Dr. Babasaheb Ambedkar Technological University
(Established as a University of Technology in the State of Maharashtra)
(under Maharashtra Act No. XXIX of 2014)
P.O. Lonere, Dist. Raigad, Pin 402 103, Maharashtra
Telephone and Fax. 02140 - 275142
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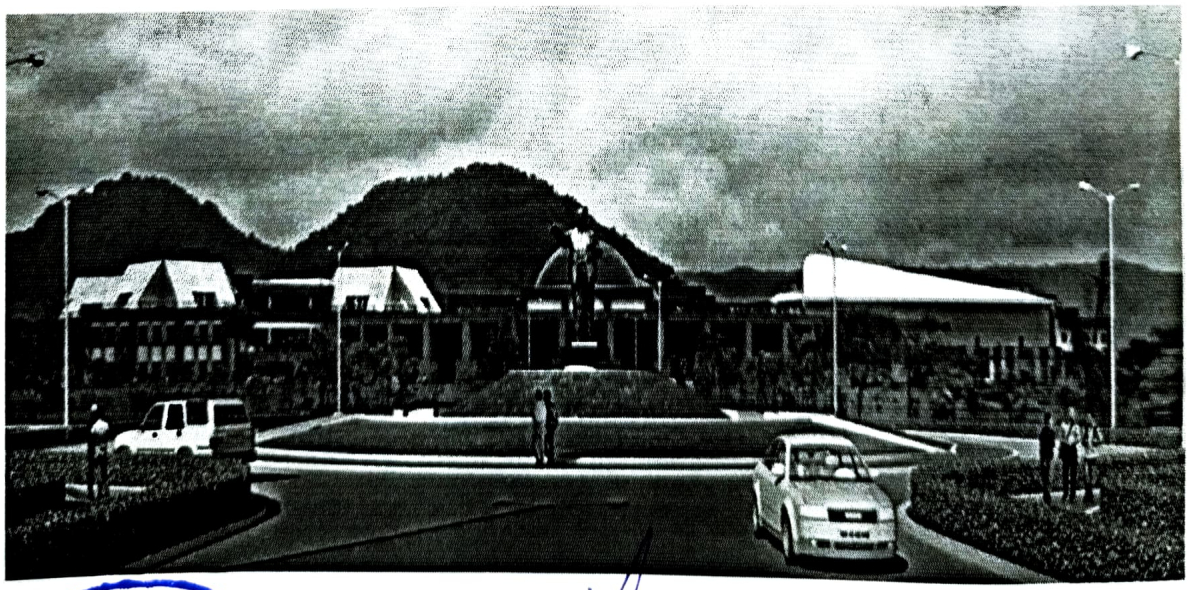
PROPOSED CURRICULUM
UNDER GRADUATE PROGRAMME
B.Tech

FIRST YEAR ENGINEERING

WITH EFFECT FROM THE ACADEMIC YEAR 2020-2021.



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Rules and Regulations

1. The normal duration of the course leading to B.Tech degree will be EIGHT semesters.
2. The normal duration of the course leading to M.Tech. degree will be FOUR semesters.
3. Each academic year shall be divided into 2 semesters, each of 20 weeks duration, including evaluation and grade finalization, etc. The Academic Session in each semester shall provide for at least 90 Teaching Days, with at least 40 hours of teaching contact periods in a five to six days session per week. The semester that is typically from Mid-July to November is called the ODD SEMESTER, and the one that is from January to Mid-May is called the EVEN SEMESTER. Academic Session may be scheduled for the Summer Session/Semester as well.For 1st year B. Tech and M. Tech the schedule will be decided as per the admission schedule declared by Government of Maharashtra.
4. The schedule of academic activities for a Semester, including the dates of registration, mid-semester examination, end-semester examination, inter-semester vacation, etc. shall be referred to as the Academic Calendar of the Semester, which shall be prepared by the Dean (Academic), and announced at least TWO weeks before the Closing Date of the previous Semester.
5. The Academic Calendar must be strictly adhered to, and all other activities including co-curricular and/or extra -curricular activities must be scheduled so as not to interfere with the Curricular Activities as stipulated in the Academic Calendar.

REGISTRATION:

1. Lower and Upper Limits for Course Credits Registered in a Semester, by a Full-Time Student of a UG/PG Programme:
   A full time student of a particular UG/PG programme shall register for the appropriate number of course credits in each semester/session that is within the minimum and maximum limits specific to that UG/PG programme as stipulated in the specific Regulations pertaining to that UG/PG programme.
2. Mandatory Pre-Registration for higher semesters:
   In order to facilitate proper planning of the academic activities of a semester, it is essential for the every institute to inform to Dean (Academics) and COE regarding details of total no. of electives offered (Course-wise) along with the number of students opted for the same. This information should be submitted within two weeks from the date of commencement of the semester as per academic calendar.
3. PhD students can register for any of PG/PhD courses and the corresponding rules of evaluation will apply.
4. Under Graduate students may be permitted to register for a few selected Post Graduate courses, in exceptionally rare circumstances, only if the DUGC/DPGC is convinced of the level of the academic achievement and the potential in a student.

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Course Pre-Requisites:

1. In order to register for some courses, it may be required either to have exposure in, or to have completed satisfactorily, or to have prior earned credits in, some specified courses.
2. Students who do not register on the day announced for the purpose may be permitted LATE REGISTRATION up to the notified day in academic calendar on payment of late fee.
3. REGISTRATION IN ABSENTIA will be allowed only in exceptional cases with the approval of the Dean (Academic) / Principal.
4. A student will be permitted to register in the next semester only if he fulfills the following conditions:

(a) Satisfied all the Academic Requirements to continue with the programme of Studies without termination
(b) Cleared all Institute, Hostel and Library dues and fines (if any) of the previous semesters;
(c) Paid all required advance payments of the Institute and hostel for the current semester;
(d) Not been debarred from registering on any specific ground by the Institute.

EVALUATION SYSTEM:

1. Absolute grading system based on absolute marks as indicated below will be implementeds from academic year 2019-20,starting from I year B.Tech.

Perentage of marks	Letter grade	Grade point
91-100	EX	10.0
86-90	AA	9.0
81-85	AB	8.5
76-80	BB	8.0
71-75	BC	7.5
66-70	CC	7.0
61-65	CD	6.5
56-60	DD	6.0
51-55	DE	5.5
40-50	EE	5.0
<40	EF	0.0

2. Class is awdared based on CGPA of all eigth semster of B.Tech Program.

CGPA for pass is minimum 5.0	
CGPAupto<5.50	Pass class
CGPA ≥ 5.50 &<6.00	SecondClass
CGPA ≥ 6.00 &<7.50	First Class
CGPA ≥ 7.50	Distinction
[Percentage of Marks =CGPA*10.0]	

3. A total of 100 Marks for each theory course are distributed as follows:

1.	MidSemester Exam (MSE) Marks	20
2.	ContinuousAssesment Marks	20
3.	EndSemesterExamination(ESE)Marks	60

4. A total of 100 Marks for each practical course are distributed as follows:

1.	ContinuousAssesment Marks	60
2.	EndSemesterExamination(ESE)Marks	40

It is mandatory for every student of B.Tech to score a minimum of 40 marks out of 100, with a minimum of 20 marks out of 60 marks in End Semester Examination for theory course.

This will be implemented from the first year of B.Tech starting from Academic Year 2019-20

5. Description of Grades:

EX Grade: An 'EX' grade stands for outstanding achievement.
EE Grade: The 'EE' grade stands for minimum passing grade.
The students may appear for the remedial examination for the subjects he/she failed for the current semester of admission only and his/her performance will be awarded with EE grade only.
If any of the students remain absent for the regular examination due to genuine reason and the same will be verified and tested by the Dean (Academics) or committee constituted by the University Authority.
FF Grade: The 'FF' grade denotes very poor performance, i.e. failure in a course due to poor performance .The students who have been awarded 'FF' grade in a course in any semester must repeat the subject in next semester.

6. Evaluation of Performance:

1. Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA)

(A) Semester Grade Point Average (SGPA) The performance of a student in a semester is indicated by Semester Grade Point Average (SGPA) which is a weighted average of the grade points obtained in all the courses taken by the student in the semester and scaled to a maximum of 10. (SGPI is to be calculated up to two decimal places). A Semester Grade Point Average (SGPA) will be computed for each semester as follows:

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$$SGPA = \frac{[\sum_{i=1}^{n} c_i g_i]}{[\sum_{i=1}^{n} c_i]}$$

Where
'n' is the number of subjects for the semester,
'ci' is the number of credits allotted to a particular subject, and
'gi' is the grade-points awarded to the student for the subject based on his performance as
per the above table.
-SGPA will be rounded off to the second place of decimal and recorded as such.
(B) Cumulative Grade Point Average (CGPA): An up to date assessment of the overall performance of a student from the time he entered the Institute is obtained by calculating Cumulative Grade Point Average (CGPA) of a student. The CGPA is weighted average of the grade points obtained in all the courses registered by the student since s/he entered the Institute. CGPA is also calculated at the end of every semester (upto two decimal places).Starting from the first semester at the end of each semester (S), a Cumulative Grade Point Average (CGPA) will be computed as follows:

$$CGPA = \frac{[\sum_{i=1}^{m} c_i g_i]}{[\sum_{i=1}^{m} c_i]}$$

Where
'm' is the total number of subjects from the first semester onwards up to and including the semester S, 'ci' is the number of credits allotted to a particular subject, and 'gi' is the grade-points awarded to the student for the subject based on his/her performance as per the above table.

-CGPA will be rounded off to the second place of decimal and recorded as such.

Award of Degree of Honours

Major Degree

The concept of Major and Minors at B.Tech level is introduced , to enhance learning skills of students, acquisition of additional knowledge in domains other than the discipline being pursued by the student, to make the students better employable with additional knowledge and encourage students to pursue cross-discipline research.

A. **Eligibility Criteria for Majors**

1. The Student should have Minimum CGPA of 7.5 up to 4th Semester
2. Student willing to opt for majors has to register at the beginning of 5th Semester
3. The Student has to complete 5 additional advanced courses from the same discipline specified in the curriculum. These five courses should be of 4 credits each amounting to 20 credits. The students should complete these credits before the end of last semester.
4. Student may opt for the courses from NPTEL/ SWAYAM platform. (if the credits of NPTEL/ SWAYAM courses do not match with the existing subject proper scaling will be done)

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Student complying with these criteria will be awarded B.Tech (Honours) Degree.

B. Eligibility Criteria for Minors

1. The Student should have Minimum CGPA of 7.5 up to 4th Semester
2. Student willing to opt for minors has to register at the beginning of 5th Semester
3. The Student has to complete 5 additional courses from other discipline of their interest, which are specified in the respective discipline. These five courses should be of 4 credits each amounting to 20 credits.
4. Student may opt for the courses from NPTEL/ SWAYAM platform. (if the credits of NPTEL/ SWAYAM courses do not match with the existing subject proper scaling will be done)

Student complying with these criteria will be awarded with B.Tech Degree in ------ Engineering with Minor in ------ --Engineering.
(For e.g.: B. Tech in Civil Engineering with Minor in Computer Engineering)

For applying for Honours and Minor Degree the student has to register themselves through the proper system.

ATTENDANCE REQUIREMENTS:

1. All students must attend every lecture, tutorial and practical classes.
2. To account for approved leave of absence (e.g.representing the Institute in sports, games or athletics; placement activities; NCC/NSS activities; etc.) and/or any other such contingencies like medical emergencies, etc., the attendance requirement shall be a minimum of 75% of the classes actually conducted.

   If the student failed to maintain 75% attendance, he/she will be detained for appearing the successive examination.

   The Dean (Academics)/ Principal is permitted to give 10% concession for the genuine reasons as such the case may be.

   In any case the student will not be permitted for appearing the examination if the attendance is less than 65%.
3. The course instructor handling a course must finalize the attendance 3 calendar days before the last day of classes in the current semester and communicate clearly to the students by displaying prominently in the department and also in report writing to the head of the department concerned.
4. The attendance records are to be maintained by the course instructor and he shall show it to the student, if and when required.

TRANSFER OF CREDITS

The courses credited elsewhere, in Indian or foreign University/Institutions/ Colleges/Swayam Courses by students during their study period at DBATU may count towards the credit requirements for the award of degree. The guidelines for such transfer of credits are as follows:

a) 20 % of the total credit will be considered for respective calculations.

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b) Credits transferred will be considered for overall credits requirements of the programme.

c) Credits transfer can be considered only for the course at same level i.e. UG, PG etc.

d) A student must provide all details (original or attested authentic copies)such as course contents, number of contact hours, course instructor /project guide and evaluation system for the course for which he is requesting a credits transfer. He shall also provide the approval or acceptance letter from the other side. These details will be evaluated by the concerned Board of Studies before giving approval. The Board of Studies will then decide the number of equivalent credits the student will get for such course(s) in DBATU. The complete details will then be forwarded to Dean for approval.

e) A student has to get minimum passing grades/ marks for such courses for which the credits transfers are to be made.

f) Credits transfers availed by a student shall be properly recorded on academic record(s) of the student.

g) In exceptional cases, the students may opt for higher credits than the prescribed.

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Bachelor of Technology, First year Engineering

Basic Science Course (BSC)

BTBS101	Engineering Mathematics – I	(3-1-0)4
BTBS102	Engineering Physics	(3-1-0)4
BTBS107L	Engineering Physics Lab	(0-0-2)1
BTBS201	Engineering Mathematics – II	(3-1-0)4
BTBS202	Engineering Chemistry	(3-1-0)4
BTBS207L	Engineering Chemistry Lab	(0-0-2)1
BTBS301	Engineering Mathematics – III	(3-1-0)4
BTBS404	Probability Theory and Random Processes	(3-0-0)3

Engineering Science Course (ESC)

BTES103	Engineering Graphics	(2-0-0)2
BTES105	Energy and Environment Engineering	(2-0-0)2
BTES106	Basic Civil and Mechanical Engineering	(2-0-0) Audit
BTES108L	Engineering Graphics Lab	(0-0-4)2
BTES203	Engineering Mechanics	(2-1-0)3
BTES204	Computer Programming	(3-0-0)3
BTES205	Workshop Practice	(0-0-4)2
BTES206	Basic Electrical and Electronics Engineering	(2-0-0) Audit
BTES208L	Engineering Mechanics Lab	(0-0-2)1
BTES209L	Computer Programming Lab	(0-0-2)1

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Humanities and Social Science including Management Courses (HSSMC)

BTHM104	Communication Skills	(2-0-0)2
BTHM109L	Communication Skills Lab	(0-0-2)1
BTHM403	Basic Human Rights	(3-0-0)3
BTHM605	Employability and Skill Development	(3-0-0)3
BTHM705	Engineering Economics and Financial Mathematics	(3-0-0)3
BTHM70	Foreign Language Studies	Audit

Seminar/Mini Project/ Internship

BTES210S	Seminar	(0-0-2)1
BTES211P	Field Training / Internship/Industrial Training (minimum of 4 weeks which can be completed partially in first semester and second Semester or in at one time). (Internship – 1)	Audit
BTETS307	Seminar I	(0-0-4)2
BTETS407	Seminar II	(0-0-4)2
BTETP408	(Internship – 2)	Audit
BTETM507	Mini Project – 1	(0-0-4)2
BTETM607	Mini Project – 2	(0-0-4)2

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Suggested Plan of Study , First Year:

No.of Courses	SEMESTER I	SEMESTER II
1	BTBS101	BTBS201
2	BTBS102	BTBS202
3	BTES103	BTES203
4	BTHM104	BTES204
5	BTES105	BTES205
6	BTES106	BTES206
7	BTBS107L	BTBS207L
8	BTES108L	BTES208L
9	BTHM109L	BTES209L
10	--	BTES210S
11	--	BTES211P (Internship - 1)

Degree Requirements:

Category of courses	Minimum credits to be earned	Credits awarded to First year
Basic Science Course (BSC)	**25**	**18**
Engineering Science Course (ESC)	**19**	**15**
Humanities and Social Science including Management Courses (HSSMC)	**12**	**03**

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Professional Core Course (PCC)	**48**	--
Professional Elective Course (PEC)	**17**	--
Open Elective Course (OEC)	**16**	--
Seminar/Mini Project/ Internship/Major Project	**23**	**01**
Total	**160**	**37**

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B. Tech in Electronics & Telecommunication Engineering
Program Educational Objectives and Outcomes

A. Program Educational Objectives (PEOs)

Graduates will able to–

a. Equip graduates with a strong foundation in engineering sciences &allied discipline fundamentals to become effective collaborators, researchers and real-time problem solver with technical competencies.

b. Perceive the limitation and impact of engineering solutions in social, legal, environmental, economical and multidisciplinary contexts.

c. Excel in Industry/technical profession, higher studies, and entrepreneurship exhibiting global competitiveness.

B. Program Outcomes

Engineering Graduate will be able to –

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specific needs with appropriate consideration for the public health and safety, and the cultural, social, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional

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engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

C. Program Specific Outcomes (PSOs)

1. Apply basic knowledge related to the discipline to solve engineering/ societal problems.
2. Recognize and adapt to technical developments and to engage in lifelong learning and develop consciousness for professional, social, legal and ethical responsibilities.
3. Excellent adaptability to the changing industrial and real world requirements

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Teaching and Evaluation Scheme for First Year B. Tech. (All Branches)

Group A

Semester I									
Course Code	**Course Title**	**Teaching Scheme**			**Evaluation Scheme**				
		L	T	P	CA	MSE	ESE	Total	Credit
Mandatory	**Induction Program**	**3-weeks duration in the beginning of semester.**							
BTBS101	Engineering Mathematics- I	3	1	-	20	20	60	100	4
BTBS102	Engineering Physics	3	1	-	20	20	60	100	4
BTES103	Engineering Graphics	2	-	-	20	20	60	100	2
BTHM104	Communication Skills	2	-	-	20	20	60	100	2
BTES105	Energy and Environment Engineering	2	-	-	20	20	60	100	2
BTES106	Basic Civil and Mechanical Engineering	2	-	-	50	-	-	50	Audit
BTBS107L	Engineering Physics Lab	-	-	2	60	-	40	100	1
BTES108L	Engineering Graphics Lab	-	-	4	60	-	40	100	2
BTHM109L	Communication Skills Lab.	-	-	2	60	-	40	100	1
		14	**2**	**8**	330	100	420	850	18
Semester II									
BTBS201	Engineering Mathematics-II	3	1	-	20	20	60	100	4
BTBS202	Engineering Chemistry	3	1	-	20	20	60	100	4
BTES203	Engineering Mechanics	2	1	-	20	20	60	100	3
BTES204	Computer Programming in C	3	-	-	20	20	60	100	3
BTES205	Workshop Practices	-	-	4	60	-	40	100	2
BTES206	Basic Electrical and Electronics Engineering	2	-	-	50	-	-	50	Audit
BTBS207L	Engineering Chemistry Lab	-	-	2	60	-	40	100	1
BTES208L	Engineering Mechanics Lab	-	-	2	60	-	40	100	1
BTES210S	Seminar	-	-	2	60	-	40	100	1
BTES211P	Field Training / Internship/Industrial Training (minimum of 4 weeks which can be completed partially in first semester and second Semester or in at one time).	-	-	-	-	-	-	-	Credits To be evaluated in III Sem.
		13	**3**	**10**	**430**	**80**	**440**	**950**	**19**
		27							

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Teaching and Evaluation Scheme for First Year B. Tech. (All Branches)

Group B

Semester I									
Course Code	**Course Title**	**Teaching Scheme**			**Evaluation Scheme**				
		L	T	P	CA	MSE	ESE	Total	Credit
Mandatory	**Induction Program**	**3-weeks duration in the beginning of semester.**							
BTBS101	Engineering Mathematics- I	3	1	-	20	20	60	100	4
BTBS102	Engineering Chemistry	3	1	-	20	20	60	100	4
BTES103	Engineering Mechanics	2	1	-	20	20	60	100	3
BTES104	Computer Programming in C	3	-	-	20	20	60	100	2
BTES105L	Workshop Practices	-	-	4	60	-	40	100	2
BTES106	Basic Electrical and Electronics Engineering	2	-	-	50	-	-	50	Audit
BTBS107L	Engineering Chemistry Lab	-	-	2	60	-	40	100	1
BTES108L	Engineering Mechanics Lab	-	-	2	60	-	40	100	1
		13	**03**	**10**	**370**	**80**	**400**	**850**	**18**
		25							
Semester II									
BTBS201	Engineering Mathematics-II	3	1	-	20	20	60	100	4
BTBS202	Engineering Physics	3	1	-	20	20	60	100	4
BTES203	Engineering Graphics	2	-	-	20	20	60	100	2
BTHM204	Communication Skills	2	-	-	20	20	60	100	2
BTES205	Energy and Environment Engineering	2	-	-	20	20	60	100	2
BTES206	Basic Civil and Mechanical Engineering	2	-	-	50	-	-	50	Audit
BTBS207L	Engineering Physics Lab	-	-	2	60	-	40	100	1
BTES208L	Engineering Graphics Lab	-	-	3	60	-	40	100	2
BTHM209L	Communication Skills Lab.	-	-	2	60	-	40	100	1
BTES210S	Seminar	-	-	2	60	-	40	100	1
BTES211P	Field Training / Internship/Industrial Training (minimum of 4 weeks which can be completed partially in first semester and second Semester or in at one time)	-	-	-	-	-	-	-	Credits To be evaluated in III Sem.
		14	**02**	**09**	**390**	**100**	**460**	**950**	**19**
		26							

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Guide to 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 institution, 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 awareness, sensitivity and understanding of the self, people around them, society at large, and nature.

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.

- **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.
- **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 every day 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.
- **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 dos and don'ts, 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. 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

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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.

- **Literary:** Literary activity would encompass reading, writing and possibly, debating, enacting a play etc.
- **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.
- **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.
- **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.
- **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 facilities.

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.

Initial Phase

Time	Activity
Day 0	
Whole day	Students arrive - Hostel allotment. (Preferably do pre-allotment)
Day 1	
9.00 AM to 3.00 PM	Academic Registration
4.30 PM to 6.00 PM	Orientation
Day 2	
9.00 AM to 10.00 AM	Diagnostic test (for English etc.)
10.15 AM to 12.25PM	Visits to Respective Departments
12.30 PM to 2.00 PM	Lunch time
2.00 PM to 3.00 PM	Director's Speech
3.00 PM to 4.00 PM	Interaction with Parents
4.00 PM to 5.30 PM	Mentor-Mentee groups- Introduction within group

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.

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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.

Session	Time	Activity	Remark
Day 3 Onwards			
I	9.00 AM to 11.00 AM	Creative Arts / Universal Human Values	Half the groups will do creative arts
II	11.00 AM to 1.00 PM	Universal Human Values/ Creative Arts	Complementar y Alternate
Lunch Time			
I V	2.00 PM to 4.00 PM	Afternoon Session	See below
V	4.00 PM to 5.00 PM	Afternoon Session	See below

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

Afternoon Activities (Non-Daily) : The following five activities are scheduled at different times of the Induction Program, and are not held daily foreveryone:

1. Familiarization to Dept./Branch &Innovations
2. Visits to LocalArea
3. Lectures by EminentPeople
4. Literary
5. Proficiency Modules

Closing Phase

Time	Activity
Last But one day	
9.00 AM to 12.00 PM	Discussions and finalizations of presentations within each group
2.00 PM to 5.00 PM	Presentation by each group in front of 4 other groups besides their own (about 100 students)
Last Day	
Whole day	Examinations if any

□ **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 6etc. (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 group should 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 Here we list some important suggestions which have come up and which have been experimentedwith.

- **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.)

- **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 Induction Program. The students be shown inspiring films, do collective art work, and group discussions be conducted. Subsequently, the groups should meet at least once amonth.

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 de-motivated to study engineering or their branch, also lose interest inlearning.

The Induction Program is designed to make the newly joined students feel comfortable, sensitize them towards exploring their academic interests and activities, reducing competition 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 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. 7nature, 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 seekhelp.

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.

BTBS101EngineeringMathematics-I **4 Credits**

Course Objectives:

1. To know the application of the matrix technique (Linear algebra) to find solutions of system of linear equations arising in many engineering problem
2. To know and apply the concept partial derivatives and their applications to Maxima/ Minima , series expansion of multi valued functions.
3. To understand Computation of Jacobian of functions of several variables and their applications to engineering problems
4. To identify and sketch of curves in various coordinate system.
5. To evaluate multiple integrals and their applications to area and volume.

Course Outcomes:

Students will be able to :

1. Apply the matrix technique (Linear algebra) to find solutions of system of linear equations arising in many engineering problem
2. Demonstrate the concept partial derivatives and their applications to Maxima/ Minima , series expansion of multi valued functions.
3. Compute Jacobian of functions of several variables and their applications to engineering problems
4. Identify and sketch of curves in various coordinate system.
5. Evaluate multiple integrals and their applications to area and volume.

Unit 1:Linear Algebra- Matrices **[07 Hours]**

Inverse of a matrix by Gauss-Jordan method; Rank of a matrix; Normal form of a matrix ; Consistency of non- homogeneous and homogeneous system of linear equations ; Eigen values and eigen vectors ; Properties of eigen values and eigen vectors (without proofs); Cayley- Hamilton's theorem (without proof) andits applications.

Unit 2:Partial Differentiation **[07 Hours]**

Partial derivatives of first and higher orders; Homogeneous functions – Euler's Theorem for functions containing two and three variables (with proofs); Total derivatives; Change of variables.

Unit 3:Applications of Partial differentiation **[07Hours]**

Jacobians - properties; Taylor's and Maclaurin's theorems (without proofs) for functions of two variables; Maxima and minima of functions of two variables; Lagrange's method of undetermined multipliers.

Unit 4: Reduction Formulae and Tracing of Curves **[07Hours]**

Reduction formulae for $\int_0^{\frac{\pi}{2}} \sin^n x\,dx$, $\int_0^{\frac{\pi}{2}} \cos^n x\,dx$, $\int_0^{\frac{\pi}{2}} \sin^m x \cos^n x\,dx$; Tracing of standard curves given in Cartesian, parametric & polar forms.

Unit 5: Multiple Integra **[08 Hours]**

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Double integration in Cartesian and polar co-ordinates; Evaluation of double integrals by changing the order of integration and changing to polar form; Triple integral; Applications of multiple integrals to find area as double integral , volume as triple integral and surface area.

Text Books

1. Higher Engineering Mathematics by B. S. Grewal, Khanna Publishers, NewDelhi.
2. Advanced Engineering Mathematics by Erwin Kreyszig, John Wiley & Sons, NewYork.
3. A Course in Engineering Mathematics (Vol I) by Dr. B. B. Singh, Synergy Knowledgeware, Mumbai.
4. A Text Book of Applied Mathematics (Vol I & II) by P. N. Wartikar and J. N. Wartikar, Pune Vidyarthi Griha Prakashan,Pune.
5. Higher Engineering Mathematics by H. K. Das and Er. Rajnish Verma, S. Chand & CO. Pvt. Ltd., New Delhi.

Reference Books

1. Higher Engineering Mathematics by B. V. Ramana, Tata McGraw-Hill Publications, New Delhi.
2. A Text Book of Engineering Mathematics by Peter O' Neil, Thomson Asia Pte Ltd. , Singapore.
3. Advanced Engineering Mathematics by C. R. Wylie & L. C. Barrett, Tata Mcgraw-Hill Publishing Company Ltd., NewDelhi.

General Instructions:

The tutorial classes in Engineering Mathematics-I are to be conducted batchwise. Each class should be divided into three batches for the purpose.

The internal assessment of the students for 20 marks will be done based on assignments, surprise tests, quizzes, innovative approach to problem solving and percentage attendance.

The minimum number of assignments should be eight covering all topics.

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BTBS102/202 Engineering Physics **4 Credits**

Course Objectives:

1. To provide a firm grounding in the basic physics principles and concept to resolve many Engineering and technological problems.

2. To understand and study the Physics principles behind the developments of Engineering materials.

Course Outcomes:

Students will be able to :

1. Explain & apply the concept of types of Oscillation,Dielectric properties & ultrsonics
2. Explain & compare between Interference & Polarisation of light ,working Principle of Lasers & Fiber optics
3. Interprete,apply &demonstrate principle of motion of charged particles in EF&MF,BAinbridge Mass spectrograph &G M counter
4. Identify Types of crystals & crystal planes using Miller indices,Experemental apprroach.

Unit I: Oscillation and Ultrasonics: **(07 Hrs)**
Free oscillation, damped oscillation, Forced oscillation and Resonance, differential wave equation, Ultrasonic waves, production of ultrasonics (Piezoelectric effect, Magnetostriction effect) and its applications

Unit II: Optics, Fibre Optics and Laser: **(07 Hrs)**
Interference of light in thin film, wedge shaped film, Newton's rings, polarization of light, methods for production of polarized light(Reflection, Refraction& Double refraction), Huygen's theory of double refraction, Principle and structure of optical fibre, acceptance angle, acceptance cone, numerical aperture.
Principle of laser, Types of laser – Ruby and He-Ne laser and their applications.

Unit III: Electron Optics, Nuclear and QuantumMechanics: **(07 Hrs)**
Motion of electron in Electric field (parallel and perpendicular), Motion of electron in magnetic field, motion of electron in combined effect, Bainbridge mass spectrograph,
G. M counter, Heisenberg's uncertainty principle, Schrödinger's time dependent and time independent wave equations, physical significance of wave function.

Unit IV: Crystal Structure, X-rays and Electrodynamics **(07 Hrs)**
Unit cell, Bravais lattice, cubic system, number of atoms per unit cell, coordination number, atomic radius, packing density, relation between lattice constant and density, lattice planes and Miller indices, X-ray diffraction, Line and Continuous Spectrum of X-ray, Introduction of Maxwell equations (no derivation).

Unit V: Magnetic, Superconducting and Semiconducting materials: **(07 Hrs)**
Types of magnetic materials (Diamagnetic, Paramagnetic and Ferromagnetic), B-H curve, Superconductivity, types of superconductors, Meissner effect, properties and applications of superconductor, Band theory of solids, conductivity of semiconductors, Halleffect.

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Expected Outcome:

1. The student will be able to understand Engineering problems based on the principle of Oscillation, Ultrasonics, Optics, Laser, Fibre optics, Nuclear physics, Quantum mechanics.
2. The student will be able to understand Fundamental of Electrodynamics, Semiconductor, Dielectric, Magnetic and Superconducting materials which forms the base of many modern devices andtechnologies.

Text books:

1. Engineering Physics M.N.Avadhanulu and P.G. Kshirsagar. S.Chandand Company LTD.
2. Engineering Physics – Dr. L. N. Singh. SynergyKnowledgeware-Mumbai.
3. Engineering Physics-R.K. Gaur and S. L.Gupta.Dhanpat Rai Publications Pvt. Ltd.-NewDelhi.
4. Fundamental of Physics - Halliday and Resnik. Willey EasternLimited.

Reference books:

1. Introduction to Electrodynamics –David R.Griffiths.
2. Concept of Modern Physics – Arthur Beizer.TataMcGraw-HillPublishing Company Limited.
3. Optics – Ajoy Ghatak, MacGraw Hill Education (India) Pvt.Ltd.
4. Science of Engineering Materials- C.M. Srivastava and C. Srinivasan. New Age InternationalPvt.Ltd.
5. Solid State Physics – A.J. Dekker. McMillan India–Limited.
6. The Feynman Lectures on Physics VolI,II,III.
7. Introduction to solid state physics – Charles Kittel. John Willey andSons

Engineering physics Lab:

Atleast 10 experiments should be performed from the following list

1. Newton's rings - Determination of radius of curvature of Plano convex lens / wavelength of light
2. Wedge Shaped film - Determination of thickness of thin wire
3. Half shade Polarimeter - Determination of specific rotation of optically active material
4. Laser - Determination of wavelength of He-Ne laser light
5. Magnetron Tube - Determination of 'e/m' of electron
6. G.M. Counter - Determination of operating voltage of G.M. tube
7. Crystal Plane – Study of planes with the help of models related Miller Indices
8. Hall Effect - Determination of Hall Coefficient
9. Four Probe Method - Determination of resistivity of semiconductor
10. Measurement of Band gap energy of Semiconductors
11. Study of I-V characteristics of P-N junction diode
12. Experiment on fibre optics
13. Ultrasonics Interferometer
14. B-H Curve Experiment
15. Susceptiblity measurement experiment

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BTES103/203 Engineering Graphics **2 Credits**

First Year B. Tech Classes (Common to all Branches)

Course Objectives:

1. To make use of drawing instruments effectively for drawing and dimensioning.
2. To understand the conventions and methods of engineering drawing.
3. To know the concept of projections of points, lines, planes, solids and section of solids.
4. To understand the Construction isometric and orthographic views of given objects.

Course Outcomes:

Students will be able to :

1. Use of drawing instruments effectively for drawing and dimensioning.
2. Explain conventions and methods of engineering drawing.
3. Apply concept of projections of points, lines, planes, solids and section of solids.
4. Construct isometric and orthographic views of given objects.

Unit 1: Drawing standards andgeometricalconstruction: **4 hrs**

Drawing standard SP: 46, Type of lines, lettering, dimensioning, scaling conventions. Geometrical construction: Dividing a given straight line into any number of equal parts, bisecting a given angle, drawing a regular polygon given one side, special methods of constructing a pentagon and a hexagon.

Unit 2: Orthographic Projections and Projections of Points: **4hrs**

Introduction to orthographic projection, drawing of orthographic views of objects from their isometric views. Projection of points lying in four quadrants.

Unit 3: Projections of Straight Lines and Planes and their Traces: **4hrs**

Projections of lines parallel and perpendicular to one or both planes, projections of lines inclined to one or both planes. Traces oflines.

Projections of planes parallel and perpendicular to one or both planes, projection of planes inclined to one or both planes.

Unit4:Projections of Solids **4hrs**

Types of solids, projections of solids with axis perpendicular and parallel to HP and VP, solids with axis inclined to one or both the planes. Projections of spheres touching each other.

Unit 5: Sectioning of Solids, Isometric Projections **4hrs**

Sectioning of solids: Section planes perpendicular to one plane and parallel or inclined to other plane. Isometric projections: Isometric scale, drawing of isometric projections from given orthographic views.

Head

Reference/Text Books:

1. N. D. Bhatt, *Engineering Drawing*, Charotar Publishing House, 46th Edition,2003.
2. K. V. Nataraajan, *A text book of Engineering Graphic*, Dhanalakshmi Publishers, Chennai, 2006.
3. K. Venugopal and V. Prabhu Raja, *Engineering Graphics*, New Age International (P) Ltd, 2008.
4. DhananjayA.Jolhe,*EngineeringDrawingwithanIntroductiontoAutocad*,Mc GrawHill Education, 2017

BTES108L Engineering Graphics Lab

Practical Scheme:	**Examination Scheme:**
Practical: 3 hrs/batch	Internal Assessment: 60 Marks External Exam: 40 Marks

Course Contents:

Llist of Experiment

1. Lines, lettering and dimensioning.
2. Geometrical Constructions.
3. Orthographic projections.
4. Projections of points and straight lines
5. Projections of planes.
6. Projections of solids.
7. Section of solids.
8. Isometric Projections.

BTHM104/204 Communication Skills **2 Credits**

Course Objectives:

1. To know and apply speaking and writing skills in professional as well as social situations
2. To Overcome Mother Tongue Influence and demonstrate neutral accent while exercising English
3. To know and apply communication skills for Presentations, Group Discussion and interpersonal interactions.
4. To know and apply grammar correctly during Speaking and Writing situations especially in context with Presentations, Public Speaking, Report writing and Business Correspondence

Course Outcomes:

Students will be able to:

1. Apply speaking and writing skills in professional as well as social situations
2. Overcome Mother Tongue Influence and demonstrate neutral accent while exercising English
3. Apply communication skills for Presentations, Group Discussion and interpersonal interactions.
4. Apply grammar correctly during Speaking and Writing situations especially in context with Presentations, Public Speaking, Report writing and Business Correspondence

Unit 1: Communication and Communication Processes **(04hrs)**

Introduction to Communication, Forms and functions of Communication, Barriers to Communication and overcoming them, Verbal and Non-verbal Communication Reading: Introduction to Reading, Barriers to Reading, Types of Reading: Skimming, Scanning, Fast Reading, Strategies for Reading, Comprehension. Listening : Importance of Listening, Types of Listening, Barriers to Listening.

Unit 2: Verbal & Non-verbal Communication **(04 hrs)**

Use of Language in Spoken Communication, Principles and Practice of Group Discussion, Public Speaking (Addressing Small Groups and Making Presentation), Interview Techniques, Appropriate Use of Non-verbal Communication, Presentation Skills, Extempore,Elocution.

Unit 3: Study of Soundsin English **(02 hrs)**

Introduction to phonetics, Study of Speech Organs, Study of Phonemic Script, Articulation of Different Sounds in English.

Unit 4:English Grammar **(05 hrs)**

Grammar: Forms of Tenses, Articles, Prepositions, Use of Auxiliaries and Modal Auxiliaries, Synonyms and Antonyms, Common Errors.

Unit 5: Writing Skills, Reading Skills & Listening Skills **(04 hrs)**

Features of Good Language, Difference between Technical Style and Literary Style, Writing Emails, Formal and Informal English, Technical Reports: Report Writing: Format, Structure and Types Letter Writing: Types, Parts, Layouts, Letters and Applications, Use of Different Expressions and Style, Writing Job Application Letter and Resume.

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Text book:

Mohd. Ashraf Rizvi, *Communication Skills for Engineers*, Tata McGraw Hill

Reference Books:

a. Sanjay Kumar, Pushp Lata, *Communication Skills*, Oxford University Press,2016
b. Meenakshi Raman, Sangeeta Sharma, *Communication Skills*, Oxford University Press,2017
c. Teri Kwal Gamble, Michael Gamble, *Communication Works*, Tata McGraw Hill Education, 2010
d. Anderson, Kenneth. Joan Maclean and Tossny Lynch. Study Speaking: A Course inSpoken English for Academic Purposes. Cambridge: CUP, 2004.
e. Aswalthapa, K. *Organisational Behaviour*, Himalayan Publication, Mumbai(1991).
f. Atreya N and Guha, *Effective Credit Management*, MMC School of Management, Mumbai (1994).
g. Balan,K.R. and Rayudu C.S., *Effective Communication*, Beacon New Delhi(1996).
h. Bellare, Nirmala. *Reading Strategies*. Vols. 1 and 2. New Delhi. Oxford University Press, 1998.
i. Bhasker, W. W. S & Prabhu, N. S.: *English through Reading*, Vols. 1 and 2. Macmillan, 1975.
j. Black, Sam. *Practical Public Relations*, E.L.B.S. London(1972).
k. Blass, Laurie, Kathy Block and Hannah Friesan. *Creating Meaning*. Oxford: OUP,2007.
l. Bovee Courtland,L and Thrill, John V. *Business Communication*, Today McGraw Hill, New York, Taxman Publication(1989).

Communication Skill Lab:

Atleast 10 experiments should be performed from the following list

1) How to introduce oneself?
2) Introduction to Phonemic symbols
3) Articulation of sounds in English with proper manner
4) Practice and exercises on articulation of sounds
5) Read Pronunciations/transcriptions from the dictionary
6) Practice and exercises on pronunciations of words
7) Introduction to stress and intonation
8) Rapid reading sessions
9) Know your friend
10) How to introduce yourself
11) Extempore
12) Group discussion
13) Participating in a debate
14) Presentation techniques
15) Interview techniques

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BTES105/205 Energy and Environment Engineering **2 Credits**

Course Objectives:

1. To Identify conventional ,non conventional energy sources.
2. To understand the power consuming and power developing devices for effective utilization and power consumption
3. To Identify various sources of air, water pollution and its effects.
4. To understand noise,soil, thermal pollution and Identify solid, biomedical and hazardous waste.

Course Outcomes:

Students will be able to:

1. Identify conventional ,non conventional energy sources.
2. Knowand discuss power consuming and power developing devices for effective utilization and power consumption
3. Identify various sources of air, water pollution and its effects.
4. Know and discuss noise,soil, thermal pollution and Identify solid, biomedical and hazardous waste.

Unit 1: Conventional Power Generation: **(4 hours)**
Steam power station, Nuclear power plant – Gas turbine power plant- Hydro power station: Schematic arrangement, advantages and disadvantages, Thermo electric and thermionic generators, Environmental aspects for selecting the sites and locations of power plants.

Unit 2: Renewable Power Generation: **(4 hours)**
Solar, Wind, Biogas and Biomass, Ocean Thermal energy conversion (OTEC), Tidal, Fuel cell, Magneto Hydro Dynamics (MHD): Schematic arrangement, advantagesanddisadvantages.

Unit 3: Energy conservation **(4 hours)**
Scope for energy conservation and its benefits Energy conservation Principle– Maximum energy efficiency, Maximum cost effectiveness, Methods and techniques of energy conservation in ventilation and air conditioners, compressors, pumps, fans and blowers, Energy conservation in electric furnaces, ovens and boilers.,lightingtechniques.

Unit 4: Air Pollution **(4 hours)**
Environment and Human health - Air pollution: sources- effects- control measures - Particulate emission, air quality standards, and measurement ofairpollution.

Unit 5: Water Pollution **(4 hours)**
Water pollution- effects- control measures- Noise pollution –effects and control measures, Disposal of solid wastes, Bio-medical wastes-Thermal pollution – Soil pollution -Nuclear hazard.

Reference/Text Books:

1. A Chakrabarti, M. L Soni, P. V. Gupta, U. S. Bhatnagar, A Text book of Power System Engineering, Dhanpat Rai Publication.
2. Rai. G. D., Non Conventional Energy Sources, Khanna Publishers, Delhi,2006.
3. Rao S., Parulekar B.B., Energy Technology-Non conventional, Renewable And Conventional, Khanna Publishers, Delhi,2005.

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4. Glynn Henry J., Gary W. Heinke, Environmental Science and Engineering, Pearson Education, Inc,2004.
5. J. M. Fowler, Energy and the Environment, McGraw-Hill, 2 nd Edition,1984.
6. Gilbert M. Masters, Introduction to Environmental Engineering and Science, 2nd Edition, Prentice Hall,2003.

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BTES106/206 Basic Civil and Mechanical Engineering **Audit**

Course Objectives:

1. To Identify various Civil Engineering materials and choose suitable material among various options.
2. To know and apply principles of surveying to solve engineering problem
3. To Identify various Civil Engineering structural components and select appropriate structural system among various options
4. To Explain and define various properties of basic thermodynamics, materials and manufacturing processes.
5. To know and discuss the working principle of various power consuming and power developing devices

Course Outcomes:

Students will be able to:

1. Identify various Civil Engineering materials and choose suitable material among various options.
2. Apply principles of surveying to solve engineering problem
3. Identify various Civil Engineering structural components and select appropriate structural system among various options
4. Explain and define various properties of basic thermodynamics, materials and manufacturing processes.
5. Know and discuss the working principle of various power consuming and power developing devices

Part I Basic Civil Engineering

Module 1: Introduction to civil engineering **(4hrs)**

Various Branches, role of civil engineer in various construction activities, basic engineering properties and uses of materials: earth, bricks, timber, stones, sand, aggregates, cement, mortar, concrete, steel, bitumen, glass, FRP, composite materials.

Module 2: Building Components & Building Planning **(4 hrs)**

Foundation and superstructure, functions of foundation, types of shallow and deep foundations, suitability in different situation, plinth, walls, lintels, beams, columns, slabs, roofs, staircases, floors, doors, windows, sills, Study of Building plans, ventilation, basics of plumbing and sanitation

Module3: Surveying **(4 hrs)**

Principles of survey, elements of distance and angular measurements, plotting of area, base line and offsets, introduction to Plane table surveying, introduction to levelling, concept of bench marks, reduced level, contours

Part II Basic Mechanical Engineering

Unit 1: Introduction to Mechanical Engineering: **(4 hrs)**

Introduction to Laws of Thermodynamics with simple examples pertaining to respective branches, IC Engines: Classification, Applications, Basic terminology, 2 and 4 stroke IC engine working principle, Power Plant: Types of Power plant; Gas power plant, Thermal power plant, Nuclear power plant, Automobiles: Basic definitions and objectives

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Unit 2:

(4 hrs)

Design Basics, Machine and Mechanisms, Factor of safety, Engineering Materials: types and applications, basics of Fasteners Machining and Machinability, Introduction to Lathe machine, Drilling machine, Milling machine, basics of machining processes such as turning, drilling and milling, Introductiontocasting

Text Books

- Anurag Kandya, "Elements of Civil Engineering", Charotar Publishing,Anand
- M. G. Shah, C. M. Kale, and S. Y. Patki, "Building Drawing", Tata McGrawHill
- Sushil Kumar, "Building Construction", Standard PublishersDistributors
- M. S. Palani Gamy, "Basic Civil Engineering", Tata Mc-Graw Hill Publication
- Kanetkar T. P. and Kulkarni S. V., "Surveying and Levelling", Vols. I, II and III, Vidyarthi Gruh Prakashan,Pune
- Punmia, "Surveying", Vol.- I, Vol.-II, Vol.-III, Laxmi Publications
- G. K. Hiraskar, "Basic Civil Engineering", Dhanpat RaiPublications
- Gopi Satheesh, "Basic Civil Engineering", PearsonEducation
- P. K. Nag "Engineering Thermodynamics", Tata McGraw Hill, New Delhi 3rd ed.2005
- Ghosh, A K Malik, "Theory of Mechanisms and Machines", Affiliated East West Press Pvt. Ltd. NewDelhi.
- Serope Kalpakaji and Steven R Schimd " Amanufacturing Engineering and Techology" Addision Wsley Laongman India 6th Edition2009
- V. B. Bhandari, " Deisgn of Machine Elements", Tata McGraw Hill Publications, NewDelhi.

BTBS201 Engineering Mathematics – II **4 Credits**

Course Objectives:

1. To know and discuss the need and use of complex variables to find roots ,to separate complex quantities and to establish relation between circular and hyperbolic functions.
2. To understand and solve first and higher order differential equations and apply them as a mathematical modeling in electric and mechanical systems.
3. To determine Fourier series representation of periodic functions over different intervals.
4. To Demonstrate the concept of vector differentiation and interpret the physical and geometrical meaning of gradient, divergence &curl in various engineering streams.
5. To know and apply the principles of vector integration to transform line integral to surface integral,surface to volume integral &vice versa using Green's , Stoke's and Gauss divergence theorems.

Course Outcomes:

Students will be able to:

1. Discuss the need and use of complex variables to find roots ,to separate complex quantities and to establish relation between circular and hyperbolic functions.
2. Solve first and higher order differential equations and apply them as a mathematical modeling in electric and mechanical systems.
3. Determine Fourier series representation of periodic functions over different intervals.
4. Demonstrate the concept of vector differentiation and interpret the physical and geometrical meaning of gradient, divergence &curl in various engineering streams.
5. Apply the principles of vector integration to transform line integral to surface integral ,surface to volume integral &vice versa using Green's , Stoke's and Gauss divergence theorems.

Unit 1: Complex Numbers **[07 Hours]**

Definition and geometrical representation ; De-Moivre's theorem(without proof) ; Roots of complex numbers by using De-Moivre's theorem ; Circular functions of complex variable – definition ; Hyperbolic functions ; Relations between circular and hyperbolic functions ; Real and imaginary parts of circular and hyperbolic functions ; Logarithm of Complexquantities.

Unit 2: Ordinary Differential Equations of First Order and First Degree and Their Applications **[07 Hours]**

Linear equations; Reducible to linear equations (Bernoulli's equation); Exact differential equations; Equations reducible to exact equations ; Applications to orthogonal trajectories , mechanical systems and electrical systems.

Unit 3: Linear Differential Equations with Constant Coefficients **[07 Hours]**

Introductory remarks - complementary function, particular integral ; Rules for finding complementary functions and particular integrals ; Method of variation of parameters ; Cauchy's homogeneous and Legendre's linear equations.

Unit 4: Fourier Series **[07 Hours]**

Introductory remarks- Euler's formulae ; Conditions for Fourier series expansion - Dirichlet's conditions ; Functions having points of discontinuity ; Change of interval ; Odd and even functions expansions of odd and even periodic functions ; Half-rangeseries.

Unit 5: Vector Calculus **[07 Hours]**

Scalar and vector fields:Gradient , divergence and curl ; Solenoidal and irrotational vector fields; Vector identities (statement without proofs) ; Green's lemma , Gauss' divergence theorem and Stokes' theorem (without proofs)

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Text Books

a. Higher Engineering Mathematics by B. S. Grewal, Khanna Publishers, NewDelhi.
b. Advanced Engineering Mathematics by Erwin Kreyszig, John Wiley & Sons, NewYork.
c. A Course in Engineering Mathematics (Vol II) by Dr. B. B. Singh, Synergy Knowledge ware,Mumbai.
d. A Text Book of Applied Mathematics (Vol I & II) by P. N. Wartikar and J. N. Wartikar, Pune Vidyarthi Griha Prakashan,Pune.
e. Higher Engineering Mathematics by H. K. Das and Er. Rajnish Verma, S. Chand & CO. Pvt. Ltd., New Delhi.

Reference Books

a. Higher Engineering Mathematics by B. V. Ramana, Tata McGraw-Hill Publications, New Delhi.
b. A Text Book of Engineering Mathematics by Peter O' Neil, Thomson Asia Pte Ltd. , Singapore.
c. Advanced Engineering Mathematics by C. R. Wylie & L. C. Barrett, Tata Mcgraw-Hill Publishing Company Ltd., NewDelhi.

General Instructions:

1. The tutorial classes in Engineering Mathematics-II are to be conducted batchwise. Each class should be divided into three batches for thepurpose.
2. The internal assessment of the students for 20 marks will be done based on assignments, surprise tests, quizzes, innovative approach to problem solving and percentageattendance.
3. The minimum number of assignments should be eight covering alltopics.

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BTBS102/202 Engineering Chemistry **4 Credits**

Course Objectives:

1. To know the demonstration of knowledge of Chemistry in technical fields.
2. To bring adaptability to new developments in Engineering Chemistry and to acquire the skills required to become a perfect engineer.
3. To understand and develop the importance of water in industrial and domestic usage.
4. To identify the concepts of Chemistry to lay the ground work for subsequent studies in various engineering fields.
5. To examine a fuel and suggest alternative fuels.

Course Outcomes:

Students will be able to:

1. Demonstrate knowledge of chemistry in technical fields.
2. Bring adaptability to new developments in Engineering Chemistry and to acquire the skills required to become a perfect engineer.
3. Develop the importance of water in industrial and domestic usage.
4. Identify the concepts of Chemistry to lay the ground work for subsequent studies in various engineering fields.
5. Examine a fuel and suggest alternative fuels.

Unit 1: Water Treatment **(7L)**

Introduction , Hard and Soft water, Disadvantages of hard water –In Domestic use, In Industrial use, Softening of water – Zeolite process, Ion exchange process, Hot Lime –Soda process, water characteristics- Hardness and its determination by EDTA method, Dissolved oxygen (DO) and its determination by Winkler's method.

Unit 2: Phase Rule **(6L)**

Phase Rule, statement, Explanation of the terms – Phase, Component, Degrees of freedom. One component system – Water and Sulphur. Reduced Phase rule equation, Two component alloy system- Phase diagram of Silver- Lead alloy system.

Unit 3: Corrosion and its Control **(7L)**

Introduction, Fundamental reason of corrosion, Electrochemical Corrosion(Wet corrosion) , Direct Chemical Corrosion(Dry corrosion), Factors affecting the rate of corrosion, Types of corrosion- Galvanic, Microbiological Corrosion, Methods to minimise the rate of corrosion- Proper designing , Cathodic and Anodic protection method.

Unit 4: Fuels and Lubricants **(7L)**

Fuels: Introduction, Classification of fuel, Calorific value of a fuel, Characteristics of a good fuel, solid fuel- Coal and Various types of Coal, Analysis of coal- Proximate and Ultimate analysis, Liquid fuel- Refining of Petroleum.

Lubricants: Introduction, classification of lubricants - Solid, Semi –solid and Liquid Lubricants, Properties of lubricants: Physical properties – Viscosity, Viscosity index, surface tension, Flash point and Fire point. Chemical properties – Acidity, Saponification.

Unit 5: Electrochemistry **(7L)**

Introduction – Definition and units of Ohm's Law, Specific Resistance, Specific Conductance, Equivalent and Molecular Conductance. Method of conductance measurement by Wheatstone bridge method, Cell constant, Conductometric titrations, Nernst equation and its application for the calculation of half-cell potential, Glass electrode, Fuel cell (H_2O_2), Advantages of fuel cell, Ostwald's theory of acid- base indicator.

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Text books:

1. Jain P.C & Jain Monica, Engineering Chemistry, Dhanpat Rai & Sons, Delhi, 1992.
2. Bhal & Tuli, Text book of Physical Chemistry , S. Chand & Company, New Delhi.
3. Shikha Agarwal, Engineering Chemistry- Fundamentals and applications, Cambridge Publishers - 2015

Reference books:

1. Barrow G.M., Physical Chemistry, McGraw-Hill Publication, New Delhi.
2. O. G. Palanna , Engineering Chemistry, Tata McGraw-Hill Publication, New Delhi.
3. WILEY, Engineering Chemistry, Wiley India, New Delhi 2014.
4. S.S.Dara, Engineering Chemistry,McGraw Hill Publication, New Delhi.

Engineering Chemistry Lab:

At least 10 experiments should be performed from the following list

1. Determination of Hardness of water sample by EDTA method.
2. Determination of Chloride content in water sample by precipitation titration method.
3. Determination of Dissolve Oxygen in water by Iodometric method.
4. Determination of Percent purity of Bleaching Powder.
5. pH – metric Titration (Acid Base titration)
6. Conductometric Titration (Acid Base titration)
7. Surface tension
8. Viscosity
9. To determine Acidity of water sample.
10. To determine Calorific value of a fuel.
11. Determination of Acid value of an oil sample.
12. Determination of Saponification value of an oil sample.
13. Experiment on water treatment by using Ion exchange resins.
14. To find out P-T curve diagram of steam.
15. To determine Alkalinity water sample.
16. Determination of rate of corrosion of metal.

Reference Books:

1. Systematic experiments in Chemistry, A. Sethi, New Age International Publication, New Delhi.
2. Practical Inorganic Chemistry, A. I. Vogel, ELBS Pub.
3. Practical in Engineering Chemistry, S. S. Dara.

BTES103/203 Engineering Mechanics 3 Credits

Course Objectives:

1. To know and apply fundamental Laws of Engineering Mechanics
2. To know and apply Conditions of static equilibrium to analyze given force system
3. To compute Centre of gravity and Moment of Inertia of plane surfaces
4. To compute the motion characteristics of a body/particle for a Rectilinear and Curvilinear Motion
5. To know and discuss relation between force and motion characteristics

Course Outcomes:

Students will be able to:

1. Apply fundamental Laws of Engineering Mechanics
2. Apply Conditions of static equilibrium to analyze given force system
3. Compute Centre of gravity and Moment of Inertia of plane surfaces
4. Compute the motion characteristics of a body/particle for a Rectilinear and Curvilinear Motion
5. Know and discuss relation between force and motion characteristics

Module1:BasicConcepts **(7Lectures)**

Objectives of Engineering Analysis and Design, Idealization of Engineering Problems, Simplification of real 3D problems to 2-D and 1-D domain,Basis of Assumptions, types of supports, types of load, free body diagram, Laws of Motion, Fundamental principles, Resolution and composition of a forces, Resultant, couple, moment, Varignon's theorem, force systems, Centroid of composite shapes, moment of inertia of planer sectionsand radius of gyration

Module2: Equilibrium **(7 Lectures)**

Static equilibrium, analytical and graphical conditions of equilibrium, Lami's theorem, equilibrium of coplanar concurrent forces, coplanar non concurrent forces, parallel forces,beams reactionsSimple trusses (plane and space), method of joints for plane trusses, method of sections for plane trusses Friction:Coulomb law, friction angles, wedge friction, sliding friction and rolling resistance

Module3:Kinematics **(7 Lectures)**

Types of motions, kinematics of particles, rectilinear motion, constant and variable acceleration, relative motion, motion under gravity, study of motion diagrams, angular motion, tangential and radial acceleration, projectile motion, kinematics of rigid bodies, concept of instantaneous center of rotation, concept of relativevelocity,

Module4:Kinetics **(6 Lectures)**

Mass moment of inertia, kinetics of particle, D'Alembert's principle:applications in linear motion, kinetics of rigid bodies, applications in translation, applications in fixed axisrotation

Module5: Work, Power, Energy **(6 Lectures)**

Principle of virtual work, virtual displacements for particle and rigid bodies, work done by a force, spring, potential energy, kinetic energy of linear motion and rotation, work energyequation, conservation of energy, power, impulse momentum principle, collision of elasticbodies.

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Text Books

- S. Timoshenko, D. H. Young, "Engineering Mechanics", McGraw Hill,1995.
- Tayal A. K., "Engineering Mechanics", Umesh Publications,2010.
- Bhavikatti S. S., Rajashekarappa K. G., "Engineering Mechanics", New Age International Publications, 2ndEdition.
- Beer, Johnston, "Vector Mechanics for Engineers", Vol. 1: Statics and Vol. 2: Dynamics, McGraw HillCompany Publication, 7th edition,1995.
- Irving H. Shames, "Engineering Mechanics - Statics and Dynamics", Pearson Educations, Fourth edition, 2003.
- McLean, Nelson, "Engineering Mechanics", Schaum's outline series, McGraw Hill Book Company, NDelhi, Publication.
- Singer F. L., "Engineering Mechanics - Statics & Dynamics", Harper and Row Pub.York.
- Khurmi R. S., "Engineering Mechanics", S. Chand Publications, N.Delhi

Engineering Mechanics Lab:

Atleast 10 experiments should be performed from the following list

1.Polygon law of coplanar forces

2. Bell crank lever.

3. Support reaction for beam.

4. Problems on beam reaction by graphics statics method

5. Simple / compound pendulum.

6. Inclined plane (to determine coefficient of friction).

7. Collision of elastic bodies (Law of conservation of momentum).

8. Moment of Inertia of fly wheel.

9. Verification of law of Machine using Screw jack

10. Assignment based on graphics statics solutions

11. Any other innovative experiment relevant to Engineering Mechanics.

12.Centroid of irregular shaped bodies.

13. Verification of law of Machine using Worm and Worm Wheel

14. Verification of law of Machine using Single and Double Gear Crab.

15. Application of Spreadsheet Program for conceptslike law of moments, beam reactions, problems in kinematics, etc

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BTES104/204 Computer Programming in C **2 Credits**

Course Objectives:

1.To give a broad perspective about the uses of computers in engineering industry and C Programming.

2. To develop the basic concept of algorithm, algorithmic thinking and flowchart.

3. To apply the use of C programming language to implement various algorithms and develops the basic concepts and terminology of programming in general.

4. To make familiar the more advanced features of the C language.

5. To identify tasks in which the numerical techniques learned are applicable and apply them to write programs and hence use computers effectively to solve the task.

Course Outcomes:

Students will be able to:

1. Gain a broad perspective about the uses of computers in engineering industry and C Programming.

2. Develop the basic concept of algorithm, algorithmic thinking and flowchart.

3. Apply the use of C programming language to implement various algorithms and develops the basic concepts and terminology of programming in general.

4. Use the more advanced features of the C language.

5. Identify tasks in which the numerical techniques learned are applicable and apply them to write programs and hence use computers effectively to solve the task.

Unit 1: Process of programming: **(4 Lectures)**

Editing, Compiling, Error Checking, executing, testing and debugging of programs. IDE commands. Eclipse for C Program development, Flowcharts, Algorithms. (4 Lectures)

Unit 2: Types,Operators and Expressions: **(4 Lectures)**

Variablenames, Data types, sizes, constants, declarations, arithmetic operators, relational and logical operators, type conversions, increment and decrement operators, bitwise operators, assignment operators and expressions, conditional expressions precedence and orderofevaluation.

Unit 3: Control Flow: **(4 Lectures)**

Statements and Blocks. If-else, else-if switch Loops while and for, do-while break and continue goto and Labels. Functions and Program Structure: Basic of functions, functions returning non-integers external variablesscoperules.

Unit 4: Arrays **in C:** **(4 Lectures)**

Initializing arrays, Initializing character arrays, multidimensional arrays.

Unit 5: Structures C: **(4 Lectures)**

Basics of structures, structures and functions arraysofstructures,

Pointer in C. Pointers to integers, characters, floats, arrays,structures.

Special Note: Topic of Pointers in C is only for lab exercises and not for end semester examinations.

Reference/Text Books:

1. Brain W. Kernighan & Dennis Ritchie, The C Programming Language, Prentice Hall, 2nd Edition, 1988.
2. R. S. Bichkar, Programming with C, Orient Blackswan, 1st Edition,2012.
3. Herbert Schildit, C the Complete Reference, McGraw-Hill Publication,2000.
4. Balguruswamy, Programming in C,PHI.
5. Yashwant Kanitkar, Let Us C,PHI

Computer Programming in C Lab:

Atleast 10 experiments should be performed from the following list

1. Assignment on Flow Chart.
2. A Simple program to display a message "Hello world" on screen.
3. A Program to take input from user and display value entered by user on screen.
4. Basic example for performing different C Operations using operator. (With and without using scanf()).
5. Basic Program on Operator. (Using scanf()).

a) Program to find and print area, perimeter and volume of geometric objects.

b) Program to check a number entered by user is Perfect number or not.

6. Program to find maximum and minimum between two numbers given by user using if-else and conditional Operators.
7. Program to swap two numbers.
8. Program to print square and factorial of an entered number using while loop.

9. Program to check a number is Palindrome number or not.
10. Program to check Armstrong number.
11. Program to check and generate prime numbers up to n.
12. Program to find GCD of two entered numbers.
13. Program to find maximum and minimum from n entered numbers.
14. Program to print alternate numbers from n entered numbers.
15. Program to search an element in an Array using linear and binary search.
16. Program to print entered numbers in ascending order using sorting.
17. Program to print addition, subtraction and multiplication of Matrices.
18. Program to find length of string. (With and without using library function).
19. Programs demonstrating use of Structures, Arrays of Structures and Structure containing arrays.
20. Programs demonstrating use of pointers to integers, floats, char, strings, structures and arrays.

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BTES106/206 Basic Electrical and Electronics Engineering **Audit**

Course Objectives:

1. To know and apply basic ideas and principles of electrical engineering.
2. To Identify protection equipment and energy storage devices.
3. To differentiate electrical and electronics domains and explain the operation of diodes and transistors.
4. To acquire knowledge of digital electronics
5. To design simple combinational and sequential logic circuits.

Course Outcomes:

Students will be able to:

1. Apply basic ideas and principles of electrical engineering.
2. Identify protection equipment and energy storage devices.
3. Differentiate electrical and electronics domains and explain the operation of diodes and transistors.
4. Acquire knowledge of digital electronics
5. Design simple combinational and sequential logic circuits.

Unit 1: Elementary Electrical Concepts: **[07 Hours]**

Fundamental of Electrical system Potential difference, Ohm's law, Effect of temperature on resister, resistance temperature coefficient, Electrical wiring system: Study of different wire gauges and their applications in domestic and industry. Energy Resources and Utilization: Conventional and nonconventional energy resources; Introduction to electrical energy generation from different resources, transmission, distribution and utilization,Advantages & Disadvantages of AC & DC transmission. Concept of Supply Demand, Power Factor, Need of unityfactor.

Unit 2: Measurement of Electrical Quantities: **[07 Hours]**

Measurement of Voltage, Current, and Power; Measurement of 3 phase power; Study of Energy meters. Study of Electrical Storage devices: Batteries such as Nickel-cadmium (NiCd), Lithium- ion (Li-ion), Lithium Polymer (Li-pol.) batteries. Study of circuit breakers & Actuators (MCB & MPCB, Power Contactors & Aux contactors, Electro-Mechanical & Solid state Relays)

Unit 3: Diodes and Circuits: **[07 Hours]**

The P-N Junction Diode, V-I characteristics, Diode as Rectifier, specifications of Rectifier Diodes, Half Wave, Full wave, Bridge rectifiers, Equations for IDCVDC VRMS, IRMS, Efficiency and Ripple Factor for each configuration. Filters: Capacitor Filter, Choke Input Filter, Capacitor InputFilter(Π Filter), Zener Diode, Characteristics, Specifications, Zener Voltage Regulator, Types of Diodes: LED,Photodiode

Unit 4: Semiconductor Devices and Applications: **[07 Hours]**

Transistors: Introduction, Classification, CE, CB, and CC configurations, α, β, concept of gain and bandwidth. Operation of BJT in cut-off, saturation and active regions (DC analysis). BJT as an amplifier, biasing techniques of BJT, BJT as a switch.
Introduction to Digital Electronics: Number System, Basic logic Gates, Universal Gates, Boolean Postulates, De-Morgan Theorems

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Reference/Text Books:

1. V. N. Mittal and Arvind Mittal, Basic Electrical Engineering, McGraw-HillPublication.
2. Brijesh Iyer and S. L. Nalbalwar, A Text book of Basic Electronics, Synergy Knowledgeware Mumbai, 2017.ISBN:978-93-8335-246-3
3. Vincent DelToro, Electrical engineering Fundamentals, PHI Publication, 2nd Edition,2011.
4. Boylstad, Electronics Devices and Circuits Theory, PearsonEducation.
5. Edward Hughes, Electrical Technology, PearsonEducation.
6. D. P. Kothari and Nagrath, Theory and Problems in Electrical Engineering, PHI Publication,2011.
7. B. L. Theraja, Basic Electronics, S. Chand Limited,2007.
8. Millman Halkias, Integrated Electronics-Analog and Digital Circuits and Systems, McGraw-Hill Publication,2000.
9. Donald Neaman, Electronic Circuit Analysis and Design, McGraw-Hill Publication, 3rd Edition.
10. Donald Neaman, Electronic Circuit Analysis and Design, McGraw-Hill Publication, 3rd Edition.
11. Printed Circuit Boards Design &Technology,WalterC. Bosshart, McGraw-Hill Publication.

Note: Students are advised to use internet resources whenever required

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BTES206L Workshop Practice

Teaching Scheme:	Examination Scheme:
Practical: 4 hrs/batch	Internal Assessment: 60 Marks External Exam: 40 Marks

Instruction to Students:
Each student is required to maintain a „workshop diary" consisting of drawing / sketches of the jobs and a brief description of tools, equipment, and procedure used for doing the job.

List of Practical: (any six)

1. Wood sizing exercises in planning, marking, sawing, chiseling and grooving to make half lap joint and cross lapjoint.
2. A job involving cutting, filing to saw cut, filing all sides and faces, corner rounding, drilling and tapping on M. S.plates.
3. A job on use of plumbing tools and preparation of plumbing line involving fixing of water tap and use of elbow, tee, union and coupling, etc.
4. Making a small parts using GI sheet involving development, marking, cutting, bending, brazing and soldering operations- i)Tray ii) Funnel and similararticles.
5. Exercise in Arc welding (MMAW) to make a square buttjoint.
6. Exercise in Resistance (Spot) welding to make a lap joint.
7. Ajobusing power operated tools related to sheet metal work, Welding, Fitting, Plumbing, Carpentry and patternmaking.
8. A job on turning of a Mild Steel cylindrical job using center lathe.

Contents:

a) **Carpentry:** Technical Terms related to wood working, Types of wood, Joining materials, Types of joints - Mortise and Tenon, Dovetail, Half Lap, etc., Methods of preparation and applications, Wood working lathe, safety precautions.

b) **Welding:** Arc welding - welding joints, edge preparation, welding tools and equipment, Gas welding - types of flames, tools and equipment, Resistance welding - Spot welding, joint preparation, tools and equipment, safety precautions.

c) **Fitting and Plumbing:** Fitting operation like chipping, filing, right angle, marking, drilling, tapping etc., Fitting hand tools like vices, cold chisel, etc. Drilling machine and its operation, Different types of pipes, joints, taps, fixtures and accessories used in plumbing, safetyprecautions.

d) **Sheet Metal Work:** Simple development and cutting, bending, Beading, Flanging, Lancing and shearing of sheet metal, Sheet metal machines - Bending Machine, Guillotine shear, Sheet metal joints, Fluxes and their use.

e) **Machine shop**: Lathe machine, types of lathes, major parts, cutting tool, turning operations, safety precautions

Reference/Text Books:

1. K. C. John, Mechanical Workshop Practice, Prentice Hall Publication, New Delhi,2010.
Hazra and Chaudhary, Workshop Technology-I, Media promoters & Publisher private limited.

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Dr. Babasaheb Ambedkar Technological University, Lonere
First Year -Bachelor of Technology
with effect from the Academic Year 2020-2021

Course Mapping with NPTEL /SWAYAM Online Platform
First Year of B. Tech. (All Branches) Group A (Sem-I and Sem-II)

Sr. No.	SEMESTER	Course Code	Name of Subject as per Curriculum	SWAYAM/ NPTEL Course	Name of Institute offering course	Name of Instructor	Relevance (%)	Duration of Course
1	Sem I	BTBS101	Engineering Mathematics-I	Engineering Mathematics – I (noc20-ma37)	IIT KGP	Prof. Jitendra Kumar	90	12 weeks
2		BTBS102	Engineering Physics	Solid state Physics	IIT KGP	Dr. Amal Kumar Dar	50	12 weeks
3		BTES103	Engineering Graphics	Engineering drawing and computer graphics (noc20-me79)	IIT KGP	Dr, Rajaram Lakka Raju	70	12 weeks
4		BTHM104	Communication Skill	Developing Soft skills and personality	IIT Kanpur	Rof. T. Ravichandran	80	08 weeks
				Soft skills (noc20-hs60)	IITR	Dr. Bindo Mishra	80	12 weeks
5		BTES105	Energy and Environmental Engineering	Conventional Energy Sources	IIT KGP	Prof Pratab Haridoss	20	08 weeks
				Non Conventional Energy Sources	IIT KGP	Prof Pratab Haridoss	20	08 weeks
				Solar Energy	IIT KGP	Dr, V. V Satyamurthy	10	04 weeks
				Wind Energy	IIT KGP		10	04 weeks
6		BTES106	Basic Civil and Mechanical Engineering	-	-		-	Course not available
7	Sem II	BTBS201	Engineering Mathematics-II	Engineering Mathematics – II (111105134)	IIT KGP	Prof. Jitendra Kumar	70	Video lectures
8		BTBS202	Engineering Chemistry	-	-		-	Course not available
9		BTES203	Engineering Mechanics	Applied mechanics (noc20-me46)	IITM	Prof. K. Ramesh	80	12 weeks
10		BTES204	Computer Programming in C	Introduction to Programming	IIT KANPUR	Prof. Anup Basu	80	08 weeks

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				In C (noc20-cs91)				
11		BTES206	Basic Electrical & Electronics Engineering	Fundamentals of Electrical Engineering (noc20-ee68)	IIT KGP	Prof. Debpriya Das	25	12 weeks
				Basic Electrical circuits	IIT KGP	Prof. Ankush Sharma	25	12 weeks
				Digital circuits	IIT M	Prof, Nagendra Krishraru	25	14 weeks
				Fundamentals of semiconductor devices	IISc Bengluru	Prof. Digbijoy N. Nath	25	12 weeks

First Year of B. Tech. (All Branches) Group B (Sem-I and Sem-II)

Sr. No.	SEMESTER	Course Code	Name of Subject as per Curriculum	SWAYAM/ NPTEL Course	Name of Institute offering course	Name of Instructor	Relevance (%)	Duration of Course
1	Sem I	BTBS101	Engineering Mathematics-I	Engineering Mathematics – II (111105134)	IIT KGP	Prof. Jitendra Kumar	70	Video lectures
2		BTBS102	Engineering Chemistry	-	-		-	Course not available
3		BTES103	Engineering Mechanics	Applied mechanics (noc20-me46)	IITM	Prof. K. Ramesh	80	12 weeks
4		BTES104	Computer Programming in C	Introduction to Programming In C (noc20-cs91)	IIT KANPUR	Prof. Anup Basu	80	08 weeks
5		BTES106	Basic Electrical & Electronics Engineering	Fundamentals of Electrical Engineering (noc20-ee68)	IIT KGP	Prof. Debpriya Das	25	12 weeks
				Basic Electrical circuits	IIT KGP	Prof. Ankush Sharma	25	12 weeks
				Digital circuits	IIT M	Prof, Nagendra Krishraru	25	14 weeks

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				Fundamentals of semiconductor devices	IISc Bengluru	Prof. Digbijoy N. Nath	25	12 weeks
7	Sem II	BTBS201	Engineering Mathematics-II	Engineering Mathematics – I (noc20-ma37)	IIT KGP	Prof. Jitendra Kumar	90	12 weeks
8		BTBS202	Engineering Physics	Solid state Physics	IIT KGP	Dr. Amal Kumar Dar	50	12 weeks
9		BTES203	Engineering Graphics	Engineering drawing and computer graphics (noc20-me79)	IIT KGP	Dr, Rajaram Lakka Raju	70	12 weeks
10		BTHM204	Communication Skill	Developing Soft skills and personality	IIT Kanpur	Rof. T. Ravichandran	80	08 weeks
				Soft skills (noc20-hs60)	IITR	Dr. Bindo Mishra	80	12 weeks
11		BTES205	Energy and Environmental Engineering	Conventional Energy Sources	IIT KGP	Prof Pratab Haridoss	20	08 weeks
				Non Conventional Energy Sources	IIT KGP	Prof Pratab Haridoss	20	08 weeks
				Solar Energy	IIT KGP	Dr, V. V Satyamurthy	10	04 weeks
				Wind Energy	IIT KGP		10	04 weeks
12		BTES206	Basic Civil and Mechanical Engineering	-	-		-	Course not available

Note: Blank field indicates there is no direct course addressing the course content available of NPTEL/ SWAYAM Platform

Registration link:

Engineering Mathematics-I

https://www.google.com/url?q=https://swayam.gov.in/nd1_noc20_ma37/preview&sa=D&ust=1591543184294000&usg=AFQjCNGHDgqXqI9K0fcvY-oaKjT-bJYvzw

Engineering Mathematics –II

https://nptel.ac.in/courses/111/105/111105134/

Engineering Mechanics

https://swayam.gov.in/nd1_noc20_me46/preview

Engineering Graphics

https://www.google.com/url?q=https://swayam.gov.in/nd1_noc20_me79/preview&sa=D&ust=1591543184334000&usg=AFQjCNFYPjKDLGuCij6dBV0D2BysdeB_2Q

Basics of Electrical Engineering

https://www.google.com/url?q=https://swayam.gov.in/nd1_noc20_ee68/preview&sa=D&ust=15

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91543184179000&usg=AFQjCNEZyH4O7lwTSdoD1Uo5CbXX7xUdnw

Communication skills

https://nptel.ac.in/courses/109/104/109104030/#

https://www.google.com/url?q=https://swayam.gov.in/nd1_noc20_hs60/preview&sa=D&ust=1591543184224000&usg=AFQjCNFu4uUp-i8EbTSW-yIVq-iTXaD1gQ

Computer Programming in C

https://www.google.com/url?q=https://swayam.gov.in/nd1_noc20_cs56/preview&sa=D&ust=1591543184129000&usg=AFQjCNHjSl1ome1khLIBuRhZBNKsSM7tcQ

Engineering Physics

https://swayam.gov.in/nd1_noc20_ph15/preview

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Dr. Babasaheb Ambedkar Technological University, Lonere.

Dr. Babasaheb Ambedkar Technological University

(Established as a University of Technology in the State of Maharashtra)

(under Maharashtra Act No. XXIX of 2014)

P.O. Lonere, Dist. Raigad, Pin 402 103, Maharashtra

Telephone and Fax. : 02140 -275142

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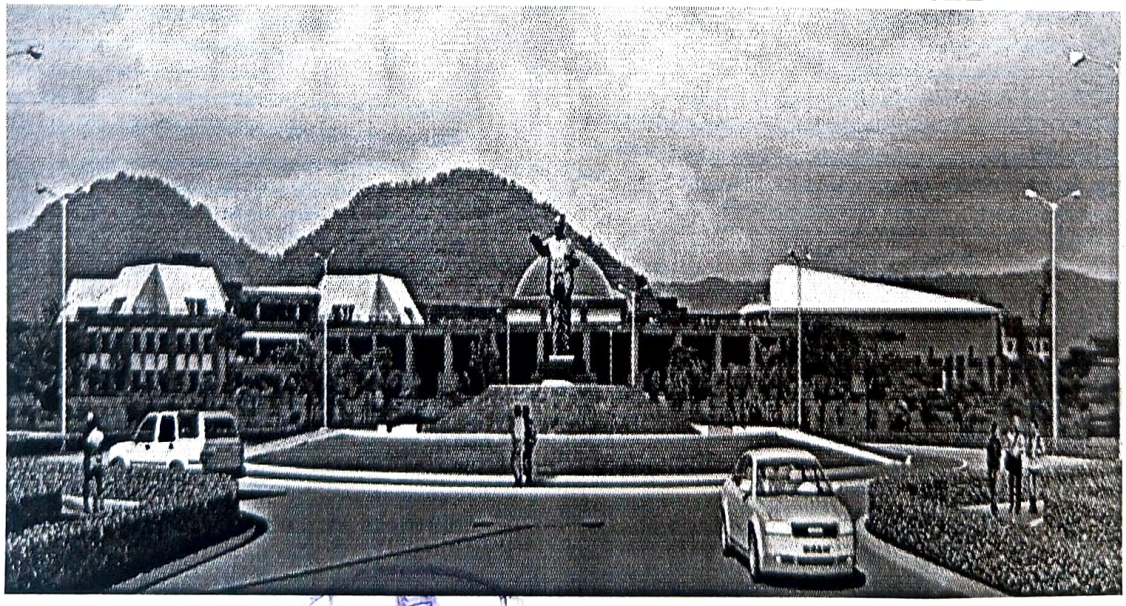
COURSE STRUCTURE AND SYLLABUS

for

Second Year B. Tech. Electrical Engineering / Electrical Engineering (Electronics and Power)/ Electrical & Electronics Engg / Electrical & Power Engineering

With effect from the Academic Year 2021-2022



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B.Tech (Electrical Engineering / Electrical Engineering (Electronics and Power)/ Electrical & Electronics Engg / Electrical & Power Engineering)

Basic Sciences Courses(BSC)		
BTBS101	Engineering Mathematics - I	(3-1-0)4
BTBS102	Engineering Physics	(3-1-0)4
BTBS107L	Engineering Physics Lab	(0-0-2)1
BTBS201	Engineering Mathematics - II	(3-1-0)4
BTBS202	Engineering Chemistry	(3-1-0)4
BTBS207L	Engineering Chemistry Lab	(0-0-2)1
BTBS301	Engineering Mathematics-III	(3-1-0)4
BTBS404	Analog and Digital Electronics	(3-0-0)3
BTBSL409	Analog and Digital Electronics Lab	(0-0-2)1

Engineering Sciences Courses(BSC)		
BTES103	Engineering Graphics	(2-0-0)2
BTES105	Energy and Environment Engineering	(2-0-0)2
BTES106	Basic Civil and Mechanical Engineering	(2-0-0)
BTES108L	Engineering Graphics Lab	(0-0-4)2
BTES203	Engineering Mechanics	(2-1-0)3
BTES204	Computer Programming	(3-0-0)3
BTES205	Workshop Practice	(0-0-4)2
BTES206	Basic Electrical and Electronics Engineering	(2-0-0)
BTES208L	Engineering Mechanics Lab	(0-0-2)1
BTES305	Engineering Material Science	(3-0-0)

Humanities and Social Science Including Management Courses(HSSMC)		
BTHM104	Communication Skills	(2-0-0)2
BTHM109L	Communication Skills Lab	(0-0-2)1
BTHM304	Basic Human Rights	Audit
BTHM506	Foreign Languages (A) Japanese Language (B) German Language	Audit
BTHM706	Engineering Operations and Project Management	Audit

Professional Core Course (PCC)		
BTEEC302	Electrical Machines-I	(3-1-0)4
BTEEC303	Electrical and Electronics Measurement	(3-1-0)4
BTEEL306	Electrical Machines Lab	(0-0-2)1
BTEEL307	Electrical and Electronics Measurement Lab	(0-0-2)1
BTEEC401	Network Theory	(3-1-0)4
BTEEC402	Power System	(3-1-0)4
BTEEC403	Electrical Machines-II	(3-1-0)4
BTEEL406	Network Theory Lab	(0-0-2)1
BTEEL407	Power System Lab	(0-0-2)1
BTEEL408	Electrical Machines-II Lab	(0-0-2)1
BTEEC501	Power System Analysis	(3-1-0)4
BTEEC502	Microprocessor and Microcontroller	(3-0-0)3
BTEEC503	Power Electronics	(3-1-0)4
BTEEL507	Power System Analysis Lab	(0-0-2)1
BTEEL508	Microprocessor and Microcontroller Lab	(0-0-2)1
BTEEL509	Power Electronics Lab	(0-0-2)1
BTEEC601	Switchgear Protection	(3-0-0)3
BTEEC602	Electrical Machine Design	(3-1-0)4
BTEEC603	Control System Engineering	(3-1-0)4

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BTEEL606	Switchgear Protection Lab	(0-0-2)1
BTEEL607	Electrical Machine Design Lab	(0-0-2)1
BTEEL608	Control System Engineering Lab	(0-0-2)1
BTEEC701	High Voltage Engineering	(3-1-0)4
BTEEC702	Power System Operation and Control	(3-1-0)4
BTEEL707	High Voltage Engineering Lab	(0-0-2)1

Professional Elective Course (PEC)		
BTEEPE405	(A)Electromagnetic Field Theory	(3-0-0)3
	(B)Signals and System	
	©Advance Renewable Energy Sources	
	(D)Electronic Devices and Circuits	
BTEEPE504	(A)Industrial Automation	(3-0-0)3
	(B)Power Quality Issues	
	©HVDC	
BTEEPE604	**(A)Application of Power Electronics in Power System**	(3-0-0)3
	(B)Smart Grid Technology	
	©Modeling, Simulation and Control of Electric Drives	
BTEEPE703	(A)Energy Audit and Conservation	(3-0-0)3
	(B)Electrical System Design for Building	
	©Flexible AC Transmission System	
	(D)Electrical Utilization	

Open Elective Course (OEC)		
BTEEOE505	(A)Embedded System	(3-0-0)3
	(B)Electrical Safety	
	©Condition Monitoring of Electric Apparatus	
BTEEOE605	**(A)E-waste Management**	(3-0-0)3
	(B)Power Plant Engineering	
	©Sensor Technology	
	(D)Lightning Interaction with Power System	
BTEEOE704	(A)Process Control Instrumentation	(3-0-0)3
	(B)Biomedical Instrumentation	
	©Mechatronics	
BTEEOE705	(A)Testing, Maintenance and Commissioning of Electrical Equipment	(3-0-0)3
	(B)Electric and Hybrid Electric Vehicles	
	©Internet of Things (IoT)	

Seminar / Mini Project / Internship		
BTES209S	Seminar	(0-0-2)1
BTES211P	(Internship – I) Field Training / Internship/Industrial Training (minimum of 4 weeks which can be completed partially in first semester and second Semester or in at one time).	1
BTEEM308	Miniproject-I	(0-0-4)2
BTEEP410	(Internship – II)	1
BTEEM509	Miniproject-II	(0-0-2)1
BTEES609	Seminar	(0-0-4)2
BTEEP610	(Internship – III)	
BTEEM708	In house project-I / Mini project-III	(0-0-4)2

Project(MP)		
BTEEP802	In house project-I / Internship & Project in Industry	(0-0-26) 13

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B.Tech (Electrical Engineering / Electrical Engineering (Electronics and Power)/ Electrical & Electronics Engg / Electrical & Power Engineering)

Plan of Study:

No.of Courses								
1	I	II	III	IV	V	VI	VII	VIII
2	BTBS101	BTBS201	BTBS301	BTEEC401	BTEEC501	BTEEC601	BTEEC701	BTEEPE801
3	BTBS102	BTBS202	BTEEC302	BTEEC402	BTEEC502	BTEEC602	BTEEC702	BTEEP802
4	BTES103	BTES203	BTEEC303	BTEEC403	BTEEC503	BTEEC603	BTEEPE703	
5	BTHM104	BTES204	BTHM304	BTBS404	BTEEPLE504	BTEEPE604	BTEEOE704	
6	BTES105	BTES205	BTES305	BTEEPE405	BTEEOE505	BTEEOE605	BTEEOE705	
7	BTES106	BTES206	BTEEL306	BTEEL406	BTHM506	BTEEL606	BTHM706	
8	BTBS107L	BTBS207L	BTEEL307	BTEEL407	BTEEL507	BTEEL607	BTEEL707	
9	BTES108L	BTES208L	BTEEP308	BTEEL408	BTEEL508	BTEEM608	BTEEM708	
10	BTHM109L	BTES209S	BTES211P	BTEEL409	BTEEPE509	BTEEP609	BTEEP609	
11		BTES211		BTEEP410	BTEEP409			

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A. Program Educational Objectives (PEOs)

Graduates will able to–

1.To equip graduates with a strong foundation in engineering sciences and Electrical Engineering fundamentals to become effective collaborators, researchers and real-time problem solver with technical competencies.

2.Perceive the limitation and impact of engineering solutions in social, legal, environmental, economical and multidisciplinary contexts.

3.Excel in Industry/technical profession, higher studies, and entrepreneurship exhibiting global competitiveness.

B. Program Outcomes (POs)

Engineering Graduate will be able to –

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

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11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

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Curriculum of Second Year

Semester III

Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credit
			L	T	P	CA	MSE	ESE	Total	
BSC	BTBS301	Engineering Mathematics-III	3	1	-	20	20	60	100	4
PCC1	BTEEC302	**Electrical Machines-I**	3	1	-	20	20	60	100	4
PCC2	BTEEC303	Electrical and Electronics Measurement	3	1	-	20	20	60	100	4
HSSMC	BTHM304	Basic Human Rights	2	-	-					Audit
ESC	BTES305	**Engineering Material Science**	3	-	-	20	20	60	100	3
LC	BTEEL306	Electrical Machines-I Lab			2	60		40	100	1
LC	BTEEL307	Electrical and Electronics Measurement Lab			2	60		40	100	1
Project	BTEEP308	Mini Project-I			4	60		40	100	2
Internship	BTES211P	Internship-I Evaluation						50	50	1
			14	3	8	260	80	410	750	20

Semester IV

Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credit
			L	T	P	CA	MSE	ESE	Total	
PCC3	BTEEC401	**Network Theory**	3	1	-	20	20	60	100	4
PCC4	BTEEC402	**Power System**	3	1	-	20	20	60	100	4
PCC5	BTEEC403	Electrical Machine-II	3	1	-	20	20	60	100	4
BSC	BTBS404	Analog and Digital Electronics	3	-	-	20	20	60	100	3
PEC1	BTEEPE405	Group A	3	-	--	20	20	60	100	3
LC	BTEEL406	Network Theory Lab	-	-	2	30		20	50	1
LC	BTEEL407	Power System Lab	-	-	2	30		20	50	1
LC	BTEEL408	Electrical Machine-II Lab	-	-	2	30		20	50	1
LC	BTEEL409	Analog and Digital Electronics lab	-	-	2	30		20	50	1
Internship	BTEEP410	Internship-II (minimum of 4 weeks which can be completed partially in third or fourth semester or in at one time)	-	-	-	-	-	-	-	-
						220	100	380	700	22

Group-A

(A)Electromagnetic Field Theory

(B) **Signals and System**

(C) Advance Renewable Energy Sources

(D) **Electronic Devices and Circuits**

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Semester III

(BTBS301) ENGINEERING MATHEMATICS **04 Credits**

Unit 1: Vector Calculus **9 Hours**

Vector Algebra, Cartesian, Cylindrical and Spherical Co-ordinate System. Transformation of Variables from Cartesian to Cylindrical and Spherical Coordinate System and Vice-Versa Coulomb's Law, Electric Field Intensity, Field of _N' Point Charges, Field of Line and Sheet of Charge, Electric Flux Density, Gauss's Law and Its Applications, Divergence and Divergence Theorem

Unit 2: Complex Numbers **9 Hours**

Complex Numbers, geometric representation, powers and roots of complex numbers, Functions of a complex variable, Analytic functions, Cauchy-Riemann equations; elementary functions, Conformal mapping (for linear transformation); Contours and contour integration, Cauchy's theorem, Cauchy integral formula; Power Series and properties

Unit 3: Fourier Series **9 Hours**

Introduction, Dirichlet Conditions, Fourier Series and its Coefficients for a given range, Even, odd functions and Fourier Series, Half-range Series, problems, Parseval Identity, Complex form of Fourier Series.

Unit 4: Differential Eqns., First Order ODE, **9 Hours**

Differential Eqns., First Order ODE, y'=f(x,y)- geometrical interpretation of solution, Eqns. reducible to separable form, Exact Eqns., integrating factor, Linear Eqns., Orthogonal trajectories,

Unit 5: Bessel functions **9 Hours**

Fourier Method for IBV problem for wave and heat equation, rectangular region, Fourier method for Laplace equation in 3 dimensions, Numerical Methods for Laplace and Poisson's equation. Biot-Savart, Amperes Circuital Laws and their Applications, Curl, Stoke's Theorem, Magnetic Flux Density, Scalar and Vector Magnetic Potential, Maxwell's Equations in Steady Electric and Magnetic Fields 30 ,FOURIER TRANSFORMS: Fourier Integral representation, Fourier integrals, Fourier transforms, Sine, Cosine transforms, inverse transforms, Illustrations, Properties, Parseval Identity, evaluation of certain real integrals.

Text Books :

1. Higher Engineering Mathematics by B. S. Grewal, Khanna Publishers, New Delhi.
2. Advanced Engineering Mathematics by Erwin Kreyszig, John Wiley & Sons, New York.
3. A Course in Engineering Mathematics (Vol III) by Dr. B. B. Singh, Synergy Knowledge ware, Mumbai.
4. A Text Book of Applied Mathematics (Vol I & II) by P. N. Wartikar and J. N. Wartikar, Pune Vidyarthi Griha Prakashan, Pune.
5. Higher Engineering Mathematics by H. K. Das and Er. Rajnish Verma, S. Chand & CO. Pvt. Ltd., New Delhi.

Reference Books :

1. Higher Engineering Mathematics by B. V. Ramana, Tata McGraw-Hill Publications, New Delhi.
2. A Text Book of Engineering Mathematics by Peter O' Neil, Thomson Asia Pte Ltd., Singapore.
3. Advanced Engineering Mathematics by C. R. Wylie & L. C. Barrett, Tata Mcgraw-Hill Publishing Company Ltd., New Delhi.

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(BTEEC302)ELECTRICAL MACHINE-I — 04 Credits

Unit 1: Single Phase Transformer — **7 Hours**

Transformer construction, Ideal and practical transformer, exact and approximate equivalent circuits, no load and on load operation, phasor diagrams, power and energy efficiency, voltage regulation, parallel operation, effect of load on power factor, Per Unit system, excitation phenomenon in transformers, switching transients, Auto transformers, Variable frequency transformer, voltage and current transformers, welding transformers, Pulse transformer and applications

Unit 2: Three Phase Transformers — **8 Hours**

Constructional features of three phase transformers, Cooling methodology, Standard and special transformer connections, Phase conversion, Parallel operation of three phase transformers, three winding transformers and its equivalent circuit, On load tap changing of transformers, Modern trends in transformers, Type and routine tests, Standards.

Unit 3: Electromechanical Energy Conversion Principles — **6 Hours**

Energy in a magnetic systems, field energy and mechanical force, energy in singly and multiply excited magnetic systems, determination of magnetic force and torque from energy and coenergy, Forces and torques in magnetic field systems, dynamic equations of electromechanical systems and analytical techniques.

Unit 4: DC Generators — **9 Hours**

Construction of armature and field systems, Working, types, emf equation, Armature windings, Characteristics and applications, Building of emf, Armature reaction - Demagnetizing and Cross magnetizing mmfs and their estimation; Remedies to overcome the armature reaction; Commutation process, Causes of bad commutation and remedies: Construction of armature and field systems, Working, types, emf equation, Armature windings, Characteristics and applications, Building of emf, Armature reaction - Demagnetizing and Cross magnetizing mmfs and their estimation; Remedies to overcome the armature reaction; Commutation process, Causes of bad commutation and remedies,

Unit 5: D.C. Motors — **9 Hours**

Principles of working, Significance of back emf, Torque Equation, Types, Characteristics and Selection of DC Motors, Starting of DC Motors, Speed Control, Losses and Efficiency, Condition for Maximum Efficiency, Braking of DC Motors, Effect of saturation and armature reaction on losses; Applications, Permanent Magnet DC Motors, Type and Routine test

Unit 6: Special Machines — **6 Hours**

Constructional details of reluctance machine, variable-reluctance machines, basic VRM analysis, practical VRM analysis, stepper motors and their analysis, Brushless DC motors.

Text Books :

1. J. B. Gupta," Theory and Performance of Electrical Machines," S. K. Kataria& Sons, New Delhi
2. P. S .Bimbra," Electrical Machinery", Khanna Publishers
3. B. L. Theraja, A. K. Theraja," A text book of Electrical Technology," S. Chand Publishers
4. Asfaq Hussein," Electric Machines," Danpat Rai Publisher

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Reference Books :

1. Bhattacharya S. K, "Electrical Machines",(Tata McGraw Hill Publications)
2. Kothari Nagrath, "Electrical Machines", (Tata McGraw Hill Publications)
3. M. N. Bandopadhyay, "Electrical Machines", (Tata McGraw Hill Publications)
4. Fitzaralda, "Electrical Machines", (Tata McGraw Hill Publications)

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BTEEC303 ELECTRICAL & ELECTRONICS MEASUREMENT

04 Credits

4 Hours

Unit 1: Philosophy of Measurement

Introduction to Measurement, Methods of Measurements, Measurement System, Instruments, Classification of Instruments, Characteristics of Instruments & Measurement System, Errors in Measurement, Types of Errors, Calibration, Standards and their classifications.

8 Hours

Unit 2: Analog Measurement of Electrical Quantities

Classification of Analog Instruments, Principle of Operation, Operating Torques, Different types of Damping and Control Systems, Types of Instrument: PMMC, Extension of Range of PMMC Instruments, Moving Iron, Electro-dynamometer, Hot wire, Thermocouple, Induction, Electrostatic, Rectifier.

Power Measurement: Power measurement in AC and DC circuits, Power and Power Factor, Electrodynamometer-type Wattmeter, Induction-type Wattmeter, Power measurement in Poly-phase systems, Power measurement in Three-Phase systems, Reactive Power measurements, Power measurement with Instrument Transformers - Potentiometer and Current Transformer.

Measurement of Energy: Induction-type Energy Meter, Errors in Induction-type Energy Meters and their compensation, Testing of Energy Meters.

8 Hours

Unit 3: A.C. and D.C. Bridges

Measurement Resistance: Wheatstone Bridge, Kelvin Bridge Method, Kelvin Double Bridge Method, Ammeter-Voltmeter Method, Direct deflection method, Loss of charge method, Megohm Bridge, Megger.

Measurement of Inductance and Capacitance: Maxwell Bridge, Hays Bridge, Anderson Bridge, De-Sauty Bridge, Schering Bridge, Wien Bridge.

Localisation of Cable Faults: Murray Loop Test, Varley Loop Test.

Magnetic Measurements: Ballistic Galvanometer, Flux Meter, Maxwell's Bridge Method, AC Potentiometer Method.

7 Hours

Unit 4: Digital Measurement of Electrical Quantities

Concept of Digital Measurement, Block diagram of Digital Instrumentation System, Digital versus Analog Instrument, Digital Voltmeter, Types of Digital Voltmeter, Digital Multi-meter Digital Counter, Digital Frequency Meter, **Power Analyzer &** Harmonic Analyzer, Spectrum & Wave analyzer, Oscilloscopes, Cathode Ray Oscilloscope (CRO), Digital Storage Oscilloscopes (DSO), Signal Generator, Q-Meter.

8 Hours

Unit 5: Transducers

Definition, Classification & selection of transducers, **Characteristics, Transducers for measurement of Displacement (RVDT & LVDT), Speed, Angular Rotation, Altitude, Force, Torque, Humidity and Moisture, Pressure, Strain and Temperature (Thermocouple and RTD method), Position, Hall Effect transducer and applications. Instrumentation amplifiers,** Signal Conditioning, **Data Transmission and Telemetry,** Data Acquisition Systems.

Displays and Recorders: Different types of Display – Different types of Recorder: Graphic Recorder, Strip Chart Recorder, **Galvanometric and** Potentiometer type **Recorders,** X-Y Recorder, Circular Chart Recorder, Magnetic Tape Recorder, **Digital Recorders,** Printer and Plotter **(Block Diagram, theory and applications only)**

Reference Books/ Text Books:

1. E.W. Golding & F.C. Widdis, "Electrical Measurement &Measuring Instrument", A.H. Wheeler & Co. India.
2. A.K. Sawhney, "Electrical & Electronic Measurement & Instrument", Dhanpat Rai & Sons.
3. Forest K. Harries, "Electrical Measurement", Willey Eastern Pvt. Ltd. India.
4. M.B. Stout, "Basic Electrical Measurement" Prentice hall of India.
5. W.D. Cooper, "Electronic Instrument & Measurement Technique", Prentice Hall International.
6. J.B. Gupta, "Electrical Measurements and Measuring Instruments", S.K. Kataria & Sons.
7. Prithwiraj Purkait, Budhaditya Biswas , Santanu Das and Chiranjib Koley, "Electrical and Electronics Measurements and Instrumentation", McGraw Hill.

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BTHM304 BASIC HUMAN RIGHTS **Audit Course**

Unit 1: The Basic Concepts **6Hrs**

Individual, Group, Civil Society, State, Equality, Justice, Human Values: - Humanity, Virtues, Compassion.

Unit 2: Human Rights and Human Duties: **6 Hrs**

Origin, Civil and Political Rights, Contribution of American Bill of Rights, French Revolution, Declaration of Independence, Rights of Citizen, Rights of working and Exploited people, Fundamental Rights and Economic program, India's Charter of freedom

Unit 3: Society, Religion, Culture, and their Inter-Relationship **6 Hrs**

Impact of Social Structure on Human behaviour, Roll of Socialization in Human Values, Science and Technology, Modernization, Globalization, and Dehumanization.

Unit 4: Social Structure and Social Problems **6 Hrs**

Social and Communal Conflicts and Social Harmony, Rural Poverty, Unemployment, Bonded Labour, Migrant workers and Human Rights Violations, Human Rights of mentally and physically challenged.

Unit 5: State, Individual Liberty, Freedom and Democracy **6 Hrs**

The changing of state with special reference to developing countries, Concept of development under development and Social action, need for Collective action in developing societies and methods of Social action, NGOs and Human Rights in India: - Land, Water, Forest issues.

Unit 6: Human Rights in Indian Constitution and Law **6 Hrs**

The constitution of India:

(i) Preamble

(ii) Fundamental Rights

(iii) Directive principles of state policy

(iv) Fundamental Duties

(v) Some other provisions

Universal declaration of Human Rights and Provisions of India, Constitution and Law, National Human Rights Commission and State Human Rights Commission

Reference Books:

1. Shastry, T. S. N., India and Human rights: Reflections, Concept Publishing Company India (P Ltd.), 2005.

2. Nirmal, C.J., Human Rights in India: Historical, Social and Political Perspectives (Law in India), Oxford India.

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(BTES 305) ENGINEERING MATERIAL SCIENCE — 04 Credits

Unit: 1 Electrical Conducting Materials — **7 Hours**

Introduction,Crsytal structure, atomic bonding,Electronic and Ionic Conduction , Conductivity in Metals , Ohm's Law , Relaxation Time , Collision Time , Mean Free Path of an Electron , Electron Scattering , Resistivity of Metals , Effect of Temperature and Impurity on Conductivity , Joule's Law , High Conductivity And Resistivity Materials , Superconductivity and Applications Conducting materials: quantum free electron theory- Fermi-Dirac distribution - Materials for electric resistances.

Unit 2: Dielectric Materials — **7 Hours**

Crystalline structure-perfection/imperfection, Dielectric as Electric Field Medium, Dielectric constant and polarizability, types of polarization,leakage currents, dielectric loss, dielectric strength,breakdown voltage,temperature and frequency dependences of Dielectric parameter, internal fields in solids, Clausius-Mosotti equation, ferroelectric, pyroelectric and piezoelectric materials, applications of dielectric materials

Unit 3: Semiconductor Materials — **7 Hours**

Semiconductors: Mechanism of conduction in semiconductors. Properties of semiconductors, Silicon wafers, integration techniques, Large and very large scale integration techniques (VLSI). Properties of Semiconductors: Electron-hole concentration, Fermi level, Generation and recombination, carrier life-time, diffusion length. Scattering and mobility of carriers. Einstein relation.LASER Plain carbon steels and their applications. Alloy steels: High speed steels, stainless steels,HSLA; Non Ferrous alloys: Al alloys, Cu alloys, applications of these alloys

Unit 4: Magnetic Materials — **7 Hours**

Classification of magnetic materials, spontaneous magnetization in ferromagnetic materials, Magnetostriction, diamagnetism, magnetically soft and hard materials, special purpose materials, feebly magnetic materials, Ferrites, cast and cermet permanent magnets, ageing of magnets. factors effecting permeability and hysteresis, Ferromagnetic materials, properties of ferromagnetic materials in static fields,curie point, anti-ferromagnetic materials, piezoelectric materials ,pyro electric materials Magnetic Properties of Materials: Atomic Interpretation of Diamagnetic, Paramagnetic, Anti-Ferromagnetic and Ferromagnetic Materials. Ferromagnetic Domain, Magnetic Materials for Ferromagnetic Tape And Memory Devices, Magnetic materials: magnetic materials used in electrical machines instruments.

Unit 5: Special Purpose Materials — **05 Hours**

Refractory Materials, Structural Material's, Radioactive Materials, Galvanization and Impregnation of materials, Non Destructive Testing: Ultrasonic Radiography, X-ray diffraction- Bragg's law.

Text Books:

1. Material Science and Engineering – V. Raghavan

Reference Books

1. Electrical Engineering Materials – A.J. Dekker
2. Science of Engineering Materials and Carbon Nanotubes - C.M. Srivastava and C. Srinivasan
3. Solid State Physics – A.J. Dekker.

(BTEEL306)ELECTRICAL MACHINE-I LABORATORY 01 Credits

Perform Any eight experiment from given list as a part of practical submission

List of Experiments

1. To perform the polarity test on single phase transformer
2. To perform the transformation ratio test on single phase transformer
3. To perform the following three phase transformer connections:
   1) Star-star 2) Star-Delta
   3) Delta – Delta 4) Delta –Star
   5)Open Delta 6) Scott Connection
4. To perform the direct loading test on three phase transformer to calculate efficiency and regulation
5. To perform the indirect loading test on three phase transformer to calculate efficiency
6. To perform the parallel operation of two single phase transformers.
7. To study D. C. Machine
8. To draw the speed characteristics of DC shunt motor by- (1) Armature Control method (2) Field Control method
9. To perform the load test on DC Shunt motor.
10. To study the load characteristics of DC generator
    I) Cumulative compound generator.
    II) Differential compound Generator
11. To study the magnetization ,internal and External characteristics of a D. C. generator
12. To Study Starters for DC Shunt Motor.

BTEEL307 ELECTRICAL & ELECTRONICS MEASUREMENTS LABORATORY 1 Credit

List of Experiments: (Perform minimum 8-10 experiments from following list)

1) Measurement of Low resistance by Kelvin Double bridge.
2) Measurement of High resistance and Insulation resistance using Megger.
3) Measurement of Inductance by Maxwell bridge, Hays bridge, Anderson bridge.
4) Measurement of Capacitance by De Sauty bridge, Schering bridge.
5) Measurement of Earth resistance using Earth Tester.
6) Study the extension of Voltmeter, Ammeter and Wattmeter.
7) Measurement of three phase power by Two Wattmeter and One Wattmeter method.
8) Study of types of instrument: PMMC, Moving Iron, Electro-dynamometer, Hot wire, Thermocouple, Induction, Electrostatic, Rectifier.
9) Study of Energy Meter.
10) Study of Instrument T/F and its types.
11) Characterize the temperature sensor (RTD):
    a) Static Characteristics of RTD: Study the change in resistance of RTD probe depending on the process temperature.
    b) Dynamic characteristics: Study the dynamic response of RTD probe
12) Characterize the Thermocouple:
    a) Static Characteristics of Thermocouple: Study the change in EMF of a thermocouple in response to the process temperature.
    b) Dynamic characteristics of Thermocouple: Study the dynamic response of Thermocouple.
13) Characterize of LVDT: To find the effect of various parameters like change in supply voltage, change in supply frequency on output of given LVDT
14) Characterize the strain gauge sensor:
    a) Study of Strain Gauge: To study the working principle of strain gauge.
    b) Study of effect of change in position of weight applied on Strain Gauge performance.
    c) Study of effect of change in temperature on the performance of Strain Gauge.
15) Measurement of phase difference and frequency of a sinusoidal ac voltage using C.R.O.
16) Study of storage oscilloscope and determination of transient response of RLC circuit.

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BTEEP308 Miniproject-I **2 Credits**

Guidelines:

Stages	Work to be carried	Time
I	• Selection of a mini viable project idea (Hardware or Software Based) on recent trends in Electrical Engineering.	4 hours
II	• Study various resources and components in electrical engineering projects • Application of those components in Selected Project	6 hours
III	• Study of Circuit Diagram • Study datasheet of basic circuit components of a project • Study various software in building of project like SCILAB, MATLAB or other circuit Simulator	6 hours
IV	• Designing of PCB for selected Project once tested on breadboard	4 hours
V	• Verification of the results obtained of the working model or the simulation results. • Compare with desired results and take corrective action	4 hours
VI	• Completion of project by developing the Project Report and submitting the report to the concerned to receive the final credits.	6 hours

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Semester IV

BTEEC401 NETWORK THEORY **04 Credits**

Unit 1:Active & Passive Circuit Element **7 Hours**

Independent & dependent voltage & current sources, R, L, C, self and mutual inductance circuit parameters, Their mathematical models, Voltage- current- power relations, Independent voltage and current sources, dependent sources, Source transformation, star-delta conversion. Classification of element: Lumped and distributed, Linear and non-linear, Unilateral and Bilateral, Time invariant and variant.

Unit 2: Network theorems **12Hours**

Kirchhoff's laws (KCL and KVL), Mesh analysis, nodal analysis, Solution of D.C. resistive network, writing loop equations, Node equations directly in matrices form, super node and super mesh analysis, Superposition theorem, Thevenin's theorem, Norton's theorem, Reciprocity theorem, Maximum power transfer theorem, Substitution theorem, Millman's Theorem, Tellegen's theorem for D.C and A.C. circuits.

Graph Theory: Network topology, graph, Tree, Branches, Chords, incidence, cut set and tie set matrix using network topology, Concept of duality & dual networks.

Unit 3: Transient Response Analysis in circuit **7 Hours**

Initial and final condition of circuit, procedure for evaluating initial conditions, solution of first and Second order differential equations of series & parallel R-L, R-C, R-L-C circuits, Time constant, General & particular solutions, Particular integral & complimentary functions, Numerical

Unit 4: Application of Laplace's Transform **7 Hours**

Standard test input signal- Unit step, Impulse & ramp functions and their Laplace transform, Solution of differential equation using Laplace transform, solve of R-L, R-C, R-L-C circuits using Laplace transform, Transient and steady state response of RL and RC circuit to various functions using Laplace transform.

Two port network: Terminals& terminal pairs, Driving points & transfer admittance, Transfer functions, Concept of poles & zeroes, Two port networks, Z, Y & the transmission parameters relationship between parameter sets.

Unit 5: Sinusoidal Steady State A. C. Circuit **7 Hours**

R-L-C series circuits, Series resonance Variation of Z with frequency, maximum value of VC & VL, Magnification, Bandwidth, Q factor. Parallel Resonance: Resonance frequency for tank circuit frequency, Locus diagram of series R-L, R-C with variable R & X.

Filter: Introduction classification, Low pass, High pass, Band pass & band reject filter, active & passive filters. Application of Fourier series, Expansion for periodic & non-sinusoidal waveforms.

Text/Reference Books:

1. N Balabanian and T.A. Bickart, "Linear Network Theory: Analysis, Properties, Design andSynthesis", Matrix Publishers, Inc. 1981.
2. L.O. Chua, C.A. Desoer, E.S. Kuh, "Linear and Nonlinear Circuits", McGraw – HillInternational Edition 1987.

3. Van Valkenburg, "Network Analysis", Third Edition, 2009, Prentice Hall of India.
4. Sudhakar, A.Shyammohan, "Circuits and Network", Third Edition, 2006, Tata McGrawHill
5. D. Roy Choudhury, "Networks and systems".New Age International Publishers
6. Kelkar and Pandit, "Linear Network Theory", Pratibha Publication.
7. Mahmood Nahvi, Joseph AEdminister, "Schaum's Outline of Electric Circuits", 6th edition,Tata McGraw-Hill.

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(BTEEC402) POWER SYSTEM — 04 Credits

Unit 1: Electrical Power Generation — **9 Hours**

Evolution of Power Systems, Typical Layout of an Electrical Power System–Introduction to different sources of energy. Construction and working of thermal power plants, Hydro power station, Nuclear Power Plant with neat block diagram of main parts. Descriptive treatment of alternator exciter & excitation systems, major electrical equipments in generating stations.

Unit 2: Electrical Design of Overhead Transmission Lines — **9 Hours**

Line conductors, inductance and capacitance of single phase and three phase lines with symmetrical and unsymmetrical spacing, concept of GMD and GMR, Composite conductors-transposition, bundled conductors, and effect of earth on capacitance. skin effect, proximity effect, Ferranti Effect.

Corona: Introduction, Factors affecting corona loss and methods of reducing corona loss, Disadvantages of corona.

Unit 3: Mechanical Design of Transmission Lines — **8 Hours**

Types of conductors, Choice of conductor materials, Stranded copper & ACSR conductor, Insulation consideration, Different types of insulator, supports, distribution of voltage across the insulator string, String efficiency, Effect of wind & ice coating on transmission line, sag due to equal & unequal supports, with their derivation, Numericals.

Unit 4: Performance of Transmission Lines — **8 Hours**

Classification of overhead transmission lines, important terms, performance of single phase short transmission lines, three phase short transmission lines, effect of load power factor on regulation and efficiency, different types of medium transmission line, Analysis of long transmission lines, generalized constant of transmission line, determination of generalized constant of transmission lines, percentage regulation, Transmission efficiency, numerical based on above.

Unit 5: AC & DC Distribution — **8 Hours**

Classification of Distribution system, Requirement of distribution system, design consideration in distribution system. AC Distribution: Calculations, method of Solving AC Distribution problem, three phase unbalanced load, four wire unbalanced star connected load, ground detector, DC Distribution: types, DC distribution calculation, three wire DC system.

Text/References :

REFERENCES:

1. V.K Mehta & Rohit Mehta. " Principles of Power System" S Chand Publications
2. Gupta B. R. " Power Plant Engineering".(Eurasia publications)
3. Nag P. K. " Power Plant Engineering",(Tata McGraw Hill Publications)
4. Kothari Nagrath, "Electric Power System", (Tata McGraw Hill Publications)
5. Wadhva S. L.,"Electric Power System",(Tata McGraw Hill Publications)
6. Stevension W. B., "Power System", (English Language Book Society publications)

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(BTEEC403)ELECTRICAL MACHINE-II — 04 Credits

Unit 1: Basic Concepts in A.C. Machines — **5 Hours**

Classification of A.C. Machines, principle of operation and constructional features of synchronous and induction machines, rotating mmf waves in A.C. Machines

Unit 2: Constructional Armature windings — **5 Hours**

Introduction, ac machine windings, winding factors, the emf equation, harmonics in generated emf, causes of harmonics and their suppressions

Unit 3: Synchronous Machines — **9 Hours**

Synchronous Machines : Construction, types, armature reaction, circuit model of synchronous machine, determination of synchronous reactance, phasor diagram, power angle characteristics, parallel operation of synchronous generators, synchronizing to infinite bus bars, two axis theory, synchronous motor operation, characteristic curves, synchronous condenser, dynamics.

Unit 4: Three phase Induction (Asynchronous) Motor — **9 Hours**

Types of induction motor, flux and mmf waves, development of circuit model, power across air gap, torque and power output, oc and sc tests, circle diagram, starting methods, cogging and crawling, speed control, deep bar/ double cage rotor, induction generator, induction machine dynamics, high efficiency induction motors

Unit 5: Fractional Kilowatt Motors — **6 Hours**

Introduction, single phase induction motors, double revolving field theory, circuit model of single phase induction motor, determination of circuit parameters

Unit 6: Special Machines — **6 Hours**

Single phase synchronous motors, permanent magnet ac motors, ac servomotors, linear induction motor

Text Books :

1. J. B. Gupta," Theory and Performance of Electrical Machines," S. K. Kataria& Sons, New Delhi
2. P. S .Bimbra," Electrical Machinery", Khanna Publishers
3. B. L. Theraja, A. K. Theraja," A text book of Electrical Technology," S. Chand Publishers
4. Asfaq Hussein," Electric Machines," Danpat Rai Publisher

Reference Books :

1. 1.Say M. G., "Design & performance of A.C. Machines", (Book Publications,3rd edition)
2. 2..Bhimra P. S., "Electric Machines", (South Ex Publications, New Delhi)
3. D. P. Kothari, I. J. Nagrath,"Electric Machines ", Tata McGraw Hill Publication, Fourth edition, reprint 2012.
4. A. F. Puchstein, T.C. Lloyd, A.G. Conrad, "Alternating current machines", John Wiley and Sons, New York 1954.
5. 5.A.E. Fitzgerald, Charles Kingsley Jr., Stephen D. Umans ,"Electric Machinery ", Tata McGraw Hill Publication, sixth edition 2002 4. Fitzaralda, "Electrical Machines", (Tata McGraw Hill Publications))

BTBS404 ANALOG AND DIGITAL ELECTRONICS 04 Hours

Unit 1: Transistor as an Amplifier **5 Hours**

Load line, Small signal low frequency analysis of single stage amplifier in different configuration, High frequency equivalent circuit of transistor (hybrid pi), Cascade amplifier, High input resistance circuits-C coupled amplifier Frequency response, Definition of 3 dB bandwidth, Effect of cascading on gain & BW, Classification of amplifiers

Unit 2: operational amplifier **6 Hours**

Block diagram of operational amplifier, Properties of ideal operational amplifier, Explanation of different terms appearing in OP-Amp application (offset, bias, quantities, PSRR, CMRR, Ad, AC, Slew rate etc.), Operation of circuit diagram of OP-Amp using discrete components & I.C. diagram, Different types of current of current sources in I.C. technology, frequency response of OP-Amp, OP-Amp parameters & minimization technique of temperature effect, Inverting & Non-inverting operation of Op-Amp & analysis for AG, RI, RO, Linear & non-linear circuit application of OP-Amp

Unit 3: Number Systems **6 Hours**

Basic Logic Gates & Boolean Algebra: Binary Arithmetic & Radix representation of different numbers. Sign & magnitude representation, fixed point representation, complement notation, various codes & arithmetic in different codes & their inter conversion. Features of logic algebra, postulates of Boolean algebra. Theorems of Boolean algebra. Boolean function. Derived logic gates: Exclusive-OR, NAND, NOR gates, their block diagrams and truth tables. Logic diagrams from Boolean expressions and Vica-versa. Converting logic diagrams to universal logic. Positive, negative and mixed logic. Logic gate conversion.

Unit 4: Digital Logic Gate Characteristics **6 Hours**

TTL logic gate characteristics: Theory & operation of TTL NAND gate circuitry. Open collector TTL. Three state output logic. TTL subfamilies. MOS & CMOS logic families. Realization of logic gates in RTL, DTL, ECL, and C-MOS & MOSFET. Interfacing logic families to one another. Sequential Systems: Latches, flip-flops, R-S, D, J-K, Master Slave flip flops. Conversions of flip-flops Counters: Synchronous & asynchronous ripple and decade counters, Modulus counter, skipping state counter, counter design, state diagrams and state reduction techniques. Ring counter. Counter applications. Registers: buffer register, shift register

Unit 5: Minimization Techniques **7 Hours**

Minterm, Maxterm, Karnaugh Map, K map upto 4 variables. Simplification of logic Conversion of truth tables in POS and SOP form Incomplete specified functions. Variable mapping Quinn-McKlusky minimization techniques c functions with K-map

Unit 6: Combinational Systems **6Hours**

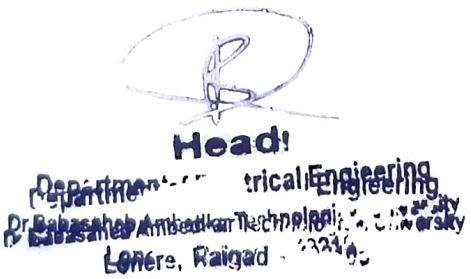
Combinational logic circuit design, half and full adder, subtractor. Binary serial and parallel adders BCD adder Binary multiplier Decoder: Binary to Gray decoder, BCD to decimal, BCD to 7-segment decoder' Multiplexer, DE multiplexer, encoder. Octal to binary, BCD to excess-3 encoder. Diode Switching matrix. Design of logic circuits by multiplexers, encoders, decoders and DE multiplexers.

Text/Reference Books:

1. Mandal, Digital Electronics: Principles and Applications, TMH 2009

2. Leach, Digital Principles and Applications, ed. 7, TMH 2008

3. M. Morris Mano, Digital Logic and Computer Design, Pearson Edu. 2014



(BTEEPE405A)ELECTROMAGNETIC FIELD THEORY 03credits Credits

Unit 1: vector calculus **7 Hours**

Scalars and vectors, Vector algebra, Vector components and unit vectors, Vector field Vector field Dot, cross products circular, cylindrical and spherical coordinate systems Coulomb's Law and electric field intensity Electric field due to a continuous Volume Charge Distribution field of a line charge field of a Sheet of a charge streamlines and sketches of fields

Unit 2: Electromagnetic field 1 **8 Hours**

Constructional Gauss's Law and its Applications: to some symmetrical charge distribution and differential volume element divergence Maxwell's first equation (electrostatics), the vector operator and the Divergence theorem Energy and Potential Energy expended in moving a point charge in an electric field line integral, potential difference potential, potential gradient, potential field of a point charge and system of charges dipole, energy density in electrostatic field

Unit 3: Electromagnetic field 2 **6 Hours**

Current and current density, continuity of current, metallic conductors conductor properties and boundary conditions method of images, semiconductors, nature of dielectric, boundary conditions for perfect dielectric capacitance, and capacitance of two-wire line. Poisson's and Laplace Equations Uniqueness theorem examples in rectangular, spherical and cylindrical coordinates, product solutions of Laplace equations, and solutions of Poisson's equations

Unit 4: Magneto statics 1 **8 Hours**

Biot-Savart's law Amperes circuital law curls strokes theorem magnetic flux and magnetic flux density scalar and vector magnetic potentials

Unit 5: Magneto statics 2 **7 Hours**

Force on moving charge, differential current element force between differential current element and torque on a closed circuit nature of magnetic materials, magnetization permeability, magnetic boundary conditions, magnetic circuit, potential energy and forces on magnetic materials, self and mutual inductance

Unit 6: Maxwell's equations **4 Hours**

Faradays law, Maxwell's equations in point form, Maxwell's equations in integral form, Retarded potentials.

Text Books :

1) "William H. Hayt & John. A. Buck, "Engineering Electromagnetics" Mc. Graw-Hill Companies, 7th Editon.2006.
2) "Sadiku- "Electromagnetic Fields" , Oxford Publications.

Reference:

3) D. J. Griffiths, _Introduction to Electrodynamics', Addison Wesley, 1999.
4) D. K. Cheng, _Field and Wave Electromagnetics', Addison Wesley, 1999.
5) N. N. Rao, _Elements of Engineering Electromagnetics', Pearson Education, Inc, 2004.
6) Mathew N.O. Sadiku,Elements of Electromagnetics,Oxford Univ Press
7) N.N. Rao, Basic electromagnetic and applications, McGraw Hill

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BTEEPE405BSignals and System **03 Credits**

Unit 1: Elements of Signal Space Theory **7 Hours**

Objective and overview, signal and system types and classifications, Different types of signals; Linearity, time invariance and causality; Impulse sequence, impulse functions and other singularity functions

Unit 2: Classification of System **9 Hours**

CT and DT system, basic properties of system – linear time invariant system and properties, LTI system: Causality, stability, step response, impulse response.

Unit 3: Convolution **7 Hours**

Convolution sum, convolution integral and their evaluation; Time-domain representation and analysis of LTI systems based on convolution and differential equations. Convolution for CT & DT signals and systems; Necessity of representations of Signals & Systems in Time- and Transformed-domains

Unit 4: Transform domain considerations **7 Hours**

Laplace transforms, inverse Laplace transforms and Z-transforms; Applications of transforms to discrete and continuous systems-analysis; Transfer function, block diagram representation.

Unit 5: Fourier series and Fourier Transform **7 Hours**

Sampling theorem, Discrete Fourier transform (DFT), estimating Fourier transform using DFT Analysis of discrete time signal: sampling of CT signals and aliasing, DTFT and properties.

Reference Books:

1. Signals and Linear Systems, Gabel R.A. and Robert R.A, John Wiley and Sons, New York
2. Signals and Systems , Oppenheim, Wilsky and Nawab, Prentice Hall, New Delhi
3. Systems and Signal Analysis, C.T.Chen, Oxford University Press, New Delhi
4. Probabilistic Methods of Signals and System Analysis, Cooper G.R and McGillem C.D, Oxford University Press, Cambridge.
5. Signals and Systems, Ziemer R.E., Tranter W.H., and Fannin D.R., Pearson Education Asia, Singapore

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(BTEEPE405C) ADVANCED RENEWABLE ENERGY SOURCES 04 Credits

Unit 1: Introduction 7 Hours

Renewable Sources of Energy- Introduction to renewable energy, various aspects of energy conversion, principle of renewable energy systems, Grid-Supplied Electricity-Distributed Generation-Renewable Energy Economics-Calculation of Electricity Generation Costs –Demand side Management Options –Supply side Management Options-Modern Electronic Controls of Power Systems.

Fuel Cells: The Fuel Cell-Low and High Temperature Fuel Cells-Commercial and Manufacturing Issues-Constructional Features of Proton Exchange-Membrane Fuel Cells –Reformers-Electrolyzer Systems and Related Precautions-Advantages and Disadvantages of Fuel Cells-Fuel Cell Equivalent Circuit-Practical Determination of the Equivalent Model Parameters -Aspects of Hydrogen as Fuel.

Unit 2: Wind Power Plants 7 Hours

Atmospheric circulations, classification, factors influencing wind, wind shear, turbulence, windspeed monitoring, Appropriate Location -Evaluation of Wind Intensity -Topography -Purpose ofthe Energy Generated -General Classification of Wind Turbines-Rotor Turbines-Multiple-BladeTurbines -Drag Turbines -Lifting Turbines-Generators and Speed Control used in Wind PowerEnergy -Analysis of Small Generating Systems. Aerodynamics of wind turbine rotor, site selection,wind resource assessment, wind energy conversion devices: classification, characteristics, andapplications. Hybrid systems, safety and environmental aspects.

Unit 3: Photovoltaic Power Plants 7 Hours

Solar Energy-Generation of Electricity by Photovoltaic Effect -Dependence of a PV CellCharacteristic on Temperature-Solar cell Output Characteristics-Equivalent Models and Parametersfor Photovoltaic Panels-Photovoltaic Systems-Applications of Photovoltaic Solar EnergyEconomical.

Analysis of Solar Energy. environment and social implications Solar Energy: Solarradiation its measurements and prediction, solar thermal flat plate collectors, concentratingcollectors, applications, heating, cooling, desalination, power generation, drying, cooking etc,principle of photovoltaic conversion of solar energy, types of solar cells and fabrication.

Photovoltaic applications: battery charger, domestic lighting, street lighting, and water pumping,power generation schemes.

Unit 4: Bio-Energy 8 Hours

Biomass resources and their classification, chemical constituents and physicochemical characteristics of biomass, biomass conversion processes, thermo chemical conversion: direct combustion, gasification, pyrolysis and liquefaction. Biochemical conversion: anaerobic digestion, alcohol production from biomass. Chemical conversion process: hydrolysis and hydrogenation.

Biogas: generation, types of Biogas Plants, applications

Induction Generators: Principles of Operation-Representation of Steady-State Operation-Power andLosses Generated-Self-Excited Induction Generator-Magnetizing Curves and Self-Excitation Mathematical Description of the Self-Excitation Process-Interconnected and Stand-alone operation Speed and Voltage Control-Economical Aspects.

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Unit 5: Storage Systems **8 Hours**

Energy Storage Parameters-Lead–Acid Batteries-Ultra Capacitors-Flywheels - SuperconductingMagnetic Storage System-Pumped Hydroelectric Energy Storage - Compressed Air Energy Storage-Storage Heat -Energy Storage as an Economic Resource.Integration of Alternative Sources of Energy: Principles of Power Injection-Instantaneous Activeand Reactive Power Control Approach-Integration of Multiple Renewable Energy SourcesIslandingandInterconnectionControl-DGControlandPowerInjection.

Interconnectionof Alternative Energy Sources with the Grid: Interconnection Technologies Standardsand Codes for Interconnection-Interconnection Considerations -InterconnectionExamples for Alternative Energy Sources.

Text/Reference Books :

1. Rao and Parulekar, Energy Technology, Khanna Publishers, New Delhi, Second reprint 2002
2. G.D Rai, Non-conventional Energy Sources,Khanna Publishers, New Delhi, tenth reprint 2002
3. C. S. Solanki, —Solar Photovoltaics Fundamentals, Technologies and Applicationsl, PHI, 2011
4. B. H. Khan,—Non-conventional Energy Resourcesl,TataMcGrawhill Publishing Co.Ltd.,2006
5. S.P. Sukhatme, J.K. Nayak, —Solar Energy-Principals of Thermal Collection and Storage,Tata Mc Graw hill Publishing Co. Ltd., New Delhi 2008
6. J. Twidell and T. Weir, —Renewable Energy Resourcesl, E & F N Spon Ltd, London, 1999
7. Thomas Ackermann, —Wind Power in Power Systeml, John Willey &Sons.

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BTEEL406 NETWORK THEORY LAB **1 Credits**

Any Eight Experiments from the following list

Expt. No.	Title of Experiment
1	Verification of Kirchhoff's Laws
2	Verification of Superposition Theorem
3	Verification of Thevenin's Theorem
4	Verification of Norton's Theorem
5	Verification of Maximum Power Transfer Theorem
6	Verification of Reciprocity Theorem
7	Determination of transient response of RL & RC series circuits
8	To study Resonance in RLC series Circuit.
9	To study Resonance in parallel RLC Circuit.
10	Determination of driving point and transfer functions of a two port ladder network and verifywith theoretical values
11	To calculate and verify 'Z'Parameters of a Two-Port Network.
12	To calculate and verify 'Y' parameters of Two-Port Network.

BTEEL407 : Power System Lab **1 Credit**

Sr. No	Experiment Title
1	To study the layout of a Thermal Power Plant with its components.
2	To study the layout, classification and components of a Hydro Power Plant.
3	To study the alternator excitation system
4	To study the types and properties of various Overhead insulators
5	To study the types and properties of various Overhead Conductors.
6	To study the Power cable and its various components and types.
7	To study the layout of a substation along with its components
8	To determine the ABCD parameters of a medium and long transmission line.
9	To Visit a Thermal Power plant and write a technical report on the observations

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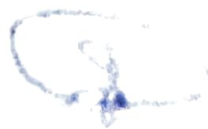

(BTEEL408)ELECTRICAL MACHINE-II LABORATORY 01 Credits

Perform Any Eight experiment from given list as a part of practical submission

List of Experiment

1. Determination of sequence impedances of salient pole synchronous machine To perform
2. Determination of Xd and Xq of a salient pole synchronous machine from slip test.
3. V and inverted V curves of a3-phasesynchronous motor 1
4. Regulation of alternator by Direct loading method (R,L,C load)
5. Regulation of alternator by synchronous impedance method
6. Regulation of alternator by MMF method
7. Parallel operation of Synchronous generator
8. To study different types of starters for three phase Squirrel cage induction motor
9. Rotor resistance starter for slip ring induction motor.
10. To conduct no load and blocked rotor test and to determine performance characteristics of three phase induction motor from circle diagram
11. Load and block rotor tests on squirrel cage induction motor
12. Brake test on slip ring induction motor
13. To control speed of wound rotor induction motor by rotor resistance control method
14. To control speed of induction motor by V/F
15. To control speed of induction motor by i) star-delta ii) autotransformer

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(BTEEL409) ANALOG AND DIGITAL ELECTRONICS LAB **01 Credits**

Perform Any Eight experiment from given list as a part of practical submission

List of Experiment

1. To plot input characteristics and Output characteristics of common emitter configuration.
2. To plot frequency response of RC coupled and Transformed coupled amplifier
3. To measurement of OP-AMP parameter
4. To verify the operation of op amp in Inverting & Non-inverting mode on AC input
5. Verify truth table of following basic and derived gates
   a. AND, OR, AND
   b. Ex-OR, NAND, NOR
6. Verification of truth table of flipflop
7. Design and implementation of 3-bit synchronous up/down counter
8. Design and implementation of half and full adder using logic gates
9. Design and implementation of Multiplexer and De-multiplexer and study of IC74150 and IC 74154
10. Design and implementation of code converters
    a. Binary to gray code converter
    b. BCD to Excess 3

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COURSE STRUCTURE AND SYLLABUS

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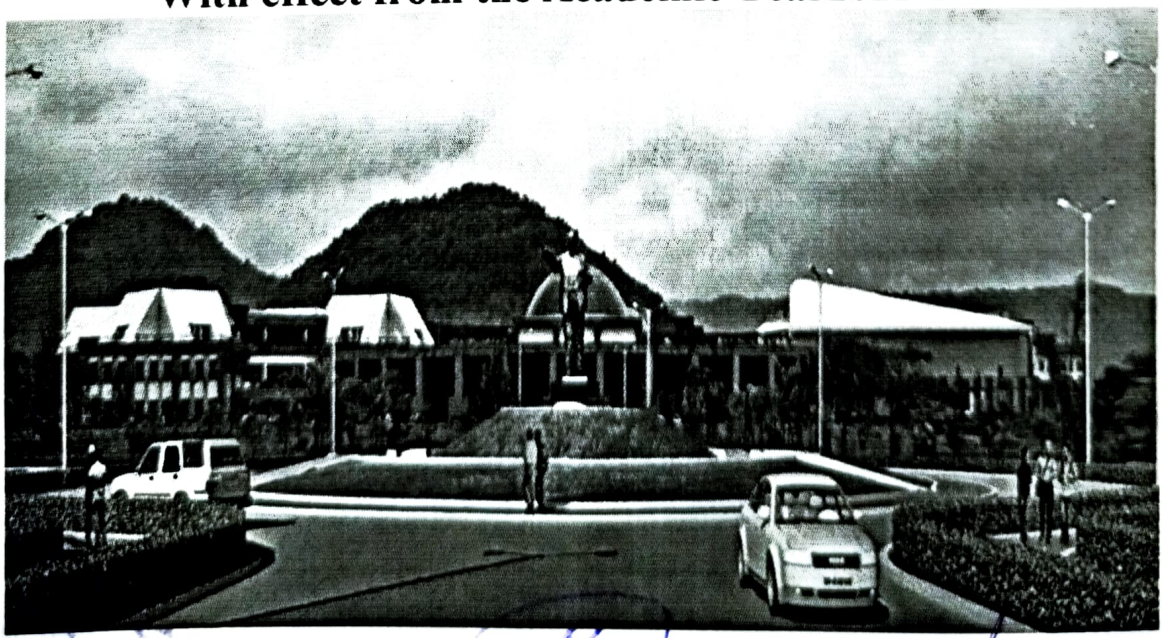

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B.Tech (Electrical Engineering / Electrical Engineering (Electronics and Power)/ Electrical & Electronics Engg / Electrical & Power Engineering)

Basic Sciences Courses(BSC)		
BTBS101	Engineering Mathematics - I	(3-1-0)4
BTBS102	Engineering Physics	(3-1-0)4
BTBS107 L	Engineering Physics Lab	(0-0-2)1
BTBS201	Engineering Mathematics - II	(3-1-0)4
BTBS202	Engineering Chemistry	(3-1-0)4
BTBS207 L	Engineering Chemistry Lab	(0-0-2)1
BTBS301	Engineering Mathematics-III	(3-1-0)4
BTBS404	Analog and Digital Electronics	(3-0-0)3
BTBSL409	Analog and Digital Electronics Lab	(0-0-2)1

Engineering Sciences Courses(BSC)		
BTES103	Engineering Graphics	(2-0-0)2
BTES105	Energy and Environment Engineering	(2-0-0)2
BTES106	Basic Civil and Mechanical Engineering	(2-0-0)
BTES108L	Engineering Graphics Lab	(0-0-4)2
BTES203	Engineering Mechanics	(2-1-0)3
BTES204	Computer Programming	(3-0-0)3
BTES205	Workshop Practice	(0-0-4)2
BTES206	Basic Electrical and Electronics Engineering	(2-0-0)
BTES208L	Engineering Mechanics Lab	(0-0-2)1
BTES305	Engineering Material Science	(3-0-0)

Humanities and Social Science Including Management Courses(HSSMC)		
BTHM104	Communication Skills	(0-0-2)1
BTHM109 L	Communication Skills Lab	(0-0-2)1
BTHM304	Basic Human Rights	Audit
BTHM506	Foreign Languages (A) Japanese Language (B) German Language	Audit
BTHM706	Engineering Operations and Project Management	Audit

Professional Core Course (PCC)		
BTEEC302	Electrical Machines-I	(3-1-0)4
BTEEC303	Electrical and Electronics Measurement	(3-1-0)4
BTEEL306	Electrical Machines Lab	(0-0-2)1
BTEEL307	Electrical and Electronics Measurement Lab	(0-0-2)1
BTEEC401	Network Theory	(3-1-0)4
BTEEC402	Power System	(3-1-0)4
BTEEC403	Electrical Machines-II	(3-1-0)4
BTEEL406	Network Theory Lab	(0-0-2)1
BTEEL407	Power System Lab	(0-0-2)1
BTEEL408	Electrical Machines-II Lab	(0-0-2)1
BTEEC501	Power System Analysis	(3-1-0)4
BTEEC502	Microprocessor and Microcontroller	(3-0-0)3
BTEEC503	Power Electronics	(3-1-0)4
BTEEL507	Power System Analysis Lab	(0-0-2)1
BTEEL508	Microprocessor and Microcontroller Lab	(0-0-2)1
BTEEL509	Power Electronics Lab	(0-0-2)1
BTEEC601	Switchgear Protection	(3-0-0)3
BTEEC602	Electrical Machine Design	(3-1-0)4
BTEEC603	Control System	(3-1-0)4

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	Engineering	
BTEEL606	Switchgear Protection Lab	(0-0-2)1
BTEEL607	Electrical Machine Design Lab	(0-0-2)1
BTEEL608	Control System Engineering Lab	(0-0-2)1
BTEEC701	High Voltage Engineering	(3-1-0)4
BTEEC702	Power System Operation and Control	(3-1-0)4
BTEEL707	High Voltage Engineering Lab	(0-0-2)1

Professional Elective Course (PEC)		
BTEEPE405	(A)Electromagnetic Field Theory	(3-0-0)3
	(B)Signals and System	
	©Advance Renewable Energy Sources	
	(D)Electronic Devices and Circuits	
BTEEPE504	(A)Industrial Automation	(3-0-0)3
	(B)Power Quality Issues	
	©HVDC	
BTEEPE604	(A)Application of Power Electronics in Power System	(3-0-0)3
	(B)Smart Grid Technology	
	©Modeling, Simulation and Control of Electric Drives	
BTEEPE703	(A)Energy Audit and Conservation	(3-0-0)3
	(B)Electrical System Design for Building	
	©Flexible AC Transmission System	
	(D)Electrical Utilization	

Open Elective Course (OEC)		
BTEEOE50	(A)Embedded System	(3-0-0)3
	(B)Electrical Safety	
	©Condition Monitoring of Electric Apparatus	
BTEEOE605	(A)E-waste Management	(3-0-0)3
	(B)Power Plant Engineering	
	©Sensor Technology	
	(D)Lightning Interaction with Power System	
BTEEOE704	(A)Process Control Instrumentation	(3-0-0)3
	(B)Biomedical Instrumentation	
	©Mechatronics	
BTEEOE705	(A)Testing, Maintenance and Commissioning of Electrical Equipment	(3-0-0)3
	(B)Electric and Hybrid Electric Vehicles	
	©Internet of Things (IoT)	

Seminar / Mini Project / Internship		
BTES209S	Seminar	(0-0-2)1
BTES211P	(Internship – I) Field Training / Internship/Industrial Training (minimum of 4 weeks which can be completed partially in first semester and second Semester or in at one time).	1
BTEEM308	Miniproject-I	(0-0-4)2
BTEEP410	(Internship – II)	1
BTEEM509	Miniproject-II	(0-0-2)1
BTEES609	Seminar	(0-0-4)2
BTEEP610	(Internship – III)	
BTEEM708	In house project-I / Mini project-III	(0-0-4)2

Project(MP)		

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BTEEP802	In house project-I / Internship & Project in Industry	(0-0-26) 13

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B.Tech (Electrical Engineering / Electrical Engineering (Electronics and Power)/ Electrical & Electronics Engg / Electrical & Power Engineering)

Plan of Study:

No.of Courses								
1	I	II	III	IV	V	VI	VII	VIII
2	BTBS101	BTBS201	BTBS301	BTEEC401	BTEEC501	BTEEC601	BTEEC701	BTEEPE801
3	BTBS102	BTBS202	BTEEC302	BTEEC402	BTEEC502	BTEEC602	BTEEC702	BTEEP802
4	BTES103	BTES203	BTEEC303	BTEEC403	BTEEC503	BTEEC603	BTEEPE703	
5	BTHM104	BTES204	BTHM304	BTBS404	BTEEPLE504	BTEEPE604	BTEEOE704	
6	BTES105	BTES205	BTES305	BTEEPE405	BTEEOE505	BTEEOE605	BTEEOE705	
7	BTES106	BTES206	BTEEL306	BTEEL406	BTHM506	BTEEL606	BTHM706	
8	BTBS107L	BTBS207 L	BTEEL307	BTEEL407	BTEEL507	BTEEL607	BTEEL707	
9	BTES108L	BTES208 L	BTEEP308	BTEEL408	BTEEL508	BTEEM608	BTEEM708	
10	BTHM109 L	BTES209S	BTES211P	BTEEL409	BTEEPE509	BTEEP609	BTEEP609	
11		BTES211		BTEEP410	BTEEP409			

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A. Program Educational Objectives (PEOs)

Graduates will able to–

1.To equip graduates with a strong foundation in engineering sciences and Electrical Engineering fundamentals to become effective collaborators, researchers and real-time problem solver with technical competencies.

2.Perceive the limitation and impact of engineering solutions in social, legal, environmental, economical and multidisciplinary contexts.

3.Excel in Industry/technical profession, higher studies, and entrepreneurship exhibiting global competitiveness.

B. Program Outcomes (POs)

Engineering Graduate will be able to –

1. **Engineering knowledge:**Apply the knowledge of mathematics, science,engineering fundamentals, and anengineering specialization to the solution ofcomplex engineering problems.
2. **Problem analysis:**Identify, formulate, review research literature, and analyzecomplex engineering problems reaching substantiated conclusions using firstprinciples of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:**Design solutions for complex engineeringproblems and design systemcomponents or processes that meet the specifiedneeds with appropriate consideration for the public health and safety, and thecultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:**Use research-based knowledgeand research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:**Create, select, and apply appropriate techniques, resources,and modern engineering and IT tools including prediction and modeling to complexengineering activities with an understanding of the limitations.
6. **The engineer and society:**Apply reasoning informed by the contextualknowledge to assess societal, health, safety, legal and cultural issues and theconsequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:**Understand the impact of the professionalengineering solutions in societal and environmental contexts, and demonstrate theknowledge of, and need for sustainable development.
8. **Ethics:**Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:**Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication:** Communicate effectively oncomplex engineering activities with the engineeringcommunity and with society at large, such as, being able to comprehend and write effective reports anddesign documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering andmanagement principles and apply these to one's own work, as a member and leader in a team, to manageprojects and in multidisciplinary environments.
12. **Life-long learning:**Recognize the need for, and have the preparation and ability to engage in independentand life-long learning in the broadest context of technological change.

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Curriculum for Semester V

Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credit
			L	T	P	CA	MSE	ESE	Total	
PCC4	BTEEC501	Power System Analysis	3	1	-	20	20	60	100	4
PCC5	BTEEC502	Microprocessor and Microcontroller	3	-	-	20	20	60	100	3
PCC6	BTEEC503	Power Electronics	3	1	-	20	20	60	100	4
PCC2	BTEEPLE504	Group B	3	-	-	20	20	60	100	3
OEC1	BTEEOE505	Group C	3	-	-	20	20	60	100	3
HSSMC	BTHM506	Foreign Language #	-	-	-	-	-	-	-	Audit
LC	BTEEL507	Power System Analysis Lab	-	-	2	60	-	40	100	1
LC	BTEEL508	Microprocessor and Microcontroller Lab	-	-	2	60	-	40	100	1
LC	BTEEL509	Power Electronics Lab	-	-	2	60	-	40	100	1
Project	BTEEPE510	Mini project-II	-	-	2	60	-	40	100	1
Internship	BTEEP410	Internship-II Evaluation	-	-	-	-	-	50	50	1
		Total	**15**	**2**	**10**	**340**	**100**	**510**	**950**	**22**

Semester VI

PCC7	BTEEC601	Switchgear and Protection	3	-	-	20	20	60	100	3
PCC8	BTEEC602	Electrical Machine Design	3	1	-	20	20	60	100	4
PCC9	BTEEC603	Control System Engineering	3	1	-	20	20	60	100	4
PEC3	BTEEPE604	Group D	3	-	-	20	20	60	100	3
OEC2	BTEEOE605	Group E	3	-	-	20	20	60	100	3
LC	BTEEL606	Switchgear and Protection Lab	-	-	2	60		40	100	1
LC	BTEEL607	Electrical Machine Design Lab	-	-	2	60		40	100	1
LC	BTEEL608	Control System Engineering Lab	-	-	2	60		40	100	1
Seminar	BTEEM609	Seminar	-	-	4	60		40	100	2
Internship	BTEEP610	Internship-III (minimum of 4 weeks which can be completed partially in third or fourth semester or in at one time)	-	-	-	-	-	-	-	Credits to be evaluated in VII sem.
		Total	**15**	**2**	**10**	**340**	**100**	**460**	**900**	**22**

BSC= Basic Science Course, ESC= Engineering Science Course, PCC= Professional Core Course, PEC= Professional Elective Course, OEC= Open Elective Course, LC= Laboratory Course, HSSMC= Humanities and Social Science including Management Course

 # Online NPTEL Course

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Semester V

BTEEPE504 Professional Elective (Group B)	BTEEOE505 Open Elective (Group C)
(A)HVDC	(A) Embedded System
(B) Power Quality Issues	(B) Electrical Safety
(C) Industrial Automation	(C) Condition Monitoring of Electric Apparatus

BTHM506 Foreign Language
(A) Japanese Language
(B)German Language

Semester VI

BTEEPE604 Professional Elective (Group D)	BTEEOE605 Open Elective (Group E)
(A) Flexible AC Transmission System	(A) E-waste Management
(B) Smart Grid Technology	(B) Power Plant Engineering
(C) Modeling, Simulation and Control of Electric Drives	(C) Sensor Technology
	(D) Lightning Interaction with Power System

Head

Semester V

BTEEC501 POWER SYSTEM ANALYSIS — 4 Credits

Unit 1: Modeling of Power System — 7 Hours

Complex power flow, balanced and reactance diagrams of a power system, per unit system per unit representation of transformers, synchronous machines, representation of loads. Graph theory and its applications for formation of primitive network and Z and Y matrices, incidence matrices, Y-bus and Z-bus matrices.

Unit 2: Load Flow Studies: — 7 Hours

Introduction, network model formulation, formation of Y-bus by singular transformation, load flow problem, Iterative methods of load flow such as Gauss Gauss-Seidel, Newton-Raphson method, decoupled load flow and fast decoupled load flow, Automatic Generation control.

Unit 3: Symmetrical Fault Analysis: — 7 Hours

Transients on a transmission line, short circuit of a synchronous machine on no load and on load. Short circuit current computation on no load and on load, selection of circuit breakers, Z-bus formulation, algorithm of short circuit studies.

Unit 4: Symmetrical Components: — 7 Hours

Fundamentals of symmetrical components, sequence impedance and sequence network of star connected loads, transmission lines, synchronous machines and transformer sequence network of a loaded generator.

Unit 5: Unsymmetrical Faults Analysis — 7 Hours

single line to ground (l-g), Line to line (L-L), double line to ground (L-L-G) faults analysis of above faults using bus impedance matrix, bus voltage and line current during faults. open conductor faults.

Unit 6: Security Analysis — 7 Hours

Basic Concepts, Security analysis, Load Dispatch centre, Contingency Analysis, preventive and emergency control, Electrical Power Quality, causes, affects and mitigation methods.

Text books:

1. I.J. Nagrath& D.P. Kothari, "Modern System Analysis", Tata McGraw- Hill

2. Stevenson W.D "Elements of Power System Analysis", McGraw- Hill Wadhawa C.L "Elements Power System", John Wiley & sons.

Reference Books:

1. "Power System Analysis", T.K. Nagsarkar, M.S. Sukhiya. (OXFERD U. P.)
2. Stevenson W.D. and Grainger J.J. "Power System Analysis" McGraw- Hill
3. A.R. Bergen and Vijay Vittal, Power Systems Analysis, Pearson Education Asia, 2001.
4. Stagg W.D. & EI-AbiadA.H.,"Computer Method in Power System Analysis", McGraw- Hill
5. H.Saadat "Power System analysis", McGraw- Hill
6. Elgred O.I. electrical Energy System Theory", McGraw-Hill.

7. J.D. Glover, M. Sarma and T.J. Overbye, Power System Analysis and Design, Fourth Edition, Thomson Engineering Press, 2008.

BTEEC502 MICROPROCESSOR AND MICROCONTROLLER 04 Credits

Unit 1: Microprocessor architecture **7 Hours**

8085 architecture, functional block diagram, Arithmetic Logic Unit (ALU), Timing and control Unit, Registers, Data and Address bus, Interface unit, 8085 instructions, Instruction word size: one byte, two byte and three byte instructions, addressing modes of 8085, assembly language programming Timing and control signals, Fetch operations, Execution operations, Machine cycle and state, Instruction and data flow, System timing diagram– interrupts.

Unit 2: Memory interfacing **7 Hours**

Types of main memories, Compatibility between memory and system BUS, Address space, Partitioning of address space, Special chips for address decoding, ROM and RAM interfacing, i/o interfacing: memory map i/o, i/o map i/o scheme. Programmable peripheral interface. Data transfer techniques and their implementation: Programmed data transfer, DMA mode of transfer, I/O port, Device polling in interrupt driven mode of data transfer, DMA controller and data transfer in DMA mode, Serial mode of data transfer

Unit 3: Applications of microprocessors **7Hours**

Interfacing of A/D converters, interfacing of D/A converter, wave generator, multiplex seven segment LED display system, measurement of frequency, phase angle and power factor. Traffic light controller and stepper motor controller.

Unit 4: 8051 Microcontroller **8 Hours**

Intel 8051 architecture, memory organization, flags, stack, and special function registers, I/O, ports - connecting external memory, counters and timers, serial data I/O, Interrupts. Microcontroller instructions - addressing modes, moving data, logical operations, arithmetic operations, jump and call instructions – subroutines - Interrupts and returns.

Unit 5: Microcontroller programming **8 Hours**

Assembly Language Programming, timer and counter programming, connection to RS 232 and RS 485, Interrupt programming. Peripherals and interfacing - Serial and parallel I/O (8251 and 8255), Programmable DMA controller, Programmable interrupt controller, ADC/DAC interfacing.

Text/Reference Books:

1. Systems and Microprocessors, John P. Hayes, Digital McGraw-Hill I.E.
2. Microprocessor Architecture, Programming and Applications, R.S.Gaonkar, Wiley Eastern.
3. Microprocessor and Interfacing: Programming and Hardware, D.V. Hall, McGraw-Hill I.E
4. Digital Systems and Microprocessors , John P. Hayes, McGraw-Hill I.E.

BTEEC 503 POWER ELECTRONICS — 04 Credits

Unit 1: Introduction — 7 Hours

Concept of Power Electronics, Different types of power electronics devices, converter systems, areas of application, recent developments. Device characteristics, protection and operation: Terminal characteristics of major power electronics devices(SCR, BJT, MOSFET, IGBT, GTO, TRIAC,), ratings, protection, heating, cooling and mounting, series and parallel operation, firing circuits, Snubber circuits

Unit 2: Phase controlled rectifiers — 7 Hours

Analysis and design of diode rectifier circuits and controlled rectifier circuits (for R, RL, RLE load), Phase control, power factor, DC load voltage, Polyphase rectifiers, Current and voltage waveforms analysis, Applications for DC motor drives. Effect of source impedance on the performance of converters, dual converters.

Unit 3: Choppers — 7 Hours

Principle of chopper operation, Control strategies, Types of chopper circuits and steady state analysis. Commutation in chopper circuits, buck, boost and buck-boost chopper, Discontinuous current analysis, Non-ideal effects and dynamic performance, Applications for DC motor drives. PWM control and operation

Unit 4: Inverters — 7 Hours

Classification of inverters, Single-phase and three-phase Voltage source Inverters, Methods of controlling output voltage, frequency and phase, Reduction of harmonics in the inverter output voltage, Current source inverters and operations. Applications for AC motor drives, Pulse Width Modulation (PWM): Types of PWM.

Unit 5: AC Voltage Controller — 10 Hours

Types of AC voltage controllers, Single phase voltage controllers, Sequence control of ac voltage controllers, 3-phase AC voltage controller operation Application of AC-AC Phase Control, Singlephase and poly phase control circuits, Applications for AC motor drives, Cycloconverters: Principles of cycloconverter operation, Methods of controlling output voltage and frequency in cases of: Single phase to single phase, three phases to single phase, three phases to three phase operation.

Applications: Power supply applications, few applications in residential and industrial systems, Electric utility.

Reference Books:

1. Power Electronics , P C Sen, TMH
2. Power Electronics, Dubey, TMH
3. Thyristorised Power Controllers, Dubey et. al., TMH
4. Power Electronics, Rashid Mohammed, PHI

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5. Power Electronics & Drives, V. Subrahmanyam, New Age

BTEEPE504A HVDC **03 Credits**

Unit 1: Introduction to HVDC transmission **7 Hours**

Development of HVDC Technology, DC versus AC Transmission, DC System components and their functions, Converter configuration, Selection of Converter Configuration, Firing angle, Current and extinction angle control, DC link power control, Reactive power control and VAR sources, MTDC system types

Unit 2: Bridge converters **7 Hours**

Rectifier and inverter operation, equivalent circuit representation, power reversal, desired features of control and actual control characteristics.

Unit 3: Basic HVDC controllers **7 Hours**

Converter faults, commutation failure, bypass action in bridges, protection issues in HVDC - DC reactors, voltage and current oscillations, DC circuit breakers and over voltage protection.

Unit 4: Harmonics in HVDC **7 Hours**

Characteristics and uncharacteristic harmonics, troubles due to harmonics, harmonic filters – active and passive filters. Introduction to Hybrid HVDC and Off-shore wind power evacuation schemes .

Unit 5: Component models for analysis of AC DC system **7 Hours**

Power flow analysis Of AC DC system, transient stability analysis, dynamic stability analysis, advances in HVDC Transmission, application in wind power generation.

Text/ Reference Books:

1. K. R. Padiyar, —HVDC power transmission systeml, Willey eastern limited, Second edition.

2. 2. E. W. Kimbark, —direct current transmissionl, Wiley- inter science, NewYork.

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BTEEPE504B POWER QUALITY ISSUES — 03 Credits

Unit 1: Introduction — 7 Hours

Definition of Power quality, Power Quality –Voltage & Current Quality, Importance of Power Quality, Power quality Evaluation. General Classes of Power quality Problems, Transients, Long-Duration Voltage Variations, Short-Duration Voltage Variations, Voltage Imbalance, Waveform Distortion, Voltage fluctuation, Power Quality Terms, CBEMA and ITI Curves. Voltage Sags and Interruptions: Sources of Sags and Interruptions, estimating voltage Sag Performance, Fundamental Principles of Protection, Solution at the End-User Level, Motor –Starting Sags.

Unit 2: Transient over Voltages — 7 Hours

Sources of Transient Over voltages, Principles of Over voltage Protection, Devices for over voltageProtection, Utility Capacitor-Switching transients, Utility System Lightning Protection, ManagingFerro-resonance, Switching Transient Problems with Loads, Computer Tools for TransientsAnalysis.

Unit 3: Fundamentals of Harmonics — 7 Hours

Harmonic Distortion, Voltage versus Current Distortion, Harmonics versus Transients, HarmonicIndexes, Harmonic Sources from Commercial Loads, Harmonic Sources from Industrial Loads,Locating Harmonic Sources, Effects of Harmonic distortion, interharmonics, Harmonic distortionEvaluations, Principles for Controlling Harmonics, Harmonic Filter design: A Case Study,Standards of Harmonics.

Unit 4: Long-Duration Voltage Variations — 7 Hours

Principles of Regulating the Voltage, Devices for Voltage Regulation, Utility Voltage Regulatorapplication, Capacitors for Voltage Regulation, End-Users Capacitors Application, and RegulatingUtility Voltage with distributed Resources Flicker.

Unit 5: Power Quality Monitoring — 7 Hours

Monitoring considerations, Historical Perspective of Power quality Measuring Instruments, PowerQuality Measurement Equipment, Assessment of Power Quality Measurement Data, Application of intelligent Systems, Power Quality Monitoring Standards, Monitoring considerations.

References/Books:

1. Chattopadhyay, Surajit, Mitra, Electric Power Quality, Springer.
2. Haytt G. T., —Electric Power Qualityl, Stars In Circle Publication.
3. NPTEL courses

BTEEP504C INDUSTRIAL AUTOMATION 03 Credits

Unit 1: Introduction to Industrial Automation **6 Hours**

Architecture of Industrial Automation Systems, Elements of an Automated System, Functional hierarchy of an Industrial Automation system, Levels of Automation.

Unit 2: Programmable Logic Controllers **8 Hours**

Introduction, Architecture of PLC, PLC Operation, **PLC Hardware Components-** Input-Output module (Discrete and Analog), **PLC Programming -** Ladder Logic, Functional Block Diagram (FBD), Ladder Logic Programming (NO-NC, Timer and Counter), PLC Communication, Application of PLCs.

Unit 3: Industrial Drives Control **7 Hours**

Classification of Industrial Drives, DC Motor Drives, Induction Motor Drives, Variable Speed Drives, Servo Motor Drives, Step Motor Drives, BLDC Motor Drives, Control of Drives, Industrial Application of Drives.

Unit 4: SCADA **8 Hours**

SCADA system Architecture, Elements of SCADA System, Human Machine Interface, Master Terminal Unit, Remote Terminal Unit. Alarm Handling and Trending, Access Control, Automation Logging, Archiving, Report Generation. Types of interfaces, SCADACommunication.SCADA Applications: Operation and control of interconnected power system, Automatic substation control, Electric Power Generation, Transmission and Distribution sector operation.

Unit 5: Distributed Control System **7 Hours**

Introduction and Overview, System Architecture, System Elements, Difference between Centralized and Distributed Control System. Displays: Group Display, Overview Display, Detail Display, Data Highways, Field Buses, Multiplexers and Remote Sensing Terminal Units, I/O Hardware, Case study of any one DCS.

Text Books/ Reference Books:

1. C. D. Johnson, "Process Control Instrumentation Technology", Prentice Hall of India.
2. B. G. Liptak, Instrument Engineer's Handbook, Process Control, Chilton Book Company.
3. W. Bolton, "Programmable Logic Controllers", Elsevier.
4 Hughes, "Programmable Controllers", ISA Publications.
5 Frank D. Petruzella, "Programmable Logic Controllers", McGraw-Hill Book Company.
6 John W. Webb and Ronald A. Reis, "Programmable Logic Controllers", PHI.
7 Stuart A. Boyer "Supervisors Control and Data Acquisition", ISA.

BTEEOE505A EMBEDDED SYSTEM — 03 Credits

Unit 1: Embedded System Architectures — **7 Hours**

Introduction, Components of Embedded Systems ARM processor - architectural design -memory organization -data operation-bus configurations. System on-chip, scalable bus architectures, Design example: Alarm clock, hybrid architectures.

Unit 2: Sensor and Actuator I/O 7 Hours

ADC, DAC, timers, Servos, Relays, stepper motors, H-Bridge, port.

Unit 3: Real time operating systems (RTOS) — **7 Hours**

real time kernel – OS tasks – task states – task scheduling –interrupt processing – clocking communication and synchronization – control blocks – memory requirements and control – kernel services.

Unit 4: Embedded Networks — **7 Hours**

Distributed Embedded Architecture – Hardware and Software Architectures, Networks for embedded systems– I2C, CAN Bus, Ethernet, Internet, Network-based design–Communication Analysis, system performance Analysis, Hardware platform design, Allocation and scheduling, Design Example: Elevator Controller.

Unit 5: System Design — **7 Hours**

Specification, Requirements and Architectural design of PBX systems, Set-top box, Ink-jet printer, Laser printer, Personal digital Assistants.

Embedded Hardware : memory map, i/o map, interrupt map, processor family, external peripherals, memory- RAM , ROM, types of RAM and ROM, memory Testing, CRC, Flash memory.

Text/ References Books:

1. Sloss Andrew N, Symes Dominic, Wright Chris, —ARM System Developer's Guide: Designing and Optimizingl, Morgan Kaufman Publication,2004.
2. Raj Kamal,—Embedded Systems – Architecture: Programming and Designl, Tata McGraw-Hill Education, 3rded.,2003.

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BTEEOE505B ELECTRICAL SAFETY — 03 Credits

Unit 1: Primary and secondary hazards arc — **7 Hours**

blast, shocks-causes and effects-safety equipment- flash and thermal protection, head and eyeprotection-rubber insulating equipment, hot sticks, insulated tools, barriersandsigns,safety tags,locking devices- voltage measuring instruments- proximity and contact testers-safety electricalone-line diagram- electrician 's safety kit.

Unit 2: General requirements for grounding and bonding — **9 Hours**

definitions-grounding of electrical equipment bonding of electrically conducting materials andother equipment-connection of grounding and bonding equipment- system grounding- purpose ofsystem grounding- grounding electrode system grounding conductor connection to electrodes-useof grounded circuit conductor for grounding equipment- grounding of low voltage and highvoltage systems

The six step safety methods- pre job briefings - hot-work decision tree-safe switching of power system-lockout-tag out- flash hazard calculation and approach distances- calculating there required level of arc protection-safetyequipment, procedure for low, medium and high voltagesystems- the one-minute safety audit.

Unit 3: Electrical safety programmer structure — **7 Hours**

development- company safety team- safety policy programme implementation- employee electrical safety teams-safety meetings- safety audit accident prevention- first aid- rescuetechniquesaccident investigation.

Unit 4: Safety related case for electrical maintenance — **6 Hours**

reliability cantered maintenance (RCM) -eight step maintenance programme- frequency of maintenance- maintenance requirement for specific equipment and location.

Unit 5: Regulatory bodies — **6 Hours**

National electrical safety code- standard for electrical safety in work place- occupational safety and health administration standards, Indian Electricity Acts related to Electrical Safety.

Text / Reference Books:

1. John Cadick, Mary Capelli-Schellpfeffer, Dennis Neitzel, Al Winfield, =Electrical SafetyHandbook ', McGraw-Hill Education, 4th Edition, 2012.
2. Maxwell Adams.J, =Electrical Safety- a guide to the causes and prevention of electrichazards ', The Institution of Electric Engineers, IET 1994.
3. Ray A. Jones, Jane G. Jones, =Electrical Safety in the Workplace ', Jones & BartlettLearning, 2000

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BTEEOE505C CONDITION MONITORING OF ELECTRICAL APPARATUS 3 Credits

Course Outcomes:

By the end of the course, students will be able to

1. Understand the necessity of condition monitoring and reliability.
2. Have knowledge about the conventional and modern methodologies/techniques.
3. Develop basic functional models for condition monitoring system to different kind of power apparatus.
4. Determine life expectancy of the equipment

Unit 1: Basic Considerations and Maintenance **07 Hours**

Basic definitions, terminologies, symbolic representation, Necessity from technical social, financial aspect, types of faults in electrical equipments {Electrical equipments such as transformer, CT/PT and rotating electrical machines, CBs, etc.}, maintenance strategies, breakdown maintenance, planned, preventative and condition based maintenance

Unit 2: Testing of Electrical Equipments **6 Hours**

Cables, Transformers, Induction motor, Capacitor banks, conventional methods, Measurement of insulation resistance, Diagnostic Testing: Routine tests, type tests, special tests, offline tests, Causes of failure and remedies.

Unit 3: Analysis tools **6 Hours**

Recent methods (offline), Dissolved Gas Analysis (DGA), Dissipation Factor (tan δ), Sweep Frequency Response Analysis (SFRA), Partial Discharge (PD), Time Domain Dielectric Response (TDDR), Frequency Domain Spectroscopy (FDS), Chemical analysis. Image processing techniques

Unit 4: Online condition monitoring and instrumentation **6 Hours**

Recent methods (online), vibration, chemical and temperature monitoring, sensor and data acquisition system, Modern algorithms, GA, and signal processing techniques. Application to various equipments such as transformer, induction motor, synchronous generator and motor, DC motor, CT and PT, case studies.

Unit 5: Current, Flux and Power Analysis **6 Hours**

Discrete time Fourier series and its convergence, discrete time Fourier Transform, its properties, frequency response. Introduction to DFT in time domain and frequency domain, Derivation of DFT from DTFT, Inverse DFT, Convolution using DFT, Computational Complexity of the DFT, Decimation-in-time FFT Algorithm, Decimation In Frequency FFT Algorithm, Wavelet transform, Lab view platform.

Unit 6: Reliability and failure rate Assessment **8 Hours**

Comparison of DIT AND DIF algorithms. Introduction to FIR and IIR Filter Design. Calculation of Power Equipment Reliability for Condition-based Maintenance Decision-making, Optimum

Reliability- Centered Maintenance, Cost Related Reliability Measures for Power System Equipment, Reliability based replacement refurbishment/planning

Text Books:

1. P. Vas, "Parameter estimation, condition monitoring and diagnosis of electrical machines", Clarendon Press Oxford, 1993.
2. P. Tavner, Li Ran, J. Penman and H. Sedding, "Condition monitoring of rotating electrical machines", IET press, 2008.

Reference Books:

1. Xose M Lo´pez, Ferna´ndez, H Bu¨lentErtan, J Turowski, "Transformers analysis, design, and measurement", CRC Press, 2012
2. S.V. Kulkarni and S. A. Khaparde, "Transformer Engineering: Design, Technology and Diagnostics", Second edition, CRC Press, 2013
3. R. Billinton and R. N. Allan, " Reliability Evaluation of Power Systems, 2nd ed. New York", NY, USA: Plenum, 1996.
4. Videos on Transformer condition evaluation with ABBs Mature Transformer Management Program
5. Induction motor condition monitoring with ABBs, Siemens, General Electricals (source You Tube

BTEEL507 POWER SYSTEM ANALYSIS LAB 1 Credit

Any Eight Experiments from the following list.(Any Experiment from the following list can be performed either SCILAB/MATLAB/Any Other Software.)

1. Write a program to draw the per unit reactance diagram of a given power system.
2. Solution of building the Bus Admittance matrix for given power system network.
3. Solution of power flow problem of a given power system using Gauss-Siedel method.
4. Solution of power flow problem of a given power system using Newton Raphson Method.
5. Solution of power flow problem of a given power system using Fast Decoupled method.
6. Single Line to Ground Fault (L-G) analysis of a Three Phase Transmission Line at no load and light load conditions.
7. Line to Line Fault (L-L) analysis of Three Phase Transmission Line at No load and Light load conditions.
8. Double Line to Ground Fault (LLG) analysis of Three Phase Transmission Line at No load and Light load conditions.
9. Symmetrical L-L-L Fault analysis of Three Phase Transmission Line at No load and Light load conditions.

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BTEEL508 MICROPROCESSOR AND MICROCONTROLLER LAB 01 Credit

1	Study of Architecture of 8085
2	Assembly language program for addition and subtraction of 8 bit &16 bit numbers based on 8085 microprocessor
3	Assembly language program for multiplication of two numbers based on 8085 microprocessor
4	Assembly language program for Multiplication and division of two numbers based on 8085 microprocessor
5	Assembly language program for determination of smaller and larger no based on 8085 microprocessor
6	Assembly language program for ascending and descending order based on 8085 microprocessor
7	Assembly language program for rolling/flash LED based on 8085 microprocessor
8	Interfacing of 7 segment LED to 8085 microprocessor
9	Interfacing of Stepper motor with microprocessor
10	Programs based on arithmetic instructions for 8051 microcontroller
11	Interfacing of stepper motor to 8051 microcontroller
12	Interfacing of DC motor to 8051 microcontroller
13	Interfacing of converters ADC 0808/0809 and DAC 0808
14	Generate Delay using Timer section of 8051 microcontroller.

Conduct any 4 practicals fro 1 to 7 and 4 practicals from 8 to 14.

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BTEEL509 POWER ELECTRONICS LAB **01 CREDIT**

1.V-I characteristics of various power electronics devices.(At least two devices SCR/MOSFET/IGBT/TRIAC/GTO)

Group A (minimum four)

2.Experimental analysis of single phase uncontrolled converter

3.Experimental analysis of single phase Half controlled converter

4.Experimental analysis of single phase fully controlled converter

5.Experimental analysis of three phase bridge inverter.

6.Experimental analysis of BUCK /BOOST/BUCK -BOOST converter

Group B

7.Simulation of Single phase Semi controlled converter

8.Simulation of Single phase Fully controlled converter

9.Simulation of Single phase inverter

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BTEEPE510 MINI PROJECT II — 01 Credits

Guidelines:

Stage	Work to be carried
I	• Selection of a project (Hardware or Software Based) on recent trends in Electrical Engineering. • Planning the outcome of the project and listing out the expected outcome of the project. • Literature Survey
II	• Development of Project Idea in the form of working model (Hardware based projects) or production of appropriate simulation results of the proposed idea (Software based projects).
III	• Verification of the results obtained of the working model or the simulation results. • Comparing if the outcomes as defined in Phase I are met and taking corrective action.
IV	• Completion of project by developing the Project Report and submitting the report to the concerned to receive the final credits.

Semester VI

BTEEC601 SWITCHGEAR AND PROTECTION **04 Credits**

Unit 1: Introduction to Switchgear and Protection **7 Hours**

Introduction, Need for power system protection, effects of faults, Requirement of Relays, Relays Terminology, basic circuit, relay connection with trip circuit and circuit breaker, types of relay, Protective Devices: Philosophy of protection, zones of protection, primary and backup protection, Methods of earthing and their effect on fault conditions. Different types of relays: attracted armature type, balanced beam type, induction type.

Unit 2: Static and Numerical Relays **7 Hours**

Amplitude and phase comparator techniques, Differential relays, directional relay, impedance relay, admittance relay, MHO relay, description of numerical relays, relaying algorithms, use of numerical relays as fault locator and disturbance recorder. Microprocessor Based Relays: Advantages, over current relays, directional relays, distance relays.

Unit 3: Circuit Breakers and Fuses **7 Hours**

Introduction, arcing in circuit breakers, arc interruption, re-striking and recovery voltage, current chopping, resistance switch, Air blast circuit breakers, minimum and bulk oil circuit breakers, SF6 and Vacuum Circuit breakers, circuit breakers rating, testing of CB, point on wave switching, Definitions of terms in fuses, HRC fuses. Introduction, fuse characteristics, types of fuses, application of HRC fuses. Selection of circuit breakers, high voltage d.c. breakers.

Unit 4: Protection of Transmission Lines **7 Hours**

Over current protection, construction and operation of instantaneous over current relay. Directional Over current relay , distance protection, unit protection schemes, carrier aided distance protection, protection of feeders, protection of ring main and parallel feeders, protection of radial feeders by over current relays, distance relays and carrier current protection scheme. Protection of induction motor's against overload, short-circuits, thermal release, miniature circuit breaker

Unit 5: Protection of Alternators & Transformers **7 Hours**

Differential protection of alternator, protection of stator against phases to ground fault, phase to phase faults, inter turn fault, protection against unbalanced loading, protection of rotor against ground fault, field failure, reverse power, back up protection, field suppression, protection of bus bars, frame leakage protection. Differential protection of transformer for different winding configurations, difficulties encountered in differential protection and their remedies. Standards and specifications related to switch gear and protection

Text/References Books:

1. Power system protection and switchgearl, Ravindranath and Chander, TMH

2. Fundamentals of power system protectionl, Paithankar and Bhide, PHI
3. J. L. Blackburn and T. J. Domin, Protective Relaying: Principles & Applications, CRC Press, 2006.
4. Electrical power systeml, Wadhwa, New Age. 2. —Power system protectionl, Badri Ram, TMH.

BTEEC602 ELECTRICAL MACHINE DESIGN — 04 Credits

Unit I: Principles of Electrical Machine Design: **6 Hours**

Principles of design, design factors, limitations, Ratings, Specifications, Standards, Performance and other criteria to be considered, Brief study of magnetic, electric, dielectric and other materials, Introduction and advantages of various approaches of Computer Aided Designing.

Unit II: Design of Simple Electrical Apparatus& AC and DC Windings: **6 Hours**

Detailed design of heating coils, starters, chokes and lifting magnets, Numerical examples.

AC & DC Windings: Constructional features, types of ac windings, Choice and design of simple/ duplex lap and wave winding, Concept of multiplex windings and reasons for choosing them, Single and double layer three phase AC winding (mush) with integral slots

Unit III: Design of Induction Motor (Stator): **10 Hours**

Calculation of Ampere-Turns for flux distribution in rotating machines, Calculation of Ampere-Turns for flux distribution in rotating machines, output equation of three phase IM, specific electrical and magnetic loadings, ranges of specific loadings, turns per phase, number of stator slots, calculations for main dimensions, stator design parameters, Numerical examples.

Unit IV: Design of Induction Motor (Rotor): **6 Hours**

Selection of length of air gap, factors affecting length of air gap, design of rotor, Unbalanced magnetic pull and its estimation, harmonic field effect on the performance of3-phase induction motor, Design of squirrel cage and wound rotor

Unit V: Heating and Ventilation of Electrical Machines: **6 Hours**

Study of different modes of heat generation, Temperature rise and heat dissipation, Heating and Cooling cycles, heating and cooling time constants, their estimation, dependence and applications, Methods of cooling / ventilation of electrical apparatus, Thermal resistance, radiated heat quantity of cooling medium (Coolant) Numerical examples.

Unit VI: Design of Transformer: **10 Hours**

Design of Transformer: Design of distribution and power transformers, Types, Classification and specifications, Design and main dimensions of core, yoke, winding, tank (with and without cooling tubes), Estimation of leakage reactance, resistance of winding, No load current, Losses, Mechanical force developed during short circuits, their estimation and measures to reduce them, Numerical examples.

Textbooks:

1. Sawhaney. A. K– A Course in Electrical Machine Design (DhanpatRai).

Reference Books:

1. .Deshpande. M. V- A Course in Electrical Machine Design (Prentice Hall Of India).

2. Siskind – Electrical Machine Design (Mcgraw Hill).

BTEEC603 CONTROL SYSTEM ENGINEERING 04 Credits

Unit 1: Introduction **10 Hours**

Concept of open & closed loop control system, Transfer Function: Concept of system: Physical system, Physical model, Linear and Nonlinear systems, Time variant and Time invariant system. Equations of physical systems (Mass-Spring-Dashpot system, R-L-C series & parallel circuit) Transfer Function, Procedure of obtaining transfer function.

Block diagrams and Signal flow graphs: a) Block diagram, Block Diagram reduction, and Numerical examples. b) Signal flow graph; Masons gain formula for deriving overall transfer function of systems. Feedback characteristics of control system: Concept of Negative and Positive feedback, Sensitivity of the system to parameter variation and with negative and positive feedback.

Unit 2: Time Domain Analysis **7 Hours**

Typical test signals, Time domain specifications, Steady state response, Types of system, Steady State Error constants and Steady State Error, Transient Response, Concept of stability, Determination of stability by Routh - Hurwitz criterion.

Unit 3: Frequency Domain Analysis **10 Hours**

Introduction to Frequency Domain Analysis, Polar plots,Bode plots, Nyquist criterion, Relative stability from Nyquistcriterion. Root Locus, Construction of Root Locus, and Stability from Root Locus plots, Effect of addition of poles & zeros on Root Locus plots, Compensation network: Lag, Lead & Lag-Lead.

Unit 4: PID Controllers **4 Hours**

Introduction to Proportional (P), Integral (I) & Derivative (D) controller, individual effect on overall system performance, P-PI & PID control and effect on overall system performance.

Unit 5: State Variable Technique **8 Hours**

Concept of State, State Variable & State Vector, State Variable Analysis: Different forms of state variable representations (Phase, Physical & Canonical form), Concept of Diagonalization, Obtaining StateEquations from Transfer Function representation and vice versa, Solution of State Equations, StateTransition Matrix (STM), Methods of finding STM, Power Series Method, Laplace Transform Method, Calay Hamilton Method, Controllability & Observability of linear system, Kalman's test.

Text Books/ReferenceBooks:

1. Ogata K., "Modem Control Engineering", Prentice Hall of India.
2. Kuo B. C., "Automatic Control System", Prentice Hall of India.
3. Nagarath I. J. and Gopal M., "Control System Engineering", Willey Eastern.
4. Norman S. Nice, "Control System Engineering", Wiley.

5. Smarajit Ghosh, "Control Systems Theory & Applications", Pearson.
6. Gopal M., "Control System", Prentice Hall of India.

BTEEPE604A FLEXIBLE AC TRANSMISSION SYSTEM **3 Credits**

Unit 1: Transmission Interconnection **7 Hours**

Flow of power in the AC system, factors affecting loading capability, power flow and dynamicstability consideration of a Transmission interconnection, Description and application of HVDCtransmission, DC System components and their functions, Converter configuration, Principles ofDC Link control and Converter control characteristics, Firing angle, Current and extinction anglecontrol, DC link power control

Unit 2: Flexible AC Transmission **7 Hours**

Benefits of FACTS, Basic Realities & Roles, Types of FACTS Controller, Principles of Series and Shunt Compensation. Introduction to Voltage source and Current source converter. Shunt compensation (SVC): Objectives of shunt compensation, Midpoint voltage regulation for long transmission line, voltage instability prevention, improvement of transient stability

Unit 3: Reactive power control and VAR sources **7 Hours**

Reactive power control and VAR sources Methods of controllable VAR generation, Description ofStatic VAR Compensators (SVC), Variable impedance type VAR generators. Thyristor controlledreactor (TCR), Thyristor Switched Capacitor (TSC), TSC-TCR, Fixed capacitor TCR (FC-TCR).Shunt compensation

Unit 4: Variable impedance type series compensator **7 Hours**

Thyristor Switches Series Capacitor (TSSC), Thyristor Controlled Series Compensators (TCSC). Switching Converter type Series Compensator. Introduction to interline power flow controller, Special purpose FACTS controllers, Thyristor controlled voltage limiter and voltage regulator, Thyristor controlled braking resistor and current limiter.

Unit 5: (STATCOM) **7 Hours**

Switching type VAR generator, Static Synchronous Compensator (STATCOM), Basic operatingprinciple, Configuration. Basic control approach, Comparison between SVC and STATCOM.Series Compensator: Objectives of series compensation, improvement of transient stabilitySynchronous Series Compensator: (SSSC) and Controller for SSSC, Basic configuration andworking of Unified Power Flow Controller (UPFC). Unified Power Flow Controller, CircuitArrangement, Basic Principle of P and Q Control, independent real and reactive power flow control, Applications GCSC, TSSC, TCSC & SSSC

Text Books/Reference Books:

1. N.G Hingorani, L. Gyugyi, —Understanding FACTS: Concepts and Technology of FlexibleAC Transmission Systemsl, IEEEPress Book, Standard Publishers and Distributors, Delhi,2001.
2. Padiyar K.R., —HVDC Power Transmission Systeml, Wiely Eastern PVT Limited.

3. Thyristor Based FACTS Controllers for Electrical Transmission System, R.M. Mathur, and R. K.Verma
4. FACTS: Controller in Power Transmission & Distribution, K. R. Padiyar, New AgeInternational.
5. HVDC and F ACTS controllers, Application of Static converter in Power System, V.K. Sood
6. E.W. Kimbark —Direct Current transmissionl, Vol.1, John Wielly, New York
7. T,J.E Miller, —Reactive Power Control in Electric Systemsl, John Wiley & Sons.

BTEEPE604B SMART GRID TECHNOLOGY — 03 Credits

Unit 1: Introduction to Smart Grid — 9 Hours

Introduction, working definitions of Smart Grid, Need of Smart Grid, Present development & International policies in Smart Grid. Introduction to Smart Meters, Real Time Pricing, Smart Appliances, Automatic Meter Reading(AMR), Outage Management System(OMS), Vehicle to Grid, Smart Sensors, Home & Building Automation Smart Substations, Substation Automation, Feeder Automation. Geographic Information System(GIS), Intelligent Electronic Devices(IED) & their application for monitoring & protection, Smart storage like Battery, SMES, Pumped Hydro, Compressed Air Energy Storage,Indian Smart Grid –Key Challenges for Smart Grid. Application and standards, Impacts of Smart Grid on reliability, Impacts of Smart Grid on air pollutant emissions reduction.

Unit 2: Smart Grid Architecture — 6 Hours

Components and Architecture of Smart Grid Design –Review of the proposed architectures for Smart Grid. The fundamental components of Smart Grid designs –Transmission Automation – Distribution Automation –Renewable Integration Tools and Techniques for Smart Grid: Computational Techniques –Static and Dynamic Optimization Techniques –Computational Intelligence Techniques –Evolutionary Algorithms – Artificial Intelligence techniques

Unit 3: Distribution Generation Technologies — 6 Hours

Introduction to Renewable Energy Technologies –Micro grids –Electric Vehicles and plug–in hybrids –Environmental impact and Climate Change –Economic Issues

Unit 4: Communication Technologies and Smart Grid — 7 Hours

Introduction to Communication Technology – Advanced Metering Infrastructure (AMI), Home Area Network (HAN), Neighborhood Area Network (NAN), Wide Area Network (WAN). Bluetooth, ZigBee, GPS, Wi-Fi, Wi-Max based communication, Synchro Phasor Measurement Units (PMUs) –Wide Area Measurement Systems (WAMS). Two-way Digital Communications Paradigm, Network Architectures, IP- based Systems Power Line Communications.

Unit 5: Control of Smart Power Grid System — 7 Hours

Load Frequency Control (LFC) in Micro Grid System –Voltage Control in Micro Grid System – Reactive Power Control in Smart Grid. Case Studies and Test beds for the Smart Grids. Security and Privacy: Cyber Security Challenges in Smart Grid, Load Altering Attacks, False Data Injection Attacks, Defense Mechanisms, Privacy Challenges.

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Reference Books:

1. James Momoh, —Smart Grid Fundamentals of Design and Analysis, Wiley, 2012

2. Keyhani, —Smart Power Grid Renewable Energy Systems, Wiley 2011
3. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, —Smart Grid: Technology and Applications, Wiley 2012.
4. Jean Claude Sabonnadiere, NouredineHadjsaid, —Smart Gridsl, Wiley ISTE 2012.

BTEEPE604C MODELING, SIMULATION AND CONTROL OF ELCTRICAL DRIVES

3 Credits

Unit 1: Introduction **7 Hours**

Introduction to Electric drives: Advantages of Electrical Drives, Parts of Electrical drive. Choice of Electric drives. Dynamics of Electrical drives: fundamental torque equations, multiquadrant operation Classes of motor duty & criteria for selection of motor.Load equalization, stability of electrical drives, sensors in drive systems.

Unit 2: DC motor drives: **6 Hours**

Review of basic characteristics of DC motors, Single phase andThree phase rectifier controlled drives.DC-DC converter drives:Principle of Rheostatic and regenerative braking control, combined control, two and four quadrant DC-DC converter fed drives.

Unit 3: AC Drives: **8 Hours**

Speed control of three phase induction motors, Stator voltage control, Rotor voltage control, frequency control, Voltage and frequency control.Principle of Scalar andVector control of Induction motor, Static rotor resistance control method, static slip power recovery control.Direct torque control of Induction motor, direct torque control of PM synchronous motor drives

Unit 4: Sensor less control of IM drives **7 Hours**

Sensor less control of PMSM drives, Predictive torque control of induction motor drive, Multiphase machine drives, Fractional-slot concentrated winding machines and drives.

Unit 5:Machine Modeling **7 Hours**

DC, induction motor and synchronous machines; simulation of transients; simulation tools: SABER, PSPICE, and MATLAB-SIMULINK; Simulations of converters, inverters and cyclo-converters etc.

Text/References Books:

1. Dubey G. K., "Fundamentals of Electrical Drives", Narosa Publishing house
2. De N. K., Sen P. K., "Electric Drives", Prentice Hall of India
3. VedamSubramanyam, "Electrical Drives and Control", TMH Publications
4. Mohammed Fazlur Rahman, —Modeling, Simulation And Control Of Electrical Drivesl, Institution of Engineering And Technology Publication

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BTEEOE605A E-WASTE MANAGEMENT 03 Credits

Unit 1: Sources **7 Hours**

Composition and characteristic of hazardous waste, Hazardous Waste (Management and Handling) Rules, 1989 and amendments, Federal Hazardous Waste Regulations under RCRA, Superfund, CERCLA and SARA. Toxicology, public health impact, Protocols, issues and challenges in transportation of hazardous waste.

Unit 2: E-waste **7 Hours**

Introduction, toxicity due to hazardous substances in e-waste and their impacts, domestic e-waste disposal, e-waste management, technologies for recovery of resource from electronic waste.

Unit 3: Guidelines for environmentally sound management of e-waste **7 Hours**

Occupational perspectives of recycling e-waste in India, Environmental health perspectives of recycling e-waste.

Unit 4: Hazardous substances waste Electrical and Electronic Equipment **7 Hours**

Characteristics of pollutants, batteries, electrical and electronic components, plastic and flame retardants, circuit boards, pollutants in waste electrical and electronic equipment.

Unit 5: E-Waste Recycling **7 Hours**

Technologies for recovery of resources from electronic waste, resource recovery potential of e-waste, steps in recycling and recovery of materials-mechanical processing, technologies for recovery of materials.

Text/References Books:

1. New Delhi. Johri R., —E-waste: implications, regulations, and management in India and current global best practicesl, TERI Press, New Delhi.
2. E-Waste Managing the Digital Dump Yard, Edited by Vishakha Munshi, ICFAI University Press
3. E-Waste Managing the Digital Dump Yard, Edited by Vishakha Munshi, ICFAI University Press
4. Tchobanoglous G., Theisen H., Viquel S.A., —Integrated Solid Waste Management: Engineering, Principles and Management issuesl, Tata McGraw Hill Publishing Company Ltd

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BTEEOE605B POWER PLANT ENGINEERING 3 Credits

Unit 1: Power Generation from conventional sources **7 Hours**

Introduction to conventional energy sources, Thermal, hydro, nuclear and gas power plants - their functions and control; types of prime movers, generators and excitation systems;

Alternate sources of power generation - solar, wind, geo-thermal, ocean-thermal, tidal, wave and MHD. Economic considerations in power systems-Load and Energy survey, load duration curve, plant factor and plant economics,

Unit 2: Thermal and Hydro Power Plants **7 Hours**

Thermal Steam and Hydro Power Plants: Selection of site, elements and operational circuits of the power plant, turbo-alternators, plant layout, steam turbines, controls and auxiliaries.

Hydro-electric Power Plants – selection of site, elements of power plant, classification, water turbines, governor action, hydro-electric generator, plant layout, pumped storage plants.

Unit 3: Nuclear Power Plants **7 Hours**

selection of site, nuclear reaction – fission process and chain reaction, constituents of power plant and layout, nuclear reactor – working, classification, control, shielding and waste disposal.

Diesel and Gas Power Plants: Advantage and limitations, types of diesel plants, general layout, and applications. Components of gas power plant, gas turbine, fuels, materials, working and applications.

Unit 4: Renewable power plants **7 Hours**

Solar power generation – Photo-voltaic and solar thermal generation – solar concentrators,

Wind power generation – types of wind mills, wind generators, tidal, biomass, geothermal and magneto hydro dynamic power generation, micro-hydel power plants, fuel cells

5: Combined operation of power plants **7 Hours**

Plant selection, choice of size and number of generator units, Concept of parallel operation of various generating sources and load sharing, interconnected systems, concept of

Grid, real and reactive power exchange among interconnected systems. Major electrical equipment in power plants, DC systems in power plants, station control - switch yard and control room. Economic considerations – types of costs, tariff and consumers.

Text/Reference Books:

1. Wadhwa, C.L.,"Generation Distribution and Utilisation of Electrical Energy", New Age International Publishers, 3rd Edition, 2010.
2. J.B.Gupta, "A Course in Power Systems", S.K.Kataria and Sons, Reprint 2010-2011.
3. M. M. El-Wakil, "Power Plant Technology", Mcgraw Hill, Digitized on Dec 2000
4. B. G, A. Skrotzki& W, A. Vopat, "Power Station Engineering & Economy", McGraw Hill, Digitized on Dec 2007.

5. Chakrabarti A., Soni M.L., Gupta P.V., and Bhatnagar U.S., "A Text Book on Power Systems Engg", DhanpatRai and Sons, New Delhi, 2nd Revised Edition, 2010.
6. Nag P. K., "Power Plant Engineering", Tata McGraw Hill Publications
7. R. K. Rajput, "Power Plant Engineering", Shree Laxmi Publications

BTEEOE605C SENSOR TECHNOLOGY 03 Credits

Unit 1: Measurement and Characteristics **7 Hours**

Elements of a Measurement System; Classification of Instruments; Static Performance Parameters; Loading and Impedance Matching; Errors and Uncertainties in Measurement; Process and Standards of Calibration; Dynamic Characteristics Transfer Function Representation of a Measurement System, Impulse and Step Responses of First and Second Order Systems, Frequency Response of First and Second Order Systems.

Unit 2: Mechanical Transducers **7 Hours**

Temperature- Bimetallic Element and Fluid Expansion type Thermometers; Pressure- Manometers and Bourdon Gauges; Force- Balances, Helical Spiral Springs, Load Cells and Elastic Force Devices; Torque- Torsion Bars and Flat Spiral Springs; Liquid Level- Float Systems and Level to Pressure Converters; Flow- Pitot Static Tubes and Turbine type Flow Meters. Hot Wire Anemometer. Proximity Sensors- Reed Sensors, Inductive proximity sensor, capacitive proximity sensor, Optical sensor with through beam, Ultrasonic sensors.

Unit 3: Electrical Transducers **7 Hours**

Resistance Thermometers; Interfacing Resistive Transducers to Electronic Circuits; Thermistors- Measurement of Temperature and Thermal Conductivity, Temperature Control; Resistance Strain Gauges- Gauge Factor, Bonded and Unbonded Strain Gauges; Self Generating and Non Self Generating Inductive Transducers; Linear Variable Differential Transformers; Capacitive Transducers – Potentiometric Transducers; Thermoelectric Transducers and Sources of Errors in Thermocouples; Piezoelectric Transducers

Unit 4: Basic Signal Conditioning Elements **7 Hours**

Amplifiers- Non Electrical and Electrical types; Op Amps Inverting, Non Inverting, Summing, Differential, and Charge Amplifiers; Differentiating and Integrating Elements; Filters;

Data Transmission Elements- Electrical, Pneumatic, Position and Radio Frequency Transmission types; Compensation Elements for First and Second Order Systems – Basic Indicating, Recording, and Display Elements .

Unit 5: Feedback in Instruments **7 Hours**

Principles of Feedback and Advantages & Disadvantages of Feedback; Digital Voltmeters-Ramp and Dual Slope types; Servo type Potentiometric and Magnetic Tape Recorders; Digital Recorders of Memory type; Data Displays-Analog and Digital types.

Text/References Books:

1. Electronic Measurements and Instrumentation, K. Lal Kishore, Pearson Education Publications
2. Electronic Instrumentation, H. S. Kalsi-TMH Publications

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3. Albert D Helfrick and William D Cooper; Modern Electronic Instrumentation and Measurement Techniques; 2004, PHI
4. BC Nakra, and Chaudhry; Instrumentation, Measurement and Analysis; 2004, Tata McGrawHill.
5. DVS Murthy; Transducers and Instrumentation; 2003, PHI.
6. CS Rangan, GR Sarma, and VSV Mani; Instrumentation Devices and Systems; Tata McGraw-Hill
7. Doeblin and Ernest; Measurement Systems Application and Design; 2004, Tata McGraw-Hill.
8. Tilak Thakur — Mechatronics I Oxford University Press 2016

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BTEEOE605D Lightning Interaction with Power System 03 Credits

Unit 1: Lightning and Climate Change **7 Hours**

Lightning Phenomenon and Parameters for Engineering Applications, Lightning Return stroke models for electromagnetic field calculations, Lightning Interaction with Power Substations, Lightning Interaction with Power Transmission Lines

Unit 2: Lightning Interaction with Medium **7 Hours**

Voltage Overhead Power Distribution Systems, Flash collection rate, Effects of various parameters on lightning overvoltage, Lightning protection of MV systems, Lightning performance of overhead distribution lines, Lightning Interaction with Low-Voltage Overhead Power Distribution Networks, Typical configurations of LV networks, Lightning surges on LV power systems, Lightning protection of LV networks,

Unit 3: Lightning Protection of Structures and system inside of buildings **7 Hours**

Lightning currents, Lightning protection of buildings, Volume protected against direct lightning strike, Air-termination and down-conductor system, Earth-termination system, Lightning equipotential bonding, Separation distance, Currents and voltages on lines, Grid-like spatial shield, Smart Grid functions and technologies, Lightning and digital recording technology, Lightning protection of Smart Grid sensors..

Unit 4: Impact on Renewable Energy Systems **7 Hours**

Wind turbine components and overview of the lightning protection system, Lightning phenomenology and wind turbines, Lightning damage to wind turbines due to direct impacts, Lightning protection of wind turbine components, Overvoltages in wind farms, Solar energy: solar radiation, parameters, hourly and daily parameters, PV systems: off-grid and grid-connected, considerations of the grid connection, Internal and overvoltage lightning protection, External lightning protection

Unit 5: Measurement of Lightning Currents and Voltages **7 Hours**

Lightning current measurements, Measurement method of lightning voltage, Application of various lightning overvoltage sensors in power systems, Application of the FDTD Method to Lightning Studies, Fundamentals, Representations of lightning source, Applications, Software Tools for the Lightning Performance Assessment, FLASH program, Lightning-induced overvoltages–electromagnetic transients program.

Text/References Books:

1. Alexandre Piantini, —Lightning Interaction with Power Systems- volume 1, Institution of Engineering and Technology

2. Alexandre Piantini, —Lightning Interaction with Power Systems- volume 2, Institution of Engineering and Technology

3. Vernan Cooray. " Lightning Protection".Power and Energy services, IET.

BTEEL606 SWITCHGEAR AND PROTECTION LAB 01 CREDITS

Conduct any 8practicals from given list

1. To verify characteristics of Static Overcurrent Relay.
2. To verify the characteristics Static over Voltage Relay.
3. To verify the characteristics of IDMT Relay.
4. To verify the characteristics of Reverse Power Overcurrent Relay/ Negative Sequence Relay.
5. To demonstrate working of Distance Protection Scheme for long transmission line.
6. To demonstrate working of Differential Protection of Transformer and sketch the schematic diagram for protection scheme.
7. To demonstrate working of Differential Protection of Alternator and sketch the schematic diagram for protection scheme.
8. Identify the components of different types of circuit breakers with their specifications (through visits/ videos/models)
9. To verify the characteristics of MCB, ELCB and HRC fuses.

BTEEL 607 ELECTRICAL MACHINE DESIGN LAB 01 Credit

Conduct any eight practical from given list

1 Symbols used in Electrical Engineering

2 Design and assembly of Choke with design report.

3 Design and assembly of Starter with design report.

4 Design and layout of simplex lap winding (Detailed Drawing Sheet)

5 Design and layout of wave winding (Detailed Drawing Sheet)

6 Design and layout of ac lap winding (Detailed Drawing Sheet)

7 Design and assembly of transformer with design report. (Detailed Sheet for General Assembly of transformer)

8 Design and assembly of three phase induction Motor with design report.(Detailed Sheet for General Assembly of Induction Motor)

9 Complete any two drawings sheets with the help of Computer Aided Design Software like AUTOCAD)

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BTEEL608 CONTROL SYSTEM ENGINEERING LAB 01 Credit

Any Eight Experiments from the following list.

1. Write a program to obtain: i) pole, zero and gain values from a given transfer functionii)Transfer function model from pole, zero, gain values.
2. Write a program to determine of step & impulse response for a first order unity feedback system
3. Write a program to generate various standard test signals.
4. Write a program to plot the root locus for a given transfer function of the system using MATLAB.
5. Write a program to plot the Bode Plot for a given system using MATLAB.
6. Write a program to plot the Nyquist Plot for a given system using MATLAB.
7. Write a program to design Proportional, Proportional + Integral, Proportional+ Derivative and P-I-D Controller for second order system.
8. Write a program to determine of step & impulse response for a second order unity feedback system
9. Write a program to determine state space model from transfer function model & vice versa.
10. Write a program to determine state space model from transfer function model & vice versa

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Dr. Babasaheb Ambedkar Technological University
(Established as a University of Technology in the State of Maharashtra)
(under Maharashtra Act No. XXIX of 2014)
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COURSE STRUCTURE AND SYLLABUS

For

Final Year B. Tech. Electrical Engineering / Electrical Engineering (Electronics and Power)/ Electrical & Electronics Engg / Electrical & Power Engineering

With effect from the Academic Year 2020-2021(Final Year)

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Dr. Babasaheb Ambedkar Technological University, Lonere.

B.Tech (Electrical Engineering / Electrical Engineering (Electronics and Power)/ Electrical & Electronics Engg / Electrical & Power Engineering)

Curriculum for Semester VII [Final Year]

Sr. No.	Course Code	Type of Course	Course Title	Hours per week			Evaluation Scheme			Total Marks	Credits
				L	T	P	MSE	CA	ESE		
1	BTEEC701	PCC1	Power System Operation & Control	3	0	0	20	20	60	100	3
2	BTEEC702	PCC2	High Voltage Engineering	3	0	0	20	20	60	100	3
3	BTEEC703	PCC3	Electrical Drives	3	0	0	20	20	60	100	3
4	BTEEE704	PEC1	Elective-IX	3	0	0	20	20	60	100	3
5	BTEEE705	PEC2	Elective-X	3	0	0	20	20	60	100	3
6	BTEEL706	Lab	Power System Operation & Control Lab	0	0	2	--	30	20	50	1
7	BTEEL707	Lab	High Voltage Engineering Lab	0	0	2	--	30	20	50	1
8	BTEEL708	Lab	Electrical Drives Lab	0	0	2	--	30	20	50	1
9	BTEES709	Seminar	Seminar	0	0	2	--	30	20	50	1
10	BTEEP710	Project	Project Part-I	0	0	6	--	30	20	50	3
11	BTEEF711	–	Field Training /Internship/Industrial Training III	–	--	--	--	–	50	50	1
			Total	**15**	**0**	**14**	**100**	**250**	**450**	**800**	**23**

Elective-IX	Elective-X
A) Special Purpose Electrical Machines	A) Digital Signal Processing
B) Electrical Traction and Utilization	B) Energy Audit and Conservation
C) Engineering System Design and Optimization	C) Electrical Power Quality
D) Financial Management	D) HVDC Transmission and FACTS

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B.Tech (Electrical Engineering / Electrical Engineering (Electronics and Power)/ Electrical & Electronics Engg / Electrical & Power Engineering)

Curriculum for Semester VIII [Final Year]

Sr. No.	Course Code	Course Title	Hours per week			Evaluation Scheme			Total Marks	Credits
			L	T	P	MSE	CA	ESE		
	1.Power Management Integrated Circuits 2.DC Power Transmission Systems 3.High Power Multilevel Converters 4.Fuzzy Sets, Logic and Systems & Applications 5.The Joy of Computing using Python 6.Introduction to Industry 4.0 and Industrial Internet of Things 7.Entrepreneurship Essentials **# Student to opt any two subjects from above list**		3	0	0	20*	20*	60*	100	3
			3	0	0	20*	20*	60*	100	3
6	BTEEP803	Project - II	0	0	30	–	100	150	250	15
		Total	**6**	**0**	**30**	**40**	**240**	**270**	**450**	**21**

** Six months of Internship in the industry*

**Students doing project at institute will have to appear for CA/MSE/ESE*

** Student doing project at Industry will give NPTEL examination / Examination conducted byuniversity i.e. CA/MSE/ESE*

 # These subjects are to be studied on self –study mode using SWAYAM/NPTEL/Any other source

 # Teacher who work as a facilitator for the course should be allotted 3 hrs/week load.

 # Project Load: 2hrs/week/project.

Mapping of Courses with MOOCs Platform SWYAM / NPTEL

S.N.	Course Name	Duration	Name of Professor	Institute offering Course
1	Power Management Integrated Circuits	12 Weeks	Prof. Qadeer Ahmad Khan	IITM
2	DC Power Transmission Systems	12 Weeks	Prof. Krishna S	IITM
3	High Power Multilevel Converters	12 Weeks	Prof. Anandarup Das	IITD
4	Fuzzy Sets, Logic and Systems & Applications	12 Weeks	Prof. Nishchal Kumar Verma	IITK
5	The Joy of Computing using Python	12 Weeks	Prof. Sudarshan Iyengar Prof. Yayati Gupta	IIT Ropar
6	Introduction to Industry 4.0 and Industrial Internet of Things	12 Weeks	Prof. Sudip Misra	IIT KGP
7	Entrepreneurship Essentials	12 Weeks	Prof. Manoj Kumar Mondal	IIT KGP

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BTEEC701: POWER SYSTEM OPERATION AND CONTROL	
Teaching Scheme:	Examination Scheme:
Theory: 3hr	Mid-term Test: 20 Marks
Tutorial: 0	Internal Assessment: 20 Marks
Total Credits: 3	End Term Exam: 60 Marks

Prerequisite:

1. Power System-II

Course Objectives:

1. To understand the fundamental concepts of power system.
2. To obtain mathematical model of Synchronous machine, excitation and speed governing system.
3. To analyze the transient stability of power system.
4. To understand the economic operation of power system.
5. To explain various techniques of reactive power and voltage Control

Course Outcome:

1. Explain the fundamental concept of power system.
2. Design the mathematical model of synchronous machine.
3. Design the mathematical model Excitation system and speed governing system.
4. Analyze the transient stability of power system using swing equation and equal area criteria.
5. Analyze the economic operation of power system.
6. Explain the methods of Voltage control.

UNIT I. FUNDAMENTALS OF POWER SYSTEM: (6hr)

Concepts of real and reactive powers, complex power, per-unit representation of power system, Transmission capacity, load characteristics, real power balance and its effect on system frequency, load frequency mechanism, reactive power, balance and its effect, on-load tap changing transformer and regulating transformer

UNIT II. SYNCHRONOUS MACHINE MODELLING (8hr)

Schematic diagram, Physical description: armature and field structure, machines with multiple pole pairs, MMF waveforms, direct and quadrature axes, Mathematical Description of a Synchronous Machine: Basic equations of a synchronous machine: stator circuit equations, stator self, stator mutual and stator to rotor mutual inductances, dq0 Transformation: flux linkage and voltage equations for stator and rotor in dq0 coordinates, electrical power and torque, physical interpretation of dq0 transformation

UNIT III. MODELLING OF EXCITATION AND SPEED GOVERNING SYSTEM (8hr)

Elements of an Excitation System; Types of Excitation System; Control and protective functions; Functional Block Diagram of Power Generation and Control, Schematic of a hydroelectric plant, classical transfer function of a hydraulic turbine, special characteristic of hydraulic turbine, electrical analogue of hydraulic turbine, Governor for Hydraulic Turbine: Requirement for a transient droop, Block diagram of governor with transient droop compensation, Steam turbine modelling: Single reheat tandem compounded type and cross compound type.

UNIT IV. TRANSIENT STABILITY: **(6hr)**

Solution of Swing equation using classical model, application of equal area creation on point by point solution

UNIT V. ECONOMIC OPERATION OF POWER SYSTEM: **(6hr)**

Distribution of load between units within a plant, transmission loss as function of plant generation, calculation of loss-coefficient, distribution of loads between plants with special reference to steam and hydro plants, automatic load dispatching, Unit commitment, constraints on unit commitment – spinning reserve, thermal and hydro constraints, methods of unit commitment – priority list and dynamic programming.

UNIT VI. REACTIVE POWER AND VOLTAGE CONTROL: **(6hr)**

Production and absorption of reactive power- Methods of Voltage Control – Shunt reactors – Shunt Capacitors – Series Capacitors – Synchronous condensers – Static Var systems – Principles of Transmission system compensation – Modeling of reactive compensating devices

Reference Books:

1. P. Kundur, "Power System Stability and Control", McGraw-Hill, 1993.
2. Gross C. A., 'Power System Analysis' McGraw Hill
3. Arrilaga J., 'Computerised Power system Analysis' McGraw Hill
4. Foud Anderson, 'Power system control dynamics' McGraw Hill
5. Kaushik, 'Computerised Power system Analysis' McGraw Hill
6. Padiyar K. R., 'Power system dynamics, ' New Age International

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BTEEC702: HIGH VOLTAGE ENGINEERING	
Teaching Scheme:	Examination Scheme:
Theory: 3hr	Mid-term Test: 20 Marks
Tutorial: 0	Internal Assessment: 20 Marks
Total Credits: 3	End Term Exam: 60 Marks

Pre-requisite: Electrical Engineering Materials,Power systems I, Power Systems II

Course Objectives:

1. To study conduction and breakdown in gases, liquids and solids.
2. To understand the methods and measurement of high voltage generation and measurement
3. To explain the lightening phenomenon and insulation co-ordination.
4. To know different non-destructive testing and standards in HV.

Course Outcomes:

1. Illustrate the concept of electric field stresses, applications of insulating materials and methods for Non-destructive testing of equipment like transformers, insulators, isolators, bushings, lightning arrestors, cables, circuit breakers and surge diverters.
2. Explain the breakdown process in solid, liquid, and gaseous materials
3. Analyze methods for generation and measurement of High Voltages and Currents (both ac and dc)
4. Describe the phenomenon of over-voltage and choose appropriate insulation co-ordination levels based on IS & IEC Standards.

UNIT I: INTRODUCTION TO HIGH VOLTAGE ENGINEERING (2hr)

Electric Field Stresses,Poisson's equation, Estimation and Control of Electric Stress, Surge Voltages, their distribution and control.

UNIT II:CONDUCTION & BREAKDOWN IN GASES: (6hr)

Gases as insulation media, ionization processes, Townsend's current growth equation, current growth in presence of secondary processes, Townsend's criterion for breakdown in electronegative gases, time lags for breakdown, Streamers theory, Paschen's law, breakdown in non-uniform fields and corona discharge, corona under positive & negative polarities, glow & arc discharge, considerations in using gases for insulation purpose.

UNIT III: BREAKDOWN IN DIELECTRIC MATERIALS: (8hr)

Conduction & breakdown in liquid dielectrics: Pure and commercial liquids, breakdown in pure and commercial liquids, theories of breakdown in liquids. Breakdown in solid dielectrics: Intrinsic, electromechanical& thermal breakdown, chemical, electrochemical deterioration, treeing, tracking, internal discharges, breakdown in composite insulation, properties of solid insulators & other materials used in practice. Insulating materials: In power transformers, rotating machines, circuit breakers, cables, power capacitors & other equipment.

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UNIT IV: OVER VOLTAGE DUE TO LIGHTENING PHENOMENON: **(8hr)**

Natural causes for over voltages – Lightning phenomenon, Overvoltage due to switching surges, system faults and other abnormal conditions, propagation of lightning voltage & current waves on transmission lines, reflection & transmission of traveling wave at junction, system control of over voltage due to switching protection of transmission lines against over voltage. Insulation co-ordination, surge diverters, equipment insulation level & co-ordination of substations.

UNIT V:GENERATION & MEASUREMENT OF HIGH VOLTAGES & CURRENTS: (10hr)

Generation of a) high d. c voltage b) power frequency high alternating voltage c) high frequency a. c. d) impulse voltages Standard impulse waves shapes and it's equation, multistage impulse generator, matrix circuit, generation of switching surges, tripping & control of impulse generators, generation of impulse currents.

Measurement of High Direct Current voltages, Abraham Voltmeter Measurement of High Voltages alternating and impulse, Measurement of High Currents-direct, alternating and Impulse, Oscilloscope for impulse voltage and current measurements

UNIT VI:NON DESTRUCTIVE TESTING: **(6hr)**

I.E.C. & IS codes for high voltage tests on electrical appliances & power apparatus &electrical motors, non- destructive testing, testing of insulators, bushings, isolators, circuit breakers, cables, transformers, surge diverter, layout of high voltage laboratories & test facilities.

Reference Books:

1) High Voltage Engineering: Fundamentals by E.Kuffel, W.S.Zaengl, J.Kuffel by Elsevier, 2nd Edition
2) High Voltage Insulation Engineering by Ravindra Arora, Wolfgang Mosch, New Age International (P) Limited, 1995.
3) High Voltage Engineering, Theory and Practice by Mazen Abdel Salam, Hussein Anis, Ahdan El-Morshedy, RoshdyRadwan, Marcel Dekker

Text Books:

1. Kamaraju V. & Naidu M. S., 'High Voltage Engineering', Tata-McGraw Hill
2. C. L. Wadhwa, "High Voltage Engineering", New Age International Pvt. Ltd

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BTEEC703: ELECTRICAL DRIVES	
Teaching Scheme:	Examination Scheme:
Theory: 3hr	Mid-term Test: 20 Marks
Tutorial: 0	Internal Assessment: 20 Marks
Total Credits: 3	End Term Exam: 60 Marks

Pre requisite :Electrical machine-II, Power Electronics

Course objective :

Students will be able to understand the dynamics of drive system.
Students will be able to use various methods of speed control of AC and DC Drive.
Students will be have the ability to analyze the drive system
Students will be able to select proficiently and the proper drive system for particular application.
Students will be able to have basic knowledge of recent advancement in Electric Drive.

Course outcomes:

Analyze the dynamics of Electrical Drives system.
Use various control techniques for controlling the speed of AC and DC motors.
Analyze the AC and DC drives.
To Select/recommend the appropriate Drive according to the particular applications.
State the recent technology of AC and DC drive

UNIT I: . INTRODUCTION

(8hr)

Advantages of Electrical Drives, Parts of Electrical drive, Choice of Electric drives Dynamics of Electrical drives: fundamental torque equations, multiquadrant operation, nature and classification of load torques, steady state stability, concept of load equalization in drives

UNIT II. .CONTROL OF ELECTRICAL DRIVES

(6hr)

Modes of operation: Steady state, Acceleration, Deceleration, Drive classification. Closed loop control of drives : Current limit control, torque control, speed control, position control, Control of multi motor drives, speed sensing, current sensing, Classes of motor duty & criteria for selection of motor.

UNIT III. DC MOTOR DRIVES

(7hr)

Review of basic characteristics of DC motors, Single phase drives : Single phase half wave converter drives, semi converter drives, Full converter drives, Dual converter drives. Three phase drives : Three phase half wave drives, semi-converter drives, full converter drives, dual-converter drives,

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DC-DC converter drives: Principle of Rheostatic and regenerative braking control, combined control, two and four quadrant DC-DC converter fed drives. Introduction to closed loop control of DC drives.

UNIT IV: INDUCTION MOTOR DRIVES **(7hr)**

Review of starting, braking and speed control of three phase induction motors, Stator voltage control, Rotor voltage control, frequency control, Voltage and frequency control, Current control, Closed loop control of Induction motors, Principle of Scalar and Vector control of Induction motor, Multiquadrant operation of induction motor drives fed from Voltage Source Inverters. Static rotor resistance control method, static slip power recovery control-Static Scherbius drive and StaticKramer drive.

UNIT V: SYNCHRONOUS MOTOR DRIVES **(6hr)**

Review of starting, pull in and braking of Synchronous motor,Static variable frequency control for Synchronous motors,Load commutated inverter fed Synchronous motor drive, Introduction to closed loop control of Load commutated inverter fed Synchronous motor drive.

UNIT VI: DRIVES FOR SPECIFIC APPLICATIONS **(6hr)**

Textile Mill: various stages and drive requirements control of ac motors for controlling torque. Steel Rolling Mill : reversing and continuous hot and cold rolling mills, Drive requirements, motors for mill drive. Cement mill : Stages in cement production, requirements of mill motors, Kiln drives, crusher drives, fan/blower drives, compressor drive. Sugar Mill : Requirements for various drive motors, selection of motors for various processes

Ref Books:

1. Dubey G. K., "Fundamentals of Electrical Drives", Narosa Publishing house
2. De N. K., Sen P. K., "Electric Drives", Prentice Hall of India
3. VedamSubramanyam, "Electrical Drives and Control", TMH Publications

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BTEEE704A: SPECIAL PURPOSE ELECTRICAL MACHINES	
Teaching Scheme:	Examination Scheme:
Theory: 3hr	Mid-term Test: 20 Marks
Tutorial: 0	Internal Assessment: 20 Marks
Total Credits: 3	End Term Exam: 60 Marks

Prerequisite:

AC Machines and DC Machines

Course Objectives:

To impart knowledge on Construction, principle of operation and performance of synchronous reluctance motors, stepping motors, switched reluctance motors, Permanent magnet brushless D.C. motors , Permanent magnet synchronous motors.

Course Outcome:

After Completion of this Course, student will be able

1. Demonstrate construction, working principle, and application of various types of special purpose electrical machines
2. Select a special Machine for a particular application
3. Demonstrate behaviour of induction generator and induction machine.

UNIT I. SYNCHRONOUS RELUCTANCE MOTORS **(6hr)**

Constructional features , Types – Axial and radial air gap motors – Operating principle – Reluctance – Phasor diagram - Characteristics – Vernier motor.

UNIT II. STEPPING MOTORS **(6hr)**

Constructional features – Principle of operation – Variable reluctance motor – Hybrid motor – Single and multi stack configurations – Theory of torque predictions – Linear and non-linear analysis – Characteristics – Drive circuits.

UNIT III. SWITCHED RELUCTANCE MOTORS **(6hr)**

Constructional features – Principle of operation – Torque prediction – Power controllers – Non-linear analysis – Microprocessor based control - Characteristics – Computer control.

UNIT IV. PERMANENT MAGNET BRUSHLESS D.C. MOTORS **(8hr)**

Principle of operation – Types – Magnetic circuit analysis – EMF and torque equations – Power controllers – Motor characteristics and control.

UNIT V. PERMANENT MAGNET SYNCHRONOUS MOTORS **(8hr)**

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Principle of operation – EMF and torque equations – Reactance – Phasor diagram – Power controllers - Converter - Volt-ampere requirements – Torque speed characteristics - Microprocessor based control.

UNIT VI. INDUCTION MACHINES **(6hr)**

Induction generator–self excitation requirement – voltage regulation – different methods of voltage control –doubly fed induction machine – generation operating mode– linear Induction Motor

Text Books:

1. K.Venkataratnam, Special Electrical Machines, Universities Press (India) Private Limited, 2008.
2. T. Kenjo, Stepping Motors and Their Microprocessor Controls, Clarendon Press London, 1984
3. E.G. Janardanan, Special electrical machines, PHI learning Private Limited, Delhi, 2014.

References:

1. R.Krishnan, Switched Reluctance Motor Drives – Modeling, Simulation, Analysis, Design and Application, CRC Press, New York, 2001.
2. T. Kenjo and S. Nagamori, Permanent Magnet and Brushless DC Motors, Clarendon Press, London, 1988.
3. T.J.E.Miller,Brushless Permanent-Magnet and Reluctance Motor Drives, Oxford University Press, 1989.
4. R.Srinivasan, Special Electrical Machines, Lakshmi Publications, 2013.

BTEEE704B: ELECTRIC TRACTION & UTILIZATION	
Teaching Scheme:	Examination Scheme:
Theory: 3hr	Mid-term Test: 20 Marks
Tutorial:	Internal Assessment: 20 Marks
Total Credits:3	End Term Exam: 60 Marks

Prerequisite:

- Basics of Electrical Engineering and Electrical Machine-II.

Course Objectives:

1. To possess knowledge of advanced and emerging topics in traction mechanism and illumination engineering and their applications in the field.
2. An ability to design a traction system, a component, to meet desired needs of locomotive industry within realistic constraints and confirms manufacturability, and sustainability.
3. To mold students professionally to possess in-depth and advanced knowledge by course contents along with emerging topics.

Course Outcomes:

After Completion of this Course, student will be able to

1. Identify types of Traction System.
2. Interprete Various Power supply in Electric Traction.
3. Analyze Various Traction Motors.
4. Define methods of Traction motor Control.
5. Elobrate Train movement & Breaking in Traction system.
6. Classify the indoor and outdoor Illumination system.

UNIT I: ELECTRIC TRACTION SYSTEM: **(8hr)**

Electrical transmission: Electrical transmission system employing D.C. generator D.C. series motor, Electrical transmission system employing 3 phase alternator supplying D.C. traction motors, electrical transmission employing 3 phase alternator supplying induction motors, Choice of traction system-battery drive, hybrid drive, flywheel drive, tramways, trolley bus. Track electrification: D.C. System, single phase low frequency A.C. system, single phase high frequency A.C. system, 3 phase A.C. system and composite system.

UNIT II: POWER SUPPLY FOR ELECTRIC TRACTION: **(6hr)**

Current collection system, current collectors for Over Head Systems, Overhead construction for Tramways and trolley buses and railways, Sag and Tension calculation for a trolley wire, Traction substations, location of substations, feeding and distributing system, substation

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equipment's. Block Diagram of AC Electric locomotive, Signaling interference in tele-communication circuits.

UNIT III: TRACTION MOTORS: **(6hr)**

Characteristics of traction motors, straight D.C. series motor, suitability of series motor for traction duty, constructional details of D.C. Traction Motors, Series motor using undulating D.C, suitability of shunt motor for traction duty, single phase series motors, Repulsion motor, compensated repulsion motor, Induction motor with variable frequency with SCR, Linear Induction motor.

UNIT IV: TRACTION CONTROL: **(6hr)**

Traction control: Duty cycle, Methods of traction motor control, series-Parallel and other types of controllers, use of interlocks, run back prevented, multiple unit control, Master controllers, Reverses, Dead man's handle, use of Metaldyne and Megavolt.

UNIT V: TRAIN MOVEMENT AND BRAKING: **(8hr)**

Speed time curve, its analysis and construction, schedule speed and factors affecting it, train resistance and its components. Tractive effort calculations, average acceleration and speed, energy output and consumption.

Braking: Mechanical versus electric breaking, rheostatic braking, Regenerative braking, method and energy saved in the process, Magnetic track brakes.

UNIT VI: ILLUMINATION: **(6hr)**

Requirement of good lighting, Classification of light fitting & luminaries, factors to be considered for design of indoor & outdoor lighting scheme, Design Procedure for factory lighting, street lighting.

Reference Books:

1) Utilization of Electrical Power and Electic Traction by J.B. Gupta. (Katson Book publisher)
2) H. Partab: Modern Electric Traction, Dhanpat Rai & sons.
3) Upadhayay J. & Mahindra S.N., Electric Traction, Allied Publishers Ltd., 1st Ed.
4) Rao P.S., Principle of 25 KV Overhead Equipments. R. (Nasik) Printpack Pvt Ltd,, 1st Ed.
5) Electric Traction for Railway Trains, by Edward P. Burch. McGraw Hill Book Co. Inc.
6) C.L.Wadhwa, "Generation, Distribution and Utilization of Electrical Energy", New Age International Publishers.

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BTEEE704C: ENGINEERING SYSTEM DESIGN OPTIMIZATION	
Teaching Scheme:	Examination Scheme:
Theory: 3hr	Mid-term Test: 20 Marks
Tutorial:	Internal Assessment: 20 Marks
Total Credits: 3	End Term Exam: 60 Marks

Pre requisite: Linear Algebra, Non-linear Problems

Course Outcome:

1. To understand different level optimization problem formulation.
2. To study novel methods in optimization.
3. To understand and develop genetic algorithm for engineering problems.

UNIT I: INTRODUCTION (8hr)

Introduction to Optimization problem formulation, optimization algorithms, applications and examples, different optimization methods available

UNIT II: SINGLE VARIABLE OPTIMIZATION (6hr)

Optimization criteria, bracketing methods– Exhaustive search method, bound phase method, Region Elimination methods– Fibonacci search method, Golden search method, Gradient based methods– Newton Raphson method, Bisection method, Root finding using optimization technique

UNIT III: MULTI OBJECTIVE OPTIMIZATION (6hr)

Optimization criteria, Different search methods, Unidirectional search, Direct search method – Evolutionary optimization method, Powell's conjugate direction method, Gradient based methods– Newton's method and Variable metric method.

UNIT IV: SPECIALIZED METHODS (6hr)

Integer programming, Geometric programming, simulated annealing, Global optimization using - steep descent method, simulated annealing.

UNIT V: GENETIC ALGORITHMS AND EVOLUTIONARY APPROACHES (6hr)

Differences and similarities between genetic algorithms and traditional techniques, operators of GA's, Computer program for simulated annealing, Newton Raphson method, Evolutionary optimization method.

References

1. Kalyanmoy Deb, "Optimization for Engineering design", Prentice Hall,India, 2005.
2. Kalyanmoy Deb, "Multi objective optimization using Evolutionaryalgorithms", John Wiley,2001

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BTEEE704D: FINANCIAL MANAGEMENT	
Teaching Scheme:	Examination Scheme:
Theory: 3hr	Mid-term Test: 20 Marks
Tutorial:	Internal Assessment: 20 Marks
Total Credits:3	End Term Exam: 60 Marks

Course Objectives:

• To help the students to develop cognizance of the importance of Financial Management in corporate valuation

• To enable students to describe how people analyze the corporate leverage under different conditions and understand why people valuate different corporates in different manner.

• To provide the students to analyze specific characteristics of Supply Chain Industry and their future action for cash flow

• To enable students to synthesize related information and evaluate options for most logical and optimal solution such that they would be able to predict and control Debt Equity incurrence and improve results.

Course Outcomes: At the end of this course students will demonstrate the ability to

1. The students would be able to understand and define basic terminology used in finance and accounts
2. The students would be able to prepare& appraise Financial Statements and evaluate a company in the light of different measurement systems.
3. The students would be able to analyze the risk and return of alternative sources of financing.
4. Estimate cash flows from a project, including operating, net working capital, and capital spending.
5. To estimate the required return on projects of differing risk ,to estimate the cash flows from an investment project, calculate the appropriate discount rate, determine the value added from the project, and make a recommendation to accept or reject the project
6. To describe and illustrate the important elements in project finance Using financial calculator and Excel in a variety of problems.

UNIT I: INTRODUCTION

Introduction to Financial Accounting, Book keeping & Recording: Meaning, Scope and importance of Financial Accounting. Financial Accounting - concepts and conventions, classification of accounts, Rules and principles governing Double Entry Book-keeping system, Meaning, Preparation of Journal, Ledger , Cash book & Trial balance.

UNIT II: FINANCIAL STATEMENT PREPARATION, ANALYSIS & INTERPRETATION

Preparation of financial statement and Profit & Loss Account, Balance Sheet. , Ratio Analysis - classification of various ratios.

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UNIT III: INTRODUCTION TO FINANCIAL MANAGEMENT

Concept of business finance, Goals & objectives of financial management, Sources of financing, Long Term financing- shares, debentures, term loans, lease & hire purchase, retained earnings, public deposits, bonds (Types, features & utility). Short Term Financing- bank finance, commercial paper, trade credit

UNIT IV: WORKING CAPITAL MANAGEMENT

Concept of working Capital, significance, types. Adequacy of working capital, Factors affecting working capital needs, financing approaches for working capital, Methods of forecasting working capital requirements, Methods of Forecasting.

UNIT V: TIME VALUE OF MONEY & CAPITAL BUDGETING

Concept of time value of money, Compounding & discounting; Future value of single amount & annuity, present value of single amount & annuity; Practical application of time value technique. Capital budgeting - Nature and significance, techniques of capital budgeting –Pay Back Method, Accounting rate of return, Internal Rate of Return, DCF, Net Present Value and profitability index.

UNIT VI: PROJECT FINANCING

Details of the company, its promoters and project finances required, profitability etc., Loan documentation-Appraisal of terms loans by financial institutions. Basic components of project finance.

TEXT & REFERENCE BOOKS:

1. Financial Management by Khan & Jain, Text, Problem & Cases, Tata McGraw Hill Publication 5th Edition.
2. Tulsian Financial Management by Dr. P.C.Tulsian, S Chand Publication 5th Edition.
3. Taxman's Financial Management by Ravi M. Kishore, Taxmann 2017 Edition.
4. A Textbook of Financial , Cost & Management Accounting by Dr.P.Pariasamy, Himalaya Publishing House
5. Fundamentals of financial Management by Bhabhtosh Banerjee, PHI publication, 2nd Edition.

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BTEEE705A: DIGITAL SIGNAL PROCESSING	
Teaching Scheme:	Examination Scheme:
Theory: 3hr	Mid-term Test: 20 Marks
Tutorial:	Internal Assessment: 20 Marks
Total Credits:3	End Term Exam: 60 Marks

Prerequisite:

Digital Systems, Interfacing, Z-Transform, Fourier Transform

Course Objectives:

To understand the design and implementation of digital Signal processing systems

Course Outcomes:

After Completion of this Course, student will be able to

1. Represent signals, systems and digital processing of analog signals.
2. Represent discrete time signals, systems and analysis of Discrete-Time Linear Time-Invariant Systems.
3. Apply digital signal processing techniques to analyze discrete time signals in time domain.
4. Apply digital signal processing techniques to analyze discrete time signals in frequency domain.
5. Design different filter structure
6. Validate system functionality and evaluate results.

UNIT I: INTRODUCTION TO DIGITAL SIGNAL PROCESSING **(8 hr)**

Signals, Systems and Signal Processing: Basic Elements of a Digital Signal Processing System, Advantages of Digital over Analog Signal Processing.

Classification of Signals: Multichannel and Multidimensional Signals, Continuous-Time versus Discrete-Time Signals, Continuous-Valued Versus Discrete-Valued Signals, Deterministic Versus Random Signals.

The Concept of Frequency in Continuous-Time and Discrete-Time Signals: Continuous-Time Sinusoidal Signals, Discrete-Time Sinusoidal Signals, Harmonically Related Complex Exponentials.

Analog-to-Digital and Digital-to-Analog Conversion: Sampling of Analog Signals, the Sampling Theorem, Quantization of Continuous-Amplitude Signals, Quantization of Sinusoidal Signals, Coding of Quantized Samples, Digital-to-Analog Conversion, Analysis of Digital Signals and Systems versus Discrete-Time Signals and Systems.

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UNIT II: DISCRETE-TIME SIGNALS AND SYSTEMS **(8 hr)**

Discrete-Time Signals: Some Elementary Discrete-Time Signals, Classification of Discrete-Time Signals, Simple Manipulations of Discrete-Time Signals.

Discrete-Time Systems: Input-Output Description of Systems, Block Diagram Representation of Discrete-Time Systems, Classification of Discrete-Time Systems, Interconnection of Discrete-Time Systems.

Analysis of Discrete-Time Linear Time-Invariant Systems: Techniques for the Analysis of Linear Systems, Resolution of a Discrete-Time Signal into Impulses, Response of LTI Systems to Arbitrary Inputs: The Convolution Sum, Properties of Convolution and the Interconnection of LTI Systems, Causal Linear Time-Invariant Systems, Stability of Linear Time-Invariant Systems, Systems with Finite-Duration and infinite-Duration Impulse Response.

Discrete-Time Systems Described by Difference Equations: Recursive and Nonrecursive Discrete-Time Systems, Linear Time-Invariant Systems Characterized by Constant-Coefficient Difference Equations, Solution of Linear Constant-Coefficient Difference Equations, The Impulse Response of a Linear Time-Invariant Recursive System

UNIT III: Z-TRANSFORM AND ITS APPLICATION TO THE ANALYSIS OF LTI SYSTEMS **(6 hr)**

Z-Transform: Direct z-Transform, Inverse z-Transform. Properties of z-transform. Rational z-Transforms: Poles and Zeros. Pole Location and Time-Domain Behavior for Causal Signals, System Function of a Linear Time-Invariant System. Inversion of the z-Transform: Inverse z-Transform by Contour Integration, Inverse z-Transform by Power Series Expansion, Inverse z-Transform by Partial-Fraction Expansion, Decomposition of Rational z-Transforms, One-sided z-Transform: Definition and Properties, Solution of Difference Equations.

UNIT IV: FREQUENCY ANALYSIS OF SIGNALS AND SYSTEMS **(4 hr)**

Properties of the Fourier Transform for Discrete-Time Signals: Symmetry Properties of the Fourier Transform, Fourier Transform Theorems and Properties.

UNITV:DISCRETE FOURIER TRANSFORM: PROPERTIES AND APPLICATIONS (8 hr)

Frequency Domain Sampling: The Discrete Fourier Transform: Frequency-Domain Sampling and Reconstruction of Discrete-Time Signals, Discrete Fourier Transform (DFT), DFT as a Linear Transformation, Relationship of the DFT to Other Transforms. Properties of the DIT: Periodicity. Linearity and Symmetry Properties, Multiplication of Two DFTs and Circular Convolution, Additional DFT Properties.

UNIT VI: IMPLEMENTATION OF DISCRETE- TIME SYSTEMS **(6 hr)**

Structures for the Realization of Discrete-Time Systems. Structures for FIR Systems: Direct-Form Structure, Cascade-Form Structures, Frequency-Sampling Structures, Lattice Structure.

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Structures for IIR Systems: Direct-Form Structures, Signal Flow Graphs and Transposed Structures, Cascade-Form Structures, Parallel-Form Structures, Latticc and Lattice-Ladder Structures for IIR Systems.

Reference Book:

1) John G. Proakis, Dimitris G.Manolakis, "Digital Signal Processing".
2) Shalivahanan, Vallavaraj and Gnanapriya, "Digital Signal Processing"

Text Book:

1) N.G.Palan, "Digital Signal Processing"
2) Ramesh Babu, "Digital Signal Processing"
3) Alon V. Oppenhelm, "Digitsl Signal Processing", PHI Pub.
4) S.K.Mitra, "Digital Signal Processing", TMH Pub.

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BTEEE705B: ENERGY AUDIT AND CONSERVATION	
Teaching Scheme:	Examination Scheme:
Theory: 3hr	Mid-term Test: 20 Marks
Tutorial:	Internal Assessment: 20 Marks
Total Credits:3	End Term Exam: 60 Marks

Pre Requisite:

Basics of Electrical Machines, Power Plant Engineering

Course Objectives:

1. To understand the basic process involved in the energy audit and the terminologies associated in the process.
2. To be able to develop audit reports of any firm including large and small scale industries, residential and commercial establishments.
3. To select and comment on the appropriate method for the planning and monitoring of any energy conservation project.

Course Outcomes:

After Completion of this Course, student will be able

1. To recognize Global Environmental Issues and Role of Renewable & non-conventional energy sources
2. To estimate Energy efficiency opportunities in Thermal- Mechanical Systems and Electrical System.
3. To analyze Energy Conservation Proposals economically and prepare audit reports.

UNIT I: SOURCES OF ENERGY: **(6hr)**

Energy resources, Stored & running resources, Environmental Concerns – Global Warning , Depletion of Ozone layer, Kyoto Protocol, UNFCCC, CDM, Carbon Emissions, Role of Renewable Energy Sources

UNIT II: **(7hr)**

Energy Conservation Act 2001, Designated Consumers, Energy Policy, BEE and its role in Energy Conservation, Energy Audit – Need, Types , Methodology, Steps involved in Energy Audit, Energy Costs and Benchmarking , Measurements for Energy Audit, Energy Management Duties and Responsibilities.

UNIT III: THERMAL MECHANICAL SYSTEMS **(8hr)**

Boiler Efficiency by direct and indirect methods, Energy efficiency opportunities in boilers, HVAC, and refrigeration systems, compressed air systems, pumps, cooling towers, fans and blowers, Cogeneration – Need and Principle , Prime movers for cogeneration, Waste heat recovery systems – Recuperators, economizer heat recovery boilers.

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UNIT IV: ELECTRICAL SYSTEMS **(7hr)**

Utilities: Energy conservation in generation, transmission,distribution & utilization, Electrical billing , load management ,maximum demand control, APFC Panel , PF improvement and benefits , Energy Efficient motors and starter, lightning systems, Electronic Ballast

UNIT V: **(6hr)**

Planning, Implementation & monitoring of energy conservation project, Time Value of money, Financial Investment – Simple payback period, ROI (Return on Investment), Net Present value, Internal rate of return, profitability index. All calculations and numerical interpretation.

UNIT VI: **(6hr)**

Case studies on various industrial sectors like Steel Plant, Thermal Plant, Industries Building and Commercial Establishments and preparing audit reports

Text Books:

1. "Industrial Energy Conservation" Charles M Gottschalk ,John Willey and Sons
2. "Energy Management" Paul O Callagham, Tata Mc Grawhill
3. "Energy Technology" – S Rao and B Parulekar , Khanna Publisher

References:

1. "Energy Management Handbook" – Wayne C Turner

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BTEEE705C: ELECTRICAL POWER QUALITY	
Teaching Scheme:	Examination Scheme:
Theory: 3hr	Mid-term Test: 20 Marks
Tutorial:	Internal Assessment: 20 Marks
Total Credits:3	End Term Exam: 60 Marks

Prerequisite:

1. Basic Electrical concepts
2. Power Electronics concepts
3. Power system concepts

Course Objectives:

1. To study the various power quality issues, their production, monitoring and mitigation.
2. To study the various power quality standards.
3. To study various power quality monitoring methods.
4. To apply appropriate solution techniques for power quality Problems.

Course Outcome:

After Completion of this Course....

1. Student will be able to get the in-depth understanding of power quality issues & standards.
2. Students will be able to understand working of power quality improving Equipment's.

UNIT I: INTRODUCTION **(7hr)**

Understanding Power quality, definitions, growing concerns to Power Quality, Evaluation Procedure,General Classes of Power Qualitydisturbances, causes and effects of Power Quality disturbances

UNIT II: TRANSIENT OVER VOLTAGES **(7hr)**

Sources, causes and effects, Principle of Overvoltage protection and solutions. VoltageSag and Interruptions: causes and effects, estimation of voltage sag performance, principle ofprotection and solutions.

UNIT III: LONG-DURATION VOLTAGE VARIATIONS **(7hr)**

Long Duration Voltage variations, principles of regulating voltage Devices for voltage regulation, flickers, flicker sources and mitigation, quantifying flicker.

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UNIT IV: FUNDAMENTALS OF HARMONICS **(7hr)**

Harmonic distortion, sources of harmonics, effects of harmonic distortion, Voltage Vs Current Harmonics,Active, Reactive, Volt-Amp power under non sinusoidal conditions, Harmonic Indices (THD and TDD),principles of harmonic control, mitigating devices, interharmonics, IEEE standard 519.

UNIT V: WIRING AND GROUNDING **(4hr)**

Reasons for Grounding, wiring and grounding problems and solutions

UNIT VI: POWER QUALITY MONITORING **(7hr)**

Monitoring Considerations, site survey, Monitoring Quality, monitoring location, PQ measuringinstruments, assessment of power quality measurement data, IEEE 1159 Standard. Impact of poor power quality on Reliability Indices.

References/Books:

1.Chattopadhyay, Surajit, Mitra, Electric Power Quality, Springer.
2.Haytt G. T., —Electric Power Qualityl, Stars In Circle Publication.
3. NPTEL courses

a) NOC:Power Quality Improvement Technique, IIT Roorkee by Avik Bhattacharyya.
b) Power Quality in Power Distribution Systems, IIT Madras by Dr. Mahesh Kumar.

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BTEEE705D: HVDC TRANSMISSION AND FACTS	
Teaching Scheme:	Examination Scheme:
Theory: 3hr	Mid-term Test: 20 Marks
Tutorial:	Internal Assessment: 20 Marks
Total Credits: 3	End Term Exam: 60 Marks

Pre requisite: Power System-II, Power Electronics

Course Outcome:

1. To understand importance, configuration and types of HVDC transmission.
2. To analyst the operation of HVDC converter, system control and protection.
3. To understand the concept of FACTS, their role, type and functionality.
4. To analyze the operation of static series and shunt compensator.

UNIT I: DC POWER TRANSMISSION FUNDAMENTALS **(8hr)**

Introduction, Economics of Dc Power transmission, comparison with AC system, Types of DC links, major components of converter station, planning of HVDC system.

UNIT II: HVDC CONVERTER **(6hr)**

Choice of converter configuration, analysis of Gratz circuit with and without overlap, working of converter as rectifier and inverter, equivalent circuit for HVDC link

UNIT III: HVDC SYSTEM CONTROL **(6hr)**

HVDC System Control: Principles of DC link control, converter control characteristics, firing angle control, current and extinction angle control, Starting and stopping of HVDC link

UNIT IV: CONVERTER FAULTS AND PROTECTION **(6hr)**

Converter Faults and Protection: Types of faults-commutation failure, Arc through, Misfire, short circuit in bridge, Over current and over voltage protection, Detection of line faults, Principle of DC circuit interruption, DC breakers, Types and characteristics of DC breakers, effects of proximity of AC and DC transmission lines.

UNIT V: FACTS CONCEPT AND GENERAL SYSTEM CONSIDERATIONS **(6hr)**

Transmission Interconnections, Flow of Power in an AC System, Loading Capability limits, Power Flow and Dynamic Stability Considerations of a Transmission Interconnection, Relative Importance of Controllable Parameters, Basic types of FACTS Controllers, Description and Definitions of FACTS Controllers, Benefits from FACTS Technology, Comparison between HVDC & FACTS.

UNIT VI: STATIC SHUNT COMPENSATORS **(6hr)**

Static Shunt Compensators: Objective of shunt compensation, Methods of Controllable VAR Generation, Static VAR Compensators: SVC and STATCOM, Comparison of SVC and

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STATCOM, Static VAR Systems (SVS)Static Series Compensation: Objective of series compensation, Variable Impedance Type Series Compensators, Switching Converter Type Series Compensators

References

1. Padiyar K. R., "HVDC Power Transmission Systems", New Age International.
2. Kimbark, " HVDC Transmission", John Willey AndSons.
3. Hingorani N. G., " Understanding FACTS", IEEE Press2001
4. Yong Hua Song, ' Flexible AC transmission systems(FACTS)'IEEE

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BTEEL706: POWER SYSTEM OPERATION AND CONTROL LAB	
Teaching Scheme:	Examination Scheme:
Practical: 2hr	Continuous Assessment: 30 Marks
Total Credits: 1	End Term Exam: 20 Marks

Sr. No.	List of the Experiment
1	Write a program for economic dispatch in power systems using
2	Simulation of Automatic voltage regulator using MATLAB.
3	Write a program to compute the voltage and power factor for a given system using MATLAB.
4	Write a program to solve Swing Equation by Classical Method.
5	Write a program to plot power angle curve of synchronous machine using MATLAB.
6	Write a program to solve the given Equal Area Criteria problem using MATLAB.
7	To demonstrate the Excitation System for Synchronous machine using MATLAB
8	Simulation of single area load frequency control using MATLAB.

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BTEEL707: HIGH VOLTAGE ENGINEERING LAB	
Teaching Scheme:	Examination Scheme:
Practical: 2hr	Continuous Assessment: 30 Marks
Total Credits: 1	End Term Exam: 20 Marks

Sr. No.	List of Experiment
1	Study of Faraday Cage for HV labs.
2	Study of Standard HV Laboratory layouts.
3	One min. (1-min.) DC high voltage withstand test on Equipment. (Max. up to 10 KV).
4	Effect of gap length on liquid insulating material.
5	Breakdown Strength of composite dielectric material.
6	Study of impulse generator.
7	High voltage withstand test on cables/safety gloves/shoes, as per IS. (Max. 2.25 KV DC)
8	Horn gap arrangement as surge diverter.
9	Measurement audible and visible corona inception and extinction voltage
10	Development of tracks and trees on polymeric insulation.
11	Study of Effect of EHV field on Human, Animals & Plants.

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BTEEL708: ELECTRICAL DRIVES LAB	
Teaching Scheme:	Examination Scheme:
Practical: 2hr	Continuous Assessment: 30 Marks
Total Credits: 1	End Term Exam: 20 Marks

Pre requisite	Basic electronics engineering, basic electronics engineering Course
Course Outcome	• Efficiently use various AC and DC drive. • Simulate various drive system
Sr.No	List of Experiments
1	Study the ramp comparator firing circuit.
2	Study of single phase half wave converter and semi converter DC Drive .
3	Study of single phase full controlled converter (Bridge converter) DC Drive.
4	Speed control of DC motor using chopper.
5	Simulation of single phase half wave and semiconductor controlled DC drive.
6	Simulation of chopper fed DC Drive .
7	Study of AC Drive .
8	Study of V/f control of AC drive
9	Study the inverter fed induction motor drive.
10	Simulation of AC drive .

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BTEES709: SEMINAR	
Teaching Scheme:	Examination Scheme:
Practical: 2hr	Continuous Assessment: 30 Marks
Total Credits: 1	End Term Exam: 20 Marks

Student shall choose a topic of his/her interest in consultation with faculty in the department. The topic for seminar may be related to Recent Developments in Instrumentation Engineering area and/or interdisciplinary area. Student shall attempt to collect necessary information and present a summary indicating comprehension of the topic and acquired depth of knowledge. A brief report on topic of seminar shall be submitted. Evaluation shall be based on report and power point presentation.

BTEEP710: PROJECT PART-I	
Teaching Scheme:	Examination Scheme:
Practical: 6hr	Continuous Assessment: 30 Marks
Total Credits: 3	End Term Exam: 20 Marks

Term work shall consist of detailed report for chosen topic and output of final working proposed. Report shall summarize the literature survey, spell out the scope of work, methodology and results. Viva-voce Examination shall be based on work carried out by the student. In case of students opting for Internship in the eighth semester, the Project may be industry-based.

BTEEF711: FIELD TRAINING/INTERNSHIP/INDUSTRIAL TRAINING III	
Teaching Scheme:	Examination Scheme:
Practical: --	Continuous Assessment: --
Total Credits: 1	End Term Exam: 50 Marks

Students are expected to undergo industrial training for at least four weeks at factory / design offices or in combination of these after VI semester. Training session shall be guided and certified by qualified engineer / industry expert. A neat detailed report on activities carried out during training is expected. Students should undergo training in Summer Vacation after Semester VI and appear at examination in Semester VII. A brief report of industrial training shall be submitted. Evaluation shall be based on report and power point presentation.

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POWER MANAGEMENT INTEGRATED CIRCUITS	
Teaching Scheme:	Examination Scheme:
Theory: 3hr	Mid-term Test: 20* Marks
Total Credits: 3	Internal Assessment: 20* Marks
	End Term Exam: 60* Marks

Prof. Qadeer Ahmad Khan | IIT Madras
Course Duration: 12 weeks

CourseOutline:

This course is intended to develop understanding of why power management circuits are needed in a VLSI system, what are the different components of a power management system with focus on voltage regulators. By the end of this course, students should be able to understand the concept behind power management circuits and design a linear (LDO) and switching regulator (dc-dc converter) for a given specifications using behavioral and circuit level simulators.

Course Plan:

Week 1 : Introduction to Power Management - Application, Need, Discrete vs. Integrated PMIC; DC-DC Converters, Types of DC-DC Converters, Linear versus Switching Regulator, Choosing between Linear and Switching Regulators, Choosing the Type of Regulator in a Multi-Chip System; Performance Parameters - Efficiency, Accuracy, Line and Load Regulation, Line and Load Transient, PSRR; Remote versus Local Feedback, Point-of-Load Regulator, Kelvin Sensing, Droop Compensation; Current Regulators and their Applications; Bandgap Voltage Reference - Designing a Bandgap Reference using PTAT and CTAT Voltage References, Brokaw Bandgap Circuit.

Week 2: Sub-1-volt Bandgap Reference; Introduction to Linear Regulator, Applications of Linear Regulator; Review of Feedback Systems and Bode Plots, Loop Gain AC Analysis, Stability Criterion and Phase Margin, Review of First-Order and Second-Order Systems, Relationship between Damping Factor and Phase Margin; Parasitic Capacitances in a MOS transistor, Finding the Poles of the Error Amplifier; Stabilising a Linear Regulator - Frequency Compensation Techniques, Dominant Pole Compensation.

Week 3 : Miller Compensation, R.H.P. zero due to Miller Compensation, Intuitive Methods of Determining Poles and Zeros after Miller Compensation, Pole Splitting due to Miller Compensation, Reducing the Effect of R.H.P. zero; LDO with NMOS Pass Element; Load Regulation and Output Impedance of LDO; Line Regulation and PSRR of LDO; Sources of Error in a Regulator, Static Offset Correction, Dynamic Offset Cancellation.

Week 4 : Digital LDO, Avoidance of Limit-Cycle Oscillations in a Digital LDO, Hybrid LDO; Short-Circuit Protection and Foldback Current Limit in an LDO; Basic Concept of a Switching Regulator, Inductor volt-second Balance, Power Stage of a Buck Converter and Calculation of Duty Cycle; Transformer Model of a Buck Converter, Resistive Losses, Efficiency of a Switching Regulator, Efficiency considering only Conduction Losses; Synchronous and Non-Synchronous Switching Converters; PWM Control Techniques (Voltage-Mode and Current-

Mode Control); Losses in Switching DC-DC Converter- Conduction Loss, Gate-Driver Switching Loss, Segmented Power FETs, Dead-Time Switching Loss.

Week 5 : Hard Switching Loss, Magnetic Loss, Relative Significance of Losses as a Function of the Load Current; Inductor Current Ripple and Output Voltage Ripple in a DC-DC Converter, Ripple Voltage versus Duty Cycle, Ripple Voltage versus Input Supply Voltage; Choosing the Inductor and Capacitor of a Buck Converter; Continuous and Discontinuous Conduction Modes - Boundary Condition, Voltage Conversion Ratio in DCM; Concept of Pulse Frequency Modulation (PFM); Classification of Pulse Width Modulators -- Trailing, Leading and Dual-Edge PW Modulators; Control Techniques for DC-DC Converters; Voltage Mode Control, Small-Signal Modeling of a DC-DC Converter, Loop Gain and Stability Analysis using Continuous-Time Model.

Week 6 : Compensating a Voltage-Mode-Controlled Buck Converter; Designing Type-I (Integral), Type-II (PI) and Type-III (PID) Compensators; Implementation of Compensators using Op Amp-RC and Gm-C Architectures, Finding Compensation Parameters; Design Examples with Simulation Demonstrations.

Week 7 : Designing Type-III Compensator using Gm-C Architecture and Design Example; Ramp Generator with Feed-Forward Line Compensation, Loop Gain Compensation via Gm-modulation; Designing a Buck Converter - Power Loss Budgeting, Sizing of Power FETs, Estimation of Switching Losses and Choice of Switching Frequency, Choosing the External Passive Components (L and C); Choice of C in Relation to Factors that Limit the Load Transient Response; Inductor and Capacitor Characteristics, Reducing the Effect of Capacitor ESL.

Week 8 : Designing the Gate-Driver (Gate Buffer and Non-Overlap Clock Generator), Designing the Ramp Generator in a Pulse-Width Modulator, Design Considerations of the Error Amplifier; Delays Associated with Pulse-Width Modulators; PFM/PSM for Light Load, Using PSM in CCM to Avoid Duty Cycle Saturation; DCM Operation using an NFET; Designing a Zero-Cross Detector/Comparator; Introduction to Current Mode Control; Peak, Valley and Average CMC; Sub-Harmonic Oscillations, Avoiding Current Loop Instability via Slope Compensation in a Current-Mode-Controlled Buck Converter.

Week 9 : Non-Linear Control Techniques for DC-DC Converters; Hysteretic Control - Stability Issues due to Phase Shift between Inductor Current and Capacitor Voltage; Voltage-Mode versus Current-Mode Hysteretic Control, Stabilising a Voltage-Mode-Controlled Hysteretic Converter using R_esr, Relation between Hysteresis Window and Switching Frequency, Using R-C Circuit as Ripple Generator in a Current-Mode-Controlled Hysteretic Converter, Hybrid Voltage-Mode and Current-Mode Hysteretic Control, Fixed-Frequency Hysteretic Control, Effect of Loop Delay, Frequency-Regulation and Voltage-Regulation Loops in a Fixed-Frequency Hysteretic Converter; Constant ON/OFF-Time Control; Basic Concept of a Boost Converter, RHP zero in a Boost Converter.

Week 10 : Introduction to the Buck-Boost Converter, Tri-Mode Buck-Boost Converter, Boundary Conditions for Mode Transition in a Tri-Mode Buck-Boost Converter, Generation of Buck and Boost Duty Cycles; Introduction to Switched-Capacitor DC-DC Converters,

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Applications of SC DC-DC Converters in Open-Loop, Output Regulation in SC DC-DC Converters using Feedback Control, H-Bridge SC DC-DC Converter, Multiple Gain Settings in SC DC-DC Converters; Current-Sensing Techniques in DC-DC converters.

Week 11 : Selecting the Process Node for a PMIC, Chip-Level Layout and Placement Guidelines, Board-Level Layout Guidelines, EMI Considerations; Introduction to Advanced Topics in Power Management --- Digitally-Controlled DC-DC Converters, Adaptive Compensation Techniques, Limitations of Analogue and Digital Controllers, Time-Based Control Techniques and their Drawbacks, Multi-Phase DC-DC Converters; Dynamic Voltage and Frequency Scaling (DVFS); Single-Inductor Multiple-Output (SIMO) DC-DC Converters.

Week 12 : Introduction to Advanced Topics in Power Management (continued) - DC-DC Converters for LED Lighting, LCD/AMOLED Display Drivers, LED Drivers for Camera Flash, Lithium-ion Battery and its Charging Phases, Battery Charger ICs.

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DC POWER TRANSMISSION SYSTEM	
Teaching Scheme:	Examination Scheme:
Theory: 03	Mid-term Test: 20* Marks
Tutorial: 00	Internal Assessment: 20* Marks
Total Credits: 3	End Term Exam: 60* Marks

Prof. Krishna S, IIT Madras

Course Duration: 12 weeks

CourseOutline:

This course gives an introduction to the DC power transmission system using the conventional line commutated converters. The topics covered include a detailed analysis of the 6 pulse line commutated converter (LCC), 12 pulse LCC, capacitor commutated converter, DC link control, and design of single tuned filter.

Course Plan:

Week 1: Introduction, choice of converter configuration

Week 2: Converter configuration for pulse number equal to 6, analysis of 6 pulse LCC neglecting overlap

Week 3: Fourier series, analysis of 6 pulse LCC neglecting overlap

Week 4: 2 and 3 valve conduction mode of 6 pulse LCC

Week 5: Extinction angle, 3 and 4 valve conduction mode and 3 valve conduction mode of 6 pulse LCC

Week 6: Commutation margin angle, normalization, characteristics of 6 pulse LCC, steady state analysis of a general LCC

Week 7: 6 pulse LCC with other circuits on the AC and DC sides

Week 8: Capacitor commutated converter, 12 pulse LCC

Week 9: Mode of operation of 12 pulse LCC, purposes of transformer, applications of DC transmission, types of DC link, DC link control

Week 10: Converter control characteristics, MTDC systems, non-characteristic harmonics

Week 11: Design of single tuned filter

Week 12: Double tuned and damped filters, reactive power requirement, comparison of AC and DC transmission

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HIGH POWER MULTILEVEL CONVERTERS	
Teaching Scheme:	Examination Scheme:
Theory: 3hr	Mid-term Test: 20* Marks
Tutorial:	Internal Assessment: 20* Marks
Total Credits: 3	End Term Exam: 60* Marks

Prof. Anandarup Das, IIT Delhi

Course Duration: 12 weeks

CourseOutline:

The course covers different types of high power converters used in the industry for applications in HVDC, FACTS, Motor Drives, Power quality improvement. Traditional converters like NPC and emerging converters like modular multilevel converters will be covered. Operational issues and design considerations for these medium/high voltage high power converters will be covered. The course will discuss many practical issues faced in the industry while designing and operation of these converters.

Course Plan:

Week 1 : (a) Half bridge, Full bridge and three phase converters, sinusoidal PWM

Week 2 : (a) 3rd harmonic addition, space vector PWM

Week 3 : (a) Different types of multilevel converters
(b) Cascaded H-Bridge converter – Basic operation

Week 4 : (a)PWM Techniques for CHB converter
(b) Fault tolerant operation of CHB converter

Week 5 : (a) Modular Multilevel converter- Topology, operation and PWM

Week 6 : (a) Capacitor voltage balancing in MMC
(b) Design of components of MMC

Week 7 : (a) NPC converter – Basic operation
(b) NPC (3 level) Space vector diagram

Week 8 : NPC - PWM technique and midpoint balancing

Week 9 : (a) Case study of High Power converters for Motor drive and HVDC application

Week 10 : (a) Multi –pulse transformers

Week 11 : (a) Gate Drive circuit designing, protection and condition monitoring in high power converters

Week 12 : (a) Other topologies : conclusion

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FUZZY SETS, LOGIC AND SYSTEMS & APPLICATIONS	
Teaching Scheme:	**Examination Scheme:**
Theory: 3hr	Mid-term Test: 20* Marks
Tutorial:	Internal Assessment: 20* Marks
Total Credits: 3	End Term Exam: 60* Marks

Prof. Nishchal Kumar Verma, IIT Kanpur

Course Duration: 12 weeks

CourseOutline:

The course is designed to give a solid grounding of fundamental concepts of fuzzy logic and its applications. The level of the course is chosen to be such that all students aspiring to be a part of computational intelligence directly or indirectly in near future should get these concepts.

Course Plan:

Week 1 :Introduction and Fuzzy Sets Theory

Week 2: Membership Functions

Week 3: Set Theoretic Operations

Week 4: Fuzzy Arithmetic

Week 5: Fuzzy Relations

Week 6: Fuzzy Inference Systems I

Week 7: Fuzzy Inference Systems II

Week 8: Wang and Mendel Model

Week 9: TSK Model

Week 10:Fuzzifiers and Defuzzifiers

Week 11: ANFIS Architecture

Week 12: Fuzzy Systems and Machine Learning

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THE JOY OF COMPUTING USING PYTHON	
Teaching Scheme:	Examination Scheme:
Theory: 3hr	Mid-term Test: 20* Marks
Tutorial: 1hr	Internal Assessment: 20* Marks
Total Credits: 3	End Term Exam: 60* Marks

Prof.Sudarshan Iyengar, Department of Computer Science and Engineering, IIT Ropar

Course Duration: 12 weeks

CourseOutline:

ThisisamostfundamentalDigitalCircuitDesigncourseforpursingamajorinVLSI. We do not deal with any Verilog coding during this course and instead discuss transistor level circuit design concepts in greatdetail.

Learning objectives of this course are:

- Characterize the key delay quantities of a standardcell
- Evaluate power dissipated in a circuit (dynamic andleakage)
- Design a circuit to perform a certain functionality with specifiedspeed
- Identify the critical path of a combinationalcircuit
- Convert the combinational block to pipelinedcircuit
- Calculate the maximum (worst case) operating frequency of the designedcircuit

Course Plan:

Motivation for Computing
Variables and Expressions: Design your own calculator
Loops and Conditionals: Hopscotch once again
Lists, Tuples and Conditionals: Let's go on a trip
Abstraction Everywhere: Apps in your phone
Counting Candies: Crowd to the rescue
Birthday Paradox: Find your twin
Google Translate: Speak in any Language
Currency Converter: Count your foreign trip expenses
Monte Hall: 3 doors and a twist
Sorting: Arrange the books
Searching: Find in seconds
Substitution Cipher: What's the secret !!
Sentiment Analysis: Analyse your Facebook data
20 questions game: I can read your mind
Permutations: Jumbled Words
Spot the similarities: Dobble game
Count the words: Hundreds, Thousands or Millions.
Rock, Paper and Scissor: Cheating not allowed !!
Lie detector: No lies, only TRUTH

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Calculation of the Area: Don't measure.
Six degrees of separation: Meet your favourites
Image Processing: Fun with images
Tic tac toe: Let's play
Snakes and Ladders: Down the memory lane.
Recursion: Tower of Hanoi
Page Rank: How Google Works !!

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Department of Electrical Engieering
Dr. Babasaheb Ambedkar Technological University
Lonere, Raigad - 402103

INTRODUCTION TO INDUSTRY 4.0 AND INDUSTRIAL INTERNET OF THINGS	
Teaching Scheme:	**Examination Scheme:**
Theory: 3hr	Mid-term Test: 20* Marks
Tutorial:	Internal Assessment: 20* Marks
Total Credits: 3	End Term Exam: 60* Marks

Prof. SudipMisra, IIT Kharagpur

Course Duration: 12 weeks

CourseOutline:

Industry 4.0 concerns the transformation of industrial processes through the integration of modern technologies such as sensors, communication, and computational processing. Technologies such as Cyber Physical Systems (CPS), Internet of Things (IoT), Cloud Computing, Machine Learning, and Data Analytics are considered to be the different drivers necessary for the transformation. Industrial Internet of Things (IIoT) is an application of IoT in industries to modify the various existing industrial systems. IIoT links the automation system with enterprise, planning and product lifecycle.

Course Plan:

Week 1 :Introduction: Sensing & actuation, Communication-Part I, Part II, Networking-Part I, Part II

Week 2 : Industry 4.0: Globalization and Emerging Issues, The Fourth Revolution, LEAN Production Systems, Smart and Connected Business Perspective, Smart Factories

Week 3 : Industry 4.0: Cyber Physical Systems and Next Generation Sensors, Collaborative Platform and Product Lifecycle Management, Augmented Reality and Virtual Reality, Artifical Intelligence, Big Data and Advanced Analysis

Week 4 : Cybersecurity in Industry 4.0, Basics of Industrial IoT: Industrial Processes-Part I, Part II, Industrial Sensing & Actuation, Industrial Internet Systems.

Week 5 :IIoT-Introduction, Industrial IoT: Business Model and RefereceArchiterture: IIoT-Business Models-Part I, Part II, IIoT Reference Architecture-Part I, Part II.

Week 6 : Industrial IoT- Layers: IIoT Sensing-Part I, Part II, IIoT Processing-Part I, Part II, IIoT Communication-Part I.

Week 7 : Industrial IoT- Layers: IIoT Communication-Part II, Part III, IIoT Networking-Part I, Part II, Part III.

Week 8 : Industrial IoT: Big Data Analytics and Software Defined Networks: IIoT Analytics - Introduction, Machine Learning and Data Science - Part I, Part II, R and Julia Programming, Data Management with Hadoop.

Week 9 : Industrial IoT: Big Data Analytics and Software Defined Networks: SDN in IIoT-Part I, Part II, Data Center Networks, Industrial IoT: Security and Fog Computing: Cloud Computing in IIoT-Part I, Part II.

Week 10 : Industrial IoT: Security and Fog Computing - Fog Computing in IIoT, Security in IIoT-Part I, Part II, Industrial IoT- Application Domains: Factories and Assembly Line, Food Industry.

Week 11 : Industrial IoT- Application Domains: Healthcare, Power Plants, Inventory

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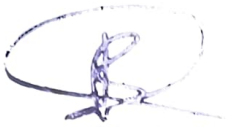
Management & Quality Control, Plant Safety and Security (Including AR and VR safety applications), Facility Management.

Week 12 : Industrial IoT- Application Domains: Oil, chemical and pharmaceutical industry, Applications of UAVs in Industries, Real case studies :

Case study - I : Milk Processing and Packaging Industries
Case study - II: Manufacturing Industries - Part I
Case study - III : Manufacturing Industries - Part II
Case study - IV : Student Projects - Part I
Case study - V : Student Projects - Part II
Case study - VI : Virtual Reality Lab
Case study - VII : Steel Technology Lab



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ENTREPRENEURSHIP ESSENTIALS	
Teaching Scheme:	Examination Scheme:
Theory: 3hr	Mid-term Test: 20* Marks
	Internal Assessment: 20* Marks
Total Credits: 3	End Term Exam: 60* Marks

Prof. Manoj Kumar Mondal, IITKharagpur

Course Duration: 12 weeks

CourseOutline:

The course provides foundational knowledge on various aspects of entrepreneurial venture creation and management during its life-cycle. It has been designed to address multidisciplinary audiences. The objective of the course is to teach key issues faced by entrepreneurs and managers at different stages of the life-cycle of an enterprise and is relevant both for aspiring entrepreneurs and for decision makers in established enterprises. Topics can be classified in some major themes such as : Making a choice to create an entrepreneurial venture, current trend of technology entrepreneurship, how to start a start-up, identifying opportunities, factors driving competitive advantages, organizational structure, basic knowledge of financial statements and project report,introductory knowledge on marketing management, human resource management, & strategic management, risk analysis, legal aspect of business, how to raise fund during life-cycle of a new ventures.

Course Plan:

Week 1 : Introduction
DhirubhaiAmbani& Sofia
Myths & Realities about entrepreneurship
entrepreneurial qualities
Why start-ups fail?

Week 2: Mission, vision, entrepreneurial qualities – I
Mission, vision, entrepreneurial qualities – II
Value proposition
Business Model canvas
Business model generation

Week 3: Competitive advantage
Lean start-up – 1
Lean start-up – 2
Team and early recruit
Legal forms of business

Week 4: Marketing management 1
Marketing management 2
Market research –I
Market research –II
Market research –Example

Week 5: Introduction to financial statements
Profit & Loss statement
Balance sheet

Cash flow
Example – 1
Example – 2
Cost-volume-profit & Bread-Even analysis
Capital budgeting

Week 6: Business plan-I
Business plan-II
Pitching
Go-to-market strategies
Does & Don'ts

Week 7: How to innovate
Design Thinking
Design-Driven Innovation, Systems thinking
Open innovation, TRIZ
How to start a start-up?

Week 8: Government incentives for entrepreneurship (1 lecture)
Incubation, acceleration
Funding new ventures – bootstrapping, crowd sourcing, angel investors, VCs, debt financing (3), due diligence
Legal aspects of business (IPR, GST, Labour law)

Week 9: Cost, volume, profit and break-even analysis
Margin of safety and degree of operating leverage
Capital budgeting for comparing projects or opportunities
Product costing
Product pricing

Week 10: Funding new ventures – bootstrapping, crowd sourcing,
Angel investors, VCs, debt financing (3), and due diligence
Incubation and acceleration
Government incentives for entrepreneurship
Project cost and Financial Closure

Week 11: Dos &Donts in entrepreneurship
Growth Hacking
Growth Strategy
Legal aspects of business (IPR, GST, Labor law)
Negotiation skill

Week 12: Human Resource management in startups
Pivoting
Entrepreneurial cases
Risk assessment and analysis
Strategy management for entrepreneurial ventures
Factors driving success and failure of ventures
Concluding remarks

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BTEEP803: PROJECT-II	
Teaching Scheme:	Examination Scheme:
Practical: 30hr	Continuous Assessment: 100 Marks
Total Credits: 15	End Term Exam: 150 Marks

Since Project Stage II is in continuation to Project Stage I, the students are expected to complete the total project by the end of semester VIII. After completion of project work, they are expected to submit the consolidated report including the work done in stage I and stage II.

The report shall be comprehensive and presented typed on A4 size sheets and bound. The number of copies to be submitted is number of students plus two. The assessment would be carried out by the panel of examiners for both, term work and oral examinations.

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