge tanks, governing equations, solution of governing equations, surge oscillations in frictionless system, stability of tanks, design considerations. Air Chamber, Valves, Optimal transient control.transients in penstocks of hydro-electric schemes; analysis for transient control using surge tanks; air chambers; air valves; pressure regulating valves etc.; Emphasis should be on development of computer programs for transient analysis; awareness about commercially available software for transient analysis

Text/Reference Books

1. Chaudhry, H., Applied hydraulic transients, Springer, New York.
2. Hydraulic Transients by Streeter, V.L. and Wylie, E.B., McGraw Hill, New York.
3. Watters, G.Z, *Analysis and control of pipe flow in pipes*, Butter Worth Publishers, 1984.
4. Design of Irrigation Structures by R.K. Sharma, Oxford IBH Pub

Seventh/Eight Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours**			**Credits**
				L	**T**	**P**	
6	Professional Course Courses	PECE-703F-18	**Urban Hydrology and Hydraulics**	3	1	0	4

External Marks: 60, Internal Marks: 40, Total Marks: 100

Content

Unit 1: Introduction- Trends of Urbanization and Industrialization, Urban water supply demand forecast, urban hydrological cycle.

Unit 2: Urban water Management- Rain water harvesting, managed aquifer recharge, effect of water management practices on urban water infrastructure, hydrology and ground water regime, mapping of water supply and sewage networks.

Urban water Infrastructure- water supply, sanitation, sewerage and wastewater conveyance infrastructures, Water supply and sewerage network hydraulics, Structural safety and mitigating plans against natural and human caused threats.

Unit 3: Urban Storm water- Master drainage plans, Estimation of urban stormwater quantity, Wastewater collection systems, Design of storm sewer network systems, Storage facilities. Interaction between urban drainage and solid waste management, Stormwater Management, Operation and maintenance of urban drainage system.

Unit 4: Sustainable Design- Sustainable urban designs, Methodologies for assessing sustainability of urban water infrastructures, Emerging sustainable materials and design procedures for water supply and sewerage pipelines,determination of design flow; runoff for highways, airports, and urban areas; design of drainage gutters, channels, sewer networks, and culverts.

Text/Reference Books

1. Geiger, W.F., Marsalek, J. Zudima and Rawls, G.J (1987), *"Manual on Drainage in Urban Areas", 2 Volumes,* UNESCO, Paris.
2. Wanielista, M.P., and Yousef, Y.A. (1993), *"Storm water Management"* John Wiley and Sons, Inc., New York.
3. Hall, M.J., (1984), *"Urban Hydrology*", Elsevier Applied Science Publishers.
4. Mays, L.W., Hydraulic Design Handbook, McGraw-Hill, 1999

SYLLABUS FOR
Open Elective

Seventh/Eight Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
1	Open Elective	OECE-701-18	**Metro Systems and Engineering**	3	0	0	3

Syllabus Content:

PART-A

Introduction toMetro systems

Overview of Metro Systems; Need for Metros; Routing studies; Basic Planning and Financials.

Planning and Development

Overview and construction methods for: Elevated and underground Stations; Viaduct spansandbridges;Undergroundtunnels;Depots;CommercialandServicebuildings.InitialSurveys&Investigations;

Traffic Management Systems

Basics of Construction Planning & Management, Construction Quality &Safety Systems. Traffic integration, multimodal transfers and pedestrian facilities; Environmental and social safeguards; Track systems-permanent way. Facilities Management Module

PARTB

Signalling Systems
Introduction to Signalling systems; Automatic fare collection; Operation Control Centre (OCCandBCC);SCADA and other control systems; Platform Screen Doors.

Electrical Systems

OHE,Traction Power;Substations-TSSandASS;PowerSCADA;StandbyandBack-upsystems;Greenbuildings, Carbon credits and clear air mechanics.

Mechanical Systems

Ventilation systems;Air conditioning for stations and buildings; Fire control systems; Lifts and Escalators

TextBooks:

1. "ElectricTractionforRailwayTrains:ABookforStudents,ElectricalandMechanicalEngineers, Superintendents of Motive Power and Others"Edward Parris BurchPalala Press2018.
2. "Metropolitan Railways: Rapid Transit in America (Railroads Past and Present)",Middleton,IndianaUniversityPress2013.
3. "WorldMetroSystems",Garbutt,CapitalTransportPublishing;2ndRevisededition1997.

Seventh/Eight Semester							
S. No.	Category	Code	Course Title	Hours per			Credits
				L	T	P	
2	Open Elective	OECE-702-18	**Traffic Management**	3	0	0	3

Unit-1 :Fundamentals of Traffic Management

Principles of Traffic management;Highway capacity and Level of service;Mixed Trafficflow:PCU concept and its limitations; Traffic stream parameters: Interrupted and Uninterrupted flow

Unit-2:Traffic Regulation and Control devices

Road Signs and markings;Channelization;At-gradeandGradeseparatedintersections;TrafficRotary;Design principles of traffic signals

Unit-3: Traffic Management techniques

Regulatory measures for Traffic management;Travel Demand Management;Role of ITS in traffic management

Unit-4 : Logistics for Traffic Management

Definition, domain, role and responsibility of traffic management agencies, Principles and systems of coordination in Traffic management; Intelligent transport system- concept, Traffic Management logistics - equipment's, vehicles and traffic control centre; Centralized Data Processing and Monitoring, Traffic personnel- skills & deployment systems.

TextBooks:

1. FredL.Mannering,ScottS.Washburn.PrinciplesofHighwayEngineeringandTrafficAnalysis.7thEdition, Wiley, 2019.
2. Kadiyali L.R.TrafficEngineering&TransportPlanning.KhannaPublications,2013.
3. KhistyC.J.andLallB.K.TransportationEngineering–AnIntroduction.3rdEdition,Pearson,2017.
4. KhannaS.K.,JustoC.E.GandVeeraragavanA.HighwayEngineering.Revised10thEdition,NemChand & Bros, 2017.

Seventh/Eight Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours per**			**Credits**
				L	**T**	**P**	
3	Open Elective	OECE-703-18	**Road Safety**	3	0	0	3

UNIT 1. Road Accidents

Causes of road accidents:Vehicle design factors &Driver characteristic s influencing road safety,Road condition,Parking and its influence on traffic safety

UNIT2. Road safety measures

Accident data collection methods; Representation of accident data:Collision and condition diagram; Methods to Identify and Prioritize Blackspots;Roadsafety:3„E‟measures

UNIT3. Road safety audits

Key elements in Road safety audit; Road safety audit procedure and investigations; Role of ITS in Road safety

UNIT4. Ensuring Traffic Safety in Road Operation:-Ensuring Traffic Safety during Repair and Maintenance, Prevention of Slipperiness and Influence of Pavement Smoothness, Restriction speeds on Roads,

Safety of Pedestrians, Cycle Paths, Informing Drivers on Road Conditions with Aid of Signs, Traffic Control Lines & Guide Posts, Guardrails & Barriers and Road Lighting.

REFERENCE BOOKS: 1. BABKOV, V.F. `Road conditions and Traffic Safety', MIR, publications,Mascow - 1975.
2. K.W. Ogden, `Safer Roads – A Guide to Road Safety Engg.' Averbury Technical, Ashgate Publishing Ltd., Aldershot, England, 1996.
3. Kadiyali, L.R., `Traffic Engineering and Transport Planning', Khanna Publications, New Delhi, 2009.
4. C. JotinKishty& B. Kent Lall, "Transportation Engineering-An Introduction" , Thrid Edition, Prentice Hall of India Private Limited, New Delhi, 2006
5. Latest Editions of Relevant Indian Roads Congress (IRC) Publications for Design of Roads and Road Safety.
6. Khanna and Justo, 'Text book of Highway Engineering', Nemchand Brothers, Roorkee,2001

Seventh/Eight Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
4	Open Elective	OECE-704-18	**Environmental Impact** Assessment	3	0	0	3

Course objectives

1. To learn the concept and methodology of EIA and its documentation
2. Understand the different steps within environmental impact assessment

Course outcomes

1. Knowledge about EIA tools & methodologies and identify the suitable methodology and prepare Rapid EIA.
2. Be able to access different case studies/examples of EIA in practice

Unit-1: Evolution of EIA; EIA at project; Regional and policy levels; Strategic EIA; EIA process; Screening and scoping criteria; Practical applications of EIA

Unit-2: Legislative and environmental clearance procedures in India and other countries, Siting criteria; CRZ; Socio Culture and Public participation; Resettlement and rehabilitation.

Unit-3: EIA methodologies; Baseline data collection; Prediction and assessment of impacts on physical, biological and socio-economic environment; Environmental management plan; Post project monitoring, EIA report and EIS; Review process.

Unit-4: Case studies on project, regional and sectoral EIA. Specialised areas like environmental health impact assessment; Environmental risk analysis; Economic valuation methods; Cost-benefit analysis; Expert system and GIS applications; Uncertainties.

Text/Reference Books:

1. Canter L. Environmental Impact Assessment, McGraw Hill.
2. Kiely G. Environmental Engineering, Tata McGraw Hill.
3. Rau G.J. and Wooten C.D. Environmental Impact Analysis Handbook, McGraw Hill.
4. Munn R.E. Environmental Impact Assessment, John Wiley & Sons.
5. Dhameja S.K. Environmental Engineering and Management, S. K. Kataria& Sons.MoEF Guidelines and amendments as updated onhttp://moef.gov.in

Seventh/Eight Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
5	Open Elective	OECE-705-18	**Construction Materials**	3	0	0	3

Course Outcomes: On completion of this course the student will be able

•To Provides a brief description about different types of materials used in building construction for members like foundation, masonry, arches, lintels, balcony, roof, floor, doors, windows, stairs, plastering, painting and other general topics. Properties of various construction materials, their uses and different applications are discussed in this subject.

Unit-I: Introduction to building construction and basic building components (Foundation, plinth, wall, sill, lintel, roof, doors, windows, ventilators, staircases, sunshades etc.) along with the building materials., Role of materials in construction, Classifications of Construction Materials, green building materials.

Unit-II: Physical and chemical properties of Cement ,Lime and Supplementary Cementation materials , CC blocks, Fly ash Bricks, pozzolanic material, aggregates, water, admixtures - characteristics, properties and uses, Mortars, Ceramic Materials: Classification, Refractories, glass-(Toughened Glass, DU Glass, Security Glass), glass wool, mechanical, thermal and electrical properties, fire resistance materials, Uses and application.

Unit-III: Rubber and plastics, properties, Polymers, fibres and composites, Fibre reinforced plastic. Water Proofing Material. Adhesives and sealants. Structural elastomeric bearings and resilient seating. Polymer foams, Aluminium Composite Panels (ACP), WPC (Wood Plastic Composite, UPVC (Unplasticized Polyvinyl Chloride), Charcoal fibres.

Unit IV: Timber and its uses (Plywood, Block board, HPL- High Pressure Laminates, Laminates etc.) Metals in construction (Aluminium Alloys, Steel, Ferrous Metals, Copper etc.)

References books:

1. Rangawala S.C. Engineering Materials Chortor Publications 1991.
2. S.K. Duggal Building Materials, New Age International Publications 2006.
3. Bruntley L.R Building Materials Technology Structural Performance & Environmental Impact McGraw Hill Inc 1995.
4. R Chudley Construction Technology, Vol I - IV Longman Group Construction Ltd. 1973
5. Neptel& Various Sites on Internet

Seventh/Eight Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
6	Professional Core courses	HSMC -255	**Professional Practice, Law & Ethics**	2	0	0	2

Basic elements of civil engineering professional practice are introduced in this course. Rolesof all participants in the process-owners, developers, designers, consultants, architects, contractors, and suppliers - are described. Basic concepts in professional practice, business management, public policy, leadership, and professional licensure are introduced. The coursecovers professional relations, civic responsibilities, and ethical obligations for engineering practice. The course also describes contracts management, and various legal aspects related to engineering. Further, the course familiarizes students with elementary knowledge of laws that would be of utility in their profession, including several new areas of law such as IPR, ADR.

The course is designed to address the following:

- To make the students understand the types of roles they are expected to play in the
- society as practitioners of the civil engineering profession
- To develop some ideas of the legal and practical aspects of their profession

UNIT 1.Professional Ethics – Definition of Ethics, Professional Ethics, Business Ethics, Corporate Ethics, Engineering Ethics, Personal Ethics; Code of Ethics as defined in thewebsite of Institution of Engineers (India); Profession, Professionalism, Professional Responsibility, Professional Ethics; Conflict of Interest, Gift Vs Bribery, Environmental breaches, Negligence, Deficiencies in state-of-the-art; Vigil Mechanism, Whistleblowing, protected disclosures.

UNIT2:***General Principles of Contracts Management: Indian Contract Act, 1972 and amendments***covering General principles of contracting; Contract Formation & Law; Privacyof contract; Various types of contract and their features; Valid & Voidable Contracts; Primeand sub-contracts; Joint Ventures & Consortium; Complex contract terminology; Tenders,Request For Proposals, Bids & Proposals; Bid Evaluation; Contract Conditions &Specifications; Critical /"Red Flag" conditions; Contract award & Notice To Proceed;Variations & Changes in Contracts; Differing site conditions; Cost escalation; Delays,Suspensions & Terminations; Time extensions & Force Majeure; Delay Analysis; Liquidated damages & Penalties; Insurance & Taxation; Performance and Excusable Non-performance;Contract documentation; Contract Notices; Wrong practices in contracting (Bid shopping,Bid fixing, Cartels); Reverse auction; Case Studies; Build-Own-Operate & variations; Public-Private Partnerships; International Commercial Terms;

UNIT 3 ***:Arbitration, Conciliation and ADR (Alternative Dispute Resolution) system:*** Arbitration – meaning, scope and types – distinction between laws of 1940 and 1996;UNCITRAL model law – Arbitration and expert determination; Extent of judicialintervention; International commercial arbitration; Arbitration agreements – essential andkinds, validity, reference and interim measures by court; Arbitration tribunal – appointment,challenge, jurisdiction of arbitral tribunal, powers, grounds of challenge, procedure and courtassistance; Award including Form and content, Grounds for setting aside an award,Enforcement, Appeal and Revision; Enforcement of foreign awards – New York and GenevaConvention Awards; Distinction between conciliation, negotiation, mediation and arbitration,confidentiality, resort to judicial proceedings, costs; Dispute Resolution Boards; LokAdalats.

UNIT 4 :*Engagement of Labour and Labour& other construction-related Laws:*Role ofLabour in Civil Engineering; Methods of engaging labour- on rolls, labour sub-contract, piece rate work; Industrial Disputes Act, 1947; Collective bargaining; Industrial Employment (Standing Orders) Act, 1946; Workmen's Compensation Act, 1923; Building & Other Construction Workers (regulation of employment and conditions of service) Act (1996) and Rules (1998); RERA Act 2017, NBC 2017

UNIT 5 : *Law relating to Intellectual property:*Introduction – meaning of intellectual property, main forms of IP, Copyright, Trademarks, Patents and Designs, Secrets; Law relating to Copyright in India including Historical evolution of Copy Rights Act, 1957, Meaning of copyright – computer programs, Ownership of copyrights and assignment, Criteria of infringement, Piracy in Internet – Remedies and procedures in India; Law relatingto Patents under Patents Act, 1970 including Concept and historical perspective of patentslaw 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;

Text/Reference Books:

1. B.S. Patil, Legal Aspects of Building and Engineering Contracts, 1974.
2. The National Building Code, BIS, 2017
3. RERA Act, 2017
4. MeenaRao (2006), Fundamental concepts in Law of Contract, 3rd Edn. Professional Offset
5. NeelimaChandiramani (2000), The Law of Contract: An Outline, 2nd Edn. AvinashPublications Mumbai
6. Avtarsingh (2002), Law of Contract, Eastern Book Co.
7. Dutt (1994), Indian Contract Act, Eastern Law House
8. Anson W.R. (1979), Law of Contract, Oxford University Press
9. Kwatra G.K. (2005), The Arbitration & Conciliation of Law in India with case law on UNCITRAL Model Law on Arbitration, Indian Council of Arbitration
10. Wadhera (2004), Intellectual Property Rights, Universal Law Publishing Co.
11. T. Ramappa (2010), Intellectual Property Rights Law in India, Asia Law House
12. Bare text (2005), Right to Information Act
13. O.P. Malhotra, Law of Industrial Disputes, N.M. Tripathi Publishers
14. K.M. Desai(1946), The Industrial Employment (Standing Orders) Act
15. Rustamji R.F., Introduction to the Law of Industrial Disputes, Asia Publishing House

Seventh/Eight Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours per**			**Credits**
				L	**T**	**P**	

7	Mandatory Course (non credit)	BTMC-701-18	**Management- I (Organizational Behavior)**	2	0	0	0

Course objectives: This course is based on three themes;

- Individuals – Behaviour in an individual context
- Groups/teams – Behavior in a n organizational context
- Organizations – How do these artificial persons behave?

Course context:

Unit 1 Organizational behavior: What managers do, Definition of OB, contributing disciplines to OB, challenges and opportunities for OB, Foundations of Individual Behavior, biographical characteristics, Learning, Attitudes, Personality: Determinants of personality, Perception: Meaning and attribution Theory.

Unit II Motivation: Definition and Process of motivation, Theories of motivation, Application of motivation. Job Satisfaction: Nature and significance of Job Satisfaction. Leadership: Meaning and theories of Leadership, Leadership in Indian culture, Nature and significance of Leadership. Transaction analysis, life position, Johari window, Emotional Intelligence and Intellectual Intelligence.

Unit III Foundation of group behavior: Nature and concept of group formation, stages of group formation, difference between group and team, Group Discussion Making: Meaning and nature: Decision making process; Conflict management: definition of conflict, Functional vs Dysfunctional conflict, conflict process; individual and group level conflict; organization level conflict; Negotiations: Meaning and definition; Negotiations process, issues in Negotiations.

Unit IV Stress Management: Meaning and concept of stress, Stress in organization, Management of stress,Power and Politics in Organization: Nature and concepts, Sources and types of power, techniques of politics, Organizational culture: Meaning and concept, cultural differences and business ethics.

Suggested Readings/Books:

1. Robbins, Organizational behavior, Pearson Education.
2. Luthans, Organizational behavior, Tata McGraw Hill
3. Parikh, Gupta, Organizational behavior, Tata McGraw Hill
4. Locum, Fundamental of Organizational behavior, Cengage Learning
5. Saiyadain, M S.: Organizational behavior, Tata McGraw Hill

WIDELY USED BOOKS FOR Organizational behavior

- I'm O.K You're O.K., Thomas Harris.
- Games people play, Eric Berne

Seventh/ Eighth Semester									
S No	**Category**	**Subject Code**	**Course Title**	**Evaluation Internal**		**External**			**Credits**
				Institute	**Industry**		**Ext**	**Total**	
1	Training (one semester)	BTCE-801-18	Software Training And Project	100	50		100	250	16
			Industrial training and Project	100	50		100	250	
			Total	**200**	**100**		**200**	**500**	**16**

***List of Software for Training to be learnt during Training Period**
Any software that enhances professional capability in civil engineering practice a partial indicative list is mentioned below:

1. GT STRUDAL
2. PRIMA VERA
3. GEOTECH
4. ARCVIEW GIS
5. GEO 5
6. Ansys
7. AUTOCAD CIVIL 3D
8. MX ROAD
9. GEOMATIC
10. STAAD PRO
11. HDM-4
12. PLAXIS
13. Abacus
13. Any other relevant software

Seventh/Eight Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
1	Professional Core courses	BTCE 802-18	**Smart Cities**	3	1	0	4

Course objectives

To obtain basic knowledge of smart cities
To learn how to analyze and compare existing smart community projects.

Unit-1:
Definition and concept ofsmart city, Difference between: Intelligent city, Digital city, and E-city,Objectives, principles, stages in to smart city planning, Smart city planning schemes.Complexities of Smart cities, Smart cities in India.

Unit-2:
Structure plan, detailed smart city planning scheme and action plan, Estimating future needs, planning standards for different land use allocation for commerce, industries, public amenities, open areas etc.,

Unit-3:
Smart infrastructure with adaptive capabilities; smartinfrastructures of energy, mobility, health and sustainabilityand their growing interdependencies.Cybersecurity, Safety, and Privacy.

Unit-4
ICT for smart City, Internet of Things, Blockchain, Artificial Intelligence, Alternate Reality, Virtual Reality, Future of Smart cities, Smart City Informatics

Reference Books:

1. Jo Beall (1997); "A city for all: valuing differences and working with diversity"; Zed books limited, London (ISBN: 1-85649-477-2)

2. UN-Habitat; "Inclusive and sustainable urban planning: a guide for municipalities"; Volume 3: Urban Development Planning (2007); United Nations Human Settlements Programme (ISBN: 978-92-1-132024-4)

3. Arup Mitra; "Insights into inclusive growth, employment and wellbeing in India"; Springer (2013), New Delhi (ISBN: 978-81-322-0655-2)

4. William J. V. Neill (2004); "Urban Planning and cultural identity"; Routledge London (ISBN: 0-415-19747-3)

5. John S. Pipkin, Mark E. La Gory, Judith R. Balu (Editors); "Remaking the city: Social science perspective on urban design"; State University of New York Press, Albany (ISBN: 0-87395-678-8)

6. Giffinger, Rudolf; Christian Fertner; Hans Kramar; Robert Kalasek; NatašaPichler-Milanovic; Evert Meijers (2007). "Smart cities – Ranking of European medium-sized cities". Smart Cities. Vienna: Centre of

Regional Science

S. No.	Category	Code	Course Title	Hours			Credits
				L	T	P	
3	Professional core	BMPD-803-18	**Mentoring and professional development**	-	-	2	0

Guidelines regarding Mentoring and Professional Development

The objective of mentoring will be development of:

- Overall Personality
- Aptitude (Technical and General)
- General Awareness (Current Affairs and GK)
- Communication Skills
- Presentation Skills

The course shall be split in two sections i.e. outdoor activities and class activities. For achieving the above, suggestive list of activities to be conducted are:

Part – A (Class Activities)

1. Expert and video lectures
2. Aptitude Test
3. Group Discussion
4. Quiz (General/Technical)
5. Presentations by the students
6. Team building Exercises

Part – B (Outdoor Activities)

1. Sports/NSS/NCC
2. Society Activities of various students chapter i.e. ISTE, SCIE, SAE, CSI, Cultural Club, etc.

Evaluation shall be based on rubrics for Part – A & B.

Mentors/Faculty incharges shall maintain proper record student wise of each activity conducted and the same shall be submitted to the department.

End