INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
(Approved by AICTE | NAAC Accreditation with 'A' Grade | Accredited by NBA | Affiliated to JNTUH)
Dundigal, Hyderabad - 500 043, Telangana

OUTCOME BASED EDUCATION
WITH
CHOICE BASED CREDIT SYSTEM

MASTER OF TECHNOLOGY

ELECTRICAL POWER SYSTEMS

ACADEMIC REGULATIONS, COURSE CATALOG AND SYLLABI
PG21

M.Tech Regular Two Year Degree Program
(for the batches admitted from the academic year 2021 - 2022)

These rules and regulations may be altered/changed from time to time by the academic council
FAILURE TO READ AND UNDERSTAND THE RULES IS NOT AN EXCUSE

INSTITUTE VISION | MISSION | QUALITY POLICY

VISION

To bring forth professionally competent and socially sensitive engineers, capable of working across cultures meeting the global standards ethically.

MISSION

To provide students with an extensive and exceptional education that prepares them to excel in their profession, guided by dynamic intellectual community and be able to face the technically complex world with creative leadership qualities.

Further, be instrumental in emanating new knowledge through innovative research that emboldens entrepreneurship and economic development for the benefit of wide spread community.

QUALITY POLICY

Our policy is to nurture and build diligent and dedicated community of engineers providing a professional and unprejudiced environment, thus justifying the purpose of teaching and satisfying the stake holders.

A team of well qualified and experienced professionals ensure quality education with its practical application in all areas of the Institute.

DEPARTMENT VISION | MISSION

VISION

To produce comprehensively trained, socially responsible, innovative electrical engineers and researchers of high quality who can contribute for the nation's and global development.

MISSION

The mission of Electrical and Electronics Engineering is to provide academic environment with a strong theoretical foundation, practical engineering skills, experience in interpersonal communication and teamwork along with emphasis on ethics, professional conduct and critical thinking. Further, the graduates will be trained to have successful engagement in research and development and entrepreneurship.

M. TECH (EEE) - PROGRAM EDUCATIONAL OBJECTIVES (PEO's)

The students of M.Tech - Electrical Power Systems, are prepared to:

PEO - I	Impart engineering knowledge in specific and re-equip with latest technologies to analyze, synthesize the problems in power system and multidisciplinary sectors.
PEO - II	Design, develop innovative products and services in the field of electrical power systems with the latest technology and toolset.
PEO - III	Inculcate research attitude and life-long learning for a successful career.
PEO - IV	Attain intellectual leadership skills to cater the needs of power industry, academia, society and environment.

M.TECH - PROGRAM OUTCOMES (PO's)

Upon completion of M.Tech Degree, the students will be able to:

PO - 1	An ability to independently carry out research/investigation and development work to solve practical problems.
PO - 2	An ability to write and present a substantial technical report / document.
PO - 3	Student should be able to demonstrate a degree of mastery over Electrical Power System in designing and analyzing real-life engineering problems and to provide strategic solutions ethically.
PO - 4	Identify, formulate and solve complex problems on modern-day issues of Power Systems using advanced technologies with a global perspective and envisage advanced research in thrust areas.
PO - 5	Model and apply appropriate techniques and modern tools on contemporary issues in multidisciplinary environment.
PO - 6	Engage in life-long learning for continuing education in doctoral level studies and professional development.

CONTENTS

“Take up one idea.
Make that one idea you’re life-think of it, dream of it, and live on that idea. Let the brain muscles, nerves, every part of your body be full of that idea and just leave every other idea alone.
This is the way to success” Swami Vivekananda

PRELIMINARY DEFINITIONS AND NOMENCLATURES

Academic Council: The Academic Council is the highest academic body of the institute and is responsible for the maintenance of standards of instruction, education and examination within the institute. Academic Council is an authority as per UGC regulations and it has the right to take decisions on all academic matters including academic research.

Academic Autonomy: Means freedom to an institute in all aspects of conducting its academic programs, granted by UGC for Promoting Excellence.

Academic Year: It is the period necessary to complete an actual course of study within a year. It comprises two consecutive semesters i.e., Even and Odd semester.

AICTE: Means All India Council for Technical Education, New Delhi.

Autonomous Institute: Means an institute designated as autonomous by University Grants Commission (UGC), New Delhi in concurrence with affiliating University (Jawaharlal Nehru Technological University, Hyderabad) and State Government.

Backlog Course: A course is considered to be a backlog course if the student has obtained a failure grade (F) in that course.

Basic Sciences: The courses offered in the areas of Mathematics, Physics, Chemistry, Biology etc., are considered to be foundational in nature.

Betterment: Betterment is a way that contributes towards improvement of the students' grade in any course(s). It can be done by either (a) re-appearing or (b) re-registering for the course.

Board of Studies (BOS): BOS is an authority as defined in UGC regulations, constituted by Head of the Organization for each of the departments separately. They are responsible for curriculum design and updation in respect of all the programs offered by a department.

Certificate course: It is a course that makes a student gain hands-on experience and skill required for holistic development in a specific area/field.

Choice Based Credit System: The credit based semester system is one which provides flexibility in designing curriculum and assigning credits based on the course content and hours of teaching along with provision of choice for the student in the course selection.

Compulsory course: Course required to be undertaken for the award of the degree as per the program.

Commission: Means University Grants Commission (UGC), New Delhi.

Continuous Internal Examination: It is an examination conducted towards internal assessment.

Course: A course is a subject offered by the University for learning in a particular semester.

Course Outcomes: The essential skills that need to be acquired by every student through a course.

Credit: A credit is a unit that gives weight to the value, level or time requirements of an academic course. The number of 'Contact Hours' in a week of a particular course determines its credit value. One credit is equivalent to one lecture hour per week.

Credit point: It is the product of grade point and number of credits for a course.

Cumulative Grade Point Average (CGPA): It is a measure of cumulative performance of a student over all the completed semesters. The CGPA is the ratio of total credit points secured by a student in various courses in all semesters and the sum of the total credits of all courses in all the semesters. It is expressed upto two decimal places.

Curriculum: Curriculum incorporates the planned interaction of students with instructional content, materials, resources and processes for evaluating the attainment of Program Educational Objectives.

Degree with Specialization: A student who fulfills all the program requirements of her/his discipline and successfully completes a specified set of professional elective courses in a specialized area is eligible to receive a degree with specialization like Structural Engineering, Embedded Systems, CSE, etc.

Department: An academic entity that conducts relevant curricular and co-curricular activities, involving both teaching and non-teaching staff and other resources in the process of study for a degree.

Detention in a course: Student who does not obtain minimum prescribed attendance in a course shall be detained in that particular course.

Dropping from the Semester: A student who doesn't want to register for any semester can apply in writing in prescribed format before commencement of that semester.

Elective Course: A course that can be chosen from a set of courses. An elective can be Professional Elective and/or Open Elective.

Evaluation: Evaluation is the process of judging the academic performance of the student in her/his courses. It is done through a combination of continuous internal assessment and semester end examinations.

Grade: It is an index of the performance of the students in a said course. Grades are indicated by alphabets.

Grade Point: It is a numerical weight allotted to each letter grade on a 10 point scale.

Institute: Means Institute of Aeronautical Engineering, Hyderabad unless indicated otherwise by the context.

Massive Open Online Course (MOOC): MOOC courses inculcate the habit of self learning. MOOC courses would be additional choices in all the elective group courses.

Pre-requisite: A course, the knowledge of which is required for registration into higher level course.

Core: The courses that are essential constituents of each engineering discipline are categorized as professional core courses for that discipline.

Professional Elective: A course that is discipline centric. An appropriate choice of minimum number of such electives as specified in the program will lead to a degree with specialization.

Program: Means, Master of Technology (M.Tech) degree program / UG degree program: B.Tech.

Program Educational Objectives: The broad career, professional and personal goals that every student will achieve through a strategic and sequential action plan.

Project work: It is a design or research based work to be taken up by a student during his/her second year to achieve a particular aim. It is a credit based course and is to be planned carefully by the student.

Re-Appearing: A student can reappear only in the semester end examination for the theory component of a course, subject to the regulations contained herein.

Registration: Process of enrolling into a set of courses in a semester of a Program.

Regulations: The regulations, common to all M.Tech programs offered by Institute are designated as "PG21" and are binding on all the stakeholders.

Semester: It is a period of study consisting of 15 to 18 weeks of academic work equivalent to normally 90 working days. The odd semester starts usually in July and even semester in December.

Semester End Examinations: It is an examination conducted for all courses offered in a semester at the end of the semester.

S/he: Means "she" and "he" both.

Student Outcomes: The essential skill sets that need to be acquired by every student during her/his program of study. These skill sets are in the areas of employability, entrepreneurial, social and behavioral.

University: Means the Jawaharlal Nehru Technological University Hyderabad, Hyderabad.

Withdraw from a Course: Withdrawing from a course means that a student can drop from a course within the first two weeks of the odd or even semester (deadlines are different for summer sessions). However s/he can choose a substitute course in place of it by exercising the option within 5 working days from the date of withdrawal.

Words 'he', him', 'his', occur, they imply 'she', 'her', 'hers' also.

FOREWORD

The autonomy is conferred to Institute of Aeronautical Engineering (IARE), Hyderabad by University Grants Commission (UGC), New Delhi based on its performance as well as future commitment and competency to impart quality education. It is a mark of its ability to function independently in accordance with the set norms of the monitoring bodies like J N T University Hyderabad (JNTUH), Hyderabad and AICTE. It reflects the confidence of the affiliating University in the autonomous institution to uphold and maintain standards it expects to deliver on its own behalf and thus awards degrees on behalf of the college. Thus, an autonomous institution is given the freedom to have its own **curriculum, examination system and monitoring mechanism**, independent of the affiliating University but under its observance.

IARE is proud to win the credence of all the above bodies monitoring the quality in education and has gladly accepted the responsibility of sustaining, if not improving upon the standards and ethics for which it has been striving for more than a decade in reaching its present standing in the arena of contemporary technical education. As a follow up, statutory bodies like Academic Council and Boards of Studies are constituted with the guidance of the Governing Body of the institute and recommendations of the JNTUH to frame the regulations, course structure and syllabi under autonomous status.

The autonomous regulations, course structure and syllabi have been prepared after prolonged and detailed interaction with several expertise solicited from academics, industry and research, in accordance with the vision and mission of the institute to order to produce a quality engineering graduate to the society.

All the faculty, parents and students are requested to go through all the rules and regulations carefully. Any clarifications needed are to be sought at appropriate time and with principal of the college, without presumptions, to avoid unwanted subsequent inconveniences and embarrassments. The Cooperation of all the stake holders is sought for the successful implementation of the autonomous system in the larger interests of the college and brighter prospects of engineering graduates.

PRINCIPAL

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

ACADEMIC REGULATIONS

M.Tech. Regular Two Year Degree Program
(for the batches admitted from the academic year 2021 - 22)

For pursuing two year postgraduate Master Degree program of study in Engineering (M.Tech) offered by Institute of Aeronautical Engineering under Autonomous status and herein after referred to as IARE.

1.0 CHOICE BASED CREDIT SYSTEM

The Indian Higher Education Institutions (HEI's) are changing from the conventional course structure to Choice Based Credit System (CBCS) along with introduction to semester system at first year itself. The semester system helps in accelerating the teaching learning process and enables vertical and horizontal mobility in learning.

The credit based semester system provides flexibility in designing curriculum and assigning credits based on the course content and hours of teaching. The choice based credit system provides a 'cafeteria' type approach in which the students can take courses of their choice, learn at their own pace, undergo additional courses and acquire more than the required credits and adopt an interdisciplinary approach to learning.

Choice Based Credit System (CBCS) is a flexible system of learning and provides choice for students to select from the prescribed elective courses. A course defines learning objectives and learning outcomes and comprises of lectures / tutorials / laboratory work / field work / project work /mini project work with seminar/ viva / seminars / presentations / self-study etc. or a combination of some of these.

Under the CBCS, the requirement for awarding a degree is prescribed in terms of number of credits to be completed by the students.

The CBCS permits students to:

1. Choose electives from a wide range of elective courses offered by the departments of the Institute.
2. Undergo additional courses of interest.
3. Adopt an inter-disciplinary approach in learning.
4. Make the best use of expertise of the available faculty.

2.0 MEDIUM OF INSTRUCTION

The medium of instruction shall be English for all courses, examinations, seminar presentations and project work. The curriculum will comprise courses of study as given in course curriculum in accordance with the prescribed syllabi.

3.0 ELIGIBILITY FOR ADMISSION

The admissions for category A and B seats shall be as per the guidelines of Telangana State Council for Higher Education (TSCHE) in consonance with government reservation policy.

a) Under Category A: 70% of the seats are filled based on GATE/PGECET ranks.
b) Under Category B: 30% seats are filled on merit basis as per guidelines of TSCHE.

4.0 UNIQUE COURSE IDENTIFICATION CODE

Every specialization of the M.Tech program will be placed in one of the groups as listed in the Table 1.

Table 1: Group of Courses

S. No	Specialization	Offering Department	Code
1	Structural Engineering	Civil Engineering	ST
2	Electrical Power Systems	Electrical and Electronics Engineering	PS
3	CAD / CAM	Mechanical Engineering	CC
4	Embedded Systems	Electronics and Communication Engineering	ES
5	Computer Science and Engineering	Computer Science and Engineering	CS
6	Aerospace Engineering	Aeronautical Engineering	AE

5.0 TYPES OF COURSES

Courses in a program may be of four kinds: **Core, Elective, Open and Audit.**

5.1 Core Course:

There may be a core course in every semester. This is the course which is to be compulsorily studied by a student as a core requirement to complete the requirement of a program in said discipline of study.

5.2 Elective Course:

Electives provide breadth of experience in respective branch and applications areas. Elective course is a course which can be chosen from a pool of courses. It may be:

- Supportive to the discipline of study
- Providing an expanded scope
- Enabling an exposure to some other discipline/domain
- Nurturing student's proficiency/skill.

There shall be five professional core elective groups out of which students can choose not more than two courses from each group. Overall, students can opt for four professional elective courses which suit their project work in consultation with the faculty advisor/mentor. In addition, one course from each of the two open electives has to be selected. A student may also opt for more elective courses in his/her area of interest.

5.3 Open Elective Course:

An elective may be discipline centric focusing on those courses which add generic proficiency to the students or may be chosen from supportive/general discipline called as "Open Elective".

5.4 Audit Course:

The value added courses are audit courses offered through joint ventures with various organizations providing ample Scope for the students as well as faculty to keep pace with the latest technologies pertaining to their chosen fields of study. A plenty of value added programs will be proposed by the departments one week before the commencement of class work. The students are given the option to choose the courses according to their desires and inclinations as they choose the desired items in a cafeteria. The expertise gained through the value added programs should enable them to face the formidable challenges of the future and also assist them in exploring new opportunities. Its result shall be declared with "Satisfactory" or "Not Satisfactory" performance.

6.0 SEMESTER STRUCTURE

The Institute shall follow semester pattern. An academic year shall consist of two semesters. Each semester shall be of 23 weeks' duration and this period includes time for course work, examination preparation and conduct of examinations. Each main semester shall have a minimum of 90 working days. The duration for each semester shall be a minimum of 17 weeks of instruction. The Academic calendar shall be declared at the beginning of the academic year as shown in Table 2.

Table 2: Academic Calendar

FIRST SEMESTER (23 weeks)	I Spell Instruction Period	9 weeks	21 weeks
	I Mid Examinations	1 week	
	II Spell Instruction Period	8 weeks	
	II Mid Examinations	1 week	
	Preparation and Practical Examinations	2 weeks	
	Semester End Examinations		2 weeks
Semester Break and Supplementary Exams			2 weeks
SECOND SEMESTER (23 weeks)	I Spell Instruction Period	9 weeks	21 weeks
	I Mid Examinations	1 week	
	II Spell Instruction Period	8 weeks	
	II Mid Examinations	1 Week	
	Preparation & Practical Examinations	2 weeks	
	Semester End Examinations		2 weeks
Summer Vacation and Supplementary Exams			4 weeks
THIRD SEMESTER	I Spell Instruction Period	9 weeks	19 weeks
	I Mid Examinations	1 week	
	II Spell Instruction Period	8 weeks	
	II Mid Examinations	1 week	
	Project Work Phase - I		
	Semester End Examinations		1 week
FOURTH SEMESTER	Project Work Phase - II		18 Weeks

7.0 PROGRAM DURATION

A student shall be declared eligible for the award of M.Tech degree, if he/she pursues a course of study and completes it successfully in not less than two academic years and not more than four academic years. A student, who fails to fulfill all the academic requirements for the award of the degree within four academic years from the year of his/her admission, shall forfeit his/her seat in M.Tech course.

a) A student will be eligible for the award of M.Tech degree on securing CGPA ≥ 6.0, and shall pass all the mandatory Audit Courses to complete the M.Tech program successfully.
b) In the event of non-completion of project work and/or non-submission of the project report by the end of the fourth semester, the candidate shall re-register by paying the semester fee for the project. In such a case, the candidate will not be permitted to submit the report earlier than three months and not later than six months from the date of registration.

8.0 CURRICULUM AND COURSE STRUCTURE

The curriculum shall comprise Core Courses, Professional core elective courses, Audit courses, Open elective courses, Laboratory courses, Mini project with seminar, Project work-1 and Project work-2.

Each Theory and Laboratory course carries credits based on the number of hours / week as follows:

- **Lecture Hours (Theory):** 1 credit per lecture hour per week.
- **Laboratory Hours (Practical):** 1 credit for 2 practical hours, 2 credits for 3 or 4 practical hours per week.
- **Project Work:** 1 credit for 2 hours of project work per week.

8.1 Credit distribution for courses offered is shown in Table 3.

Table 3: Credit distribution

S. No	Course	Hours	Credits
1	Core Courses	3	3
2	Professional Core Elective Courses	3	3
3	Audit Courses	2	0
4	Laboratory Courses	4	2
5	Open Elective Courses	3	3
6	Mini Project with Seminar	2	2
7	Project Work-1 Dissertation	20	10
8	Project Work-2 Dissertation	32	16

8.2 Course wise break-up for the total credits:

Total Theory Courses (12) Core Courses (04)+Professional Core Electives (05) + Open Electives (01)	04@3credits + 05 @ 3 credits + 01@3 credits	30
Total Laboratory Courses (04)	04@2credits	08
Mini Project with Seminar(01)	1@2credit	02
Research Methodology and IPR	1@2 credit	02
Project Work-1	1 @10credit	10
Project Work-2	1 @16credits	16
TOTAL CREDITS		**68**

9.0 EVALUATION METHODOLOGY

9.1 Theory Course:

Each theory course will be evaluated for a total of 100 marks, out of which 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE).

9.1.1 Semester End Examination (SEE):

The SEE shall be conducted for 70 marks of 3 hours duration. The syllabus for the theory courses shall be divided into FIVE units and each unit carries equal weightage in terms of marks distribution. The question paper pattern shall be as defined below. Two full questions with ‘either’ ‘or’ choice will be drawn from each unit. Each question carries 14 marks. There could be a maximum of three sub divisions in a question.

The emphasis on the questions is broadly based on the following criteria:

50 %	To test the objectiveness of the concept
30 %	To test the analytical skill of the concept
20 %	To test the application skill of the concept

9.1.2 Continuous Internal Assessment (CIA):

For each theory course the CIA shall be conducted by the faculty / teacher handling the course. CIA is conducted for a total of 30 marks, with 20 marks for Continuous Internal Examination (CIE), 05 marks for Assignment and 05 marks for Alternative Assessment Tool (AAT). **Two CIE Tests are Compulsory** and sum of the two tests, along with the scores obtained in the assignment / AAT shall be considered for computing the final CIA of a student in a given course.

The CIE Tests/Assignment /AAT shall be conducted by the course faculty with due approval from the HOD. Advance notification for the conduction of Assignment/AAT is mandatory and the responsibility lies with the concerned course faculty.

Table 4: Assessment pattern for Theory Courses

Component		Marks	Total Marks
CIA	Continuous Internal Examination – 1 (Mid-term)	10	30
	Continuous Internal Examination – 2 (End-term)	10	
	Assignment	5	
	Alternative Assessment Tool (AAT)	5	
SEE	Semester End Examination (SEE)	70	70
Total Marks			**100**

Continuous Internal Examination (CIE):

Two CIE exams shall be conducted at the end of the 9th and 17th week of the semester respectively for 10 marks each of 2 hours duration consisting of five descriptive type questions out of which four questions have to be answered. The valuation and verification of answer scripts of CIE exams shall be completed within a week after the conduct of the Examination.

Assignment:

To improve the writing skills in the course an assignment will be evaluated for 05 marks. One assignment has to submit at the end of the CIE2 for the questions provided by the each course coordinator in that semester. Assignments to be handed in as loose paper collection stapled together at the top left corner. The assignment should be presented as a professional report. It must consist of a cover sheet, content page, and should have an introduction, a body, a conclusion or recommendation, and a reference page.

Alternative Assessment Tool (AAT):

In order to encourage innovative methods while delivering a course, the faculty members are encouraged to use the Alternative Assessment Tool (AAT). This AAT enables faculty to design own assessment patterns during the CIA. The AAT enhances the autonomy (freedom and flexibility) of individual faculty and enables them to create innovative pedagogical practices. If properly applied, the AAT converts the classroom into an effective learning center. **The AAT may includes, concept videos, course related term paper, technical seminar, term paper, paper presentations conducted by reputed organizations relevant to the course etc.**

9.2 Laboratory Course:

Each lab will be evaluated for a total of 100 marks consisting of 30 marks for internal assessment and 70 marks for semester end lab examination. Out of 30 marks of internal assessment, continuous lab assessment will be done for 20 marks for the day to day performance and 10 marks for the final internal lab assessment. The semester end lab examination for 70 marks shall be conducted by two examiners, one of them being a internal examiner and another is external examiner, both nominated by the Principal from the panel of experts recommended by Chairman, BOS.

All the drawing related courses are evaluated in line with lab courses. The distribution shall be 30 marks for internal evaluation (20 marks for day–to–day work, and 10 marks for internal tests) and 70 marks for semester end lab examination. There shall be ONE internal test for 10 marks each in a semester.

9.3 Project work

Normally, the project work should be carried out at Host Institute (Institute of Aeronautical Engineering). However, it can also be carried out in any of the recognized Educational Institutions, National Laboratories, Research Institutions, Industrial Organizations, Service Organizations or Government Organizations with the prior permission from the guide and concerned Head of the Department. A student shall submit the outcome of the project work in the form of a dissertation.

9.3.1 The student shall submit the project work synopsis at the end of III semester for Phase-I of project evaluation. The Phase-I of project work shall be evaluated by Project Review Committee (PRC) at the end of the third semester for a maximum of 100 marks. Head of the Department (HOD) shall constitute a PRC comprising of senior faculty of the specialization, Guide and Head of the Department.

9.3.2 The first phase of project work is to be carried out in IV semester for Phase –II of Project work. The student will be allowed to appear for final viva voce examination at the end of IV semester only if s/he has submitted s/he project work in the form of paper for presentation/ publication in a conference/journal and produce the proof of acceptance of the paper from the organizers / publishers.

9.3.3 The student shall submit the project work in the form of dissertation at least four weeks ahead of the completion of the program. Head of the Department shall constitute an Internal Evaluation Committee (IEC) comprising of the Chairman BOS (PG), HOD and Guide. As per convenes of all meeting for open pre-submission seminar evaluation of the student. If the open pre-submission seminar by a student is not satisfactory, another seminar shall be scheduled within two weeks.

The evaluation of the project work and the marks allotted are as under:

S. No	Project Phases	Mode	Evaluation Committee	Marks
1	Phase - I	Continuous evaluation at the end of III Semester	Guide	30
2		Evaluation at the end of III Semester	Project Review Committee (PRC) comprising of senior faculty of the specialization, guide and HOD.	70
Total (Phase – I)				**100**
3	Phase - II	An open pre-submission seminar by the student	The Internal Evaluation Committee (IEC) comprising of the Chairman, BOS (PG), HOD and guide wherein the HOD convenes its meeting.	30
4		End Semester Examination (An open seminar followed by viva- voce)	The External Evaluation Committee (EEC) comprising of External Examiner, HOD and guide wherein the HOD shall be the chairman of the committee.	70
Total (Phase-II)				**100**

9.3.4 As soon as a student submits his project work, Principal shall appoint the External Examiner among the panel of examiners recommended by the Chairman, BOS (PG).

9.3.5 The Principal shall schedule the End Semester Examination in project work soon after the completion of the study of program and a student can appear for the same provided s/he has earned successfully all the requisite credits. The student shall produce the dissertation duly certified by the guide and HOD during the Examination.

9.3.6 The project reports of M.Tech students who have not completed their course work successfully will be evaluated in that semester itself and the result sent confidentially to the Controller of Examinations. The results of the project work evaluation will be declared by the Controller of Examinations only after the successful completion of the courses by those students.

10.0 ATTENDANCE REQUIREMENTS AND DETENTION POLICY

10.1 It is desirable for a candidate to put on 100% attendance in each course. In every course (theory/laboratory), student has to maintain a minimum of 75% attendance including the days of attendance in sports, games, NCC and NSS activities to be eligible for appearing in Semester End Examination of the course.

10.2 For cases of medical issues, deficiency of attendance in each course to the extent of 15% may be condoned by the College Academic Committee (CAC) on the recommendation of Head of the Department if his/her attendance is between 80% to 65% in every course, subjected to submission of medical certificate and other needful documents to the concerned department.

10.3 The basis for the calculation of the attendance shall be the period prescribed by the institute by its calendar of events. For late admission, attendance is reckoned from the date of admission to the program.

10.4 However, in case of a student having less than 65% attendance in any course, s/he shall be detained in the course and in no case such process will be relaxed.

10.5 Students whose shortage of attendance is not condoned in any subject are not eligible to write their semester end examination of that courses and their registration shall stand cancelled.

10.6 A prescribed fee shall be payable towards Condonation of shortage of attendance.

10.7 A candidate shall put in a minimum required attendance at least in three (3) theory courses for getting promoted to next higher class / semester. Otherwise, s/he shall be declared detained and has to repeat semester.

10.8 A student shall not be promoted to the next semester unless he satisfies the attendance requirement of the present semester, as applicable. They may seek readmission into that semester when offered next. If any candidate fulfills the attendance requirement in the present semester, s/he shall not be eligible for readmission into the same class.

11.0 CONDUCT OF SEMESTER END EXAMINATIONS AND EVALUATION

11.1 Semester end examination shall be conducted by the Controller of Examinations (COE) by inviting Question Papers from the External Examiners.

11.2 Question papers may be moderated for the coverage of syllabus, pattern of questions by Semester End Examination Committee chaired by Head of the Department one day before the commencement of semester end examinations.

11.3 Internal Examiner shall prepare a detailed scheme of valuation.

11.4 The answer papers of semester end examination should be evaluated by the internal examiner immediately after the completion of exam and the award sheet should be submitted to COE in a sealed cover before the same papers are kept for second evaluation by external examiner.

11.5 In case of difference is more than 15% of marks, the answer paper shall be re-evaluated by a third examiner appointed by the Examination Committee and marks awarded by him shall be taken as final.

11.6 HOD shall invite 3-9 external examiners to evaluate all the end semester answer scripts on a prescribed date(s). Practical laboratory exams are conducted involving external examiners.

11.7 Examination Control Committee shall consolidate the marks awarded by internal and external examiners to award grades.

12.0 SCHEME FOR THE AWARD OF GRADE

12.1 A student shall be deemed to have satisfied the minimum academic requirements and earn the credits for each theory course, if s/he secures:

i. Not less than 40% marks for each theory course in the semester end examination, and

ii. A minimum of 50% marks for each theory course considering both CIA and SEE

12.2 A student shall be deemed to have satisfied the minimum academic requirements and earn the credits for each Laboratory / Seminar / Project, if s/he secures

i. Not less than 40% marks for each Laboratory / Seminar / Project course in the semester end examination,

ii. A minimum of 50% marks for each Laboratory / Mini project with Seminar / Project course considering both internal and semester end examination.

12.3 If a candidate fails to secure a pass in a particular course, it is mandatory that s/he shall register and reappear for the examination in that course during the next semester when examination is conducted in that course. It is mandatory that s/he should continue to register and reappear for the examination till s/he secures a pass.

13.0 LETTER GRADES AND GRADE POINTS

13.1 Performances of students in each course are expressed in terms of marks as well as in Letter Grades based on absolute grading system. The UGC recommends a 10point grading system with the following letter grades as given below:

Range of Marks	Grade Point	Letter Grade
90% and above (≥ 90% , ≤ 100%)	10	S (Superior)
Below 90% but not less than 80% (≥80% , <90%)	9	A+ (Excellent)
Below 80% but not less than 70% (≥70% , <80%)	8	A (Very Good)
Below 70% but not less than 60% (≥60% , <70%)	7	B+ (Good)
Below 60% but not less than 50% (≥ 50% , <60%)	6	B (Average)
Below 50% (<50%)	0	F (Fail)
Absent	0	AB (Absent)

13.2 A student is deemed to have passed and acquired to correspondent credits in particular course if s/he obtains any one of the following grades: "S", "A+", "A", "B+", "B".

13.3 A student obtaining Grade "F" shall be considered Failed and will be required to reappear in the examination.

13.4 At the end of each semester, the institute issues grade sheet indicating the SGPA and CGPA of the student. However, grade sheet will not be issued to the student if s/he has any outstanding dues.

14.0 COMPUTATION OF SGPA AND CGPA

The UGC recommends tocompute the Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA). The credit points earned by a student are used for calculating the Semester Grade Point Average (SGPA) and the Cumulative Grade Point Average (CGPA), both of which are important performance indices of the student. SGPA is equal to the sum of all the total points earned by the student in a given semester divided by the number of credits registered by the student in that semester. CGPA gives the sum of all the total points earned in all the previous semesters and the current semester divided by the number of credits registered in all these semesters. Thus,

$$SGPA = \sum_{i=1}^{n}(C_i G_i) / \sum_{i=1}^{n} C_i$$

Where, C_i is the number of credits of the i^{th} course and G_i is the grade point scored by the student in the i^{th} course and n represent the number of courses in which a student's is registered in the concerned semester.

$$CGPA = \sum_{j=1}^{m}(C_j S_j) / \sum_{j=1}^{m} C_j$$

Where, S_j is the SGPA of the j^{th} semester and $C_j$is the total number of credits upto the semester and m represent the number of semesters completed in which a student registered upto the semester. The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

15.0 ILLUSTRATION OF COMPUTATION OF SGPA AND CGPA

15.1 Illustration for SGPA

Course Name	Course Credits	Grade letter	Grade point	Credit Point (Credit x Grade)
Course 1	4	A	8	4 x 8 = 32
Course 2	4	S	10	4 x 10 = 40
Course 3	4	B	6	4 x 6 = 24
Course 4	3	B	6	3 x 6 = 18
Course 5	3	A+	9	3 x 9 = 27
Course 6	3	B	6	3 x 6 = 18
	21			**159**

Thus, SGPA = 159 / 21 = 7.57

15.2 Illustration for CGPA

Semester 1	Semester 2	Semester 3	Semester 4
Credits: 24 SGPA: 7	Credits: 24 SGPA: 6	Credits: 24 SGPA: 6.5	Credits: 24 SGPA: 6

Thus, $CGPA = \dfrac{24x7 + 24x6 + 24x6.5 + 24x6 = 6.37}{96}$

16.0 REVALUATION

If the examinee is not satisfied with the marks awarded, he/she may apply for revaluation of answer book in prescribed format online within three (3) working days from the date of declaration of result of the examination or issue of the statement of marks, whichever is earlier. The revaluation facility shall be for theory papers only. The revaluation of answer book shall not be permitted in respect of the marks awarded to the scripts of practical examination / project work (including theory part) and in viva voce / oral / comprehensive examinations.

The revaluation will be done by a second independent examiner. The result after revaluation shall be as follows:

- The revaluation marks are considered only if the difference between the original award and award on revaluation is more than equal to 15% of 70 marks (11 marks).
- If the difference between the original award and the award on reevaluation is more than 20% (14 marks), a third evaluator is to be appointed and the average of two nearest awards (in the range of 15%) shall be considered

17.0 GRADUATION REQUIREMENTS

The following academic requirements shall be met for the award of M .Tech degree.

17.1 Student shall register and acquire minimum attendance in all courses and secure 68 credits.

17.2 A Student who fails to earn 68 credits as per the specified course catalogue, and as indicated above, within four academic years from the date of commencement of his first year first semester, shall forfeit his/her seat in M. Tech. program and his admission shall stand cancelled.

18.0 AWARD OF DEGREE

After a student has earned the requirements prescribed for the completion of the program and is eligible for the award of M.Tech. Degree, he shall be placed in one of the following three classes based on the CGPA:

Class Awarded	CGPA
First Class with Distinction	≥ 7.75
First Class	$6.75 \leq$ CGPA < 7.75
Second Class	$6.00 \leq$ CGPA < 6.75

A student with final CGPA (at the end of the M.Tech program) < 6.00 shall not be eligible for the Award of Degree.

All the candidates who register for the semester end examination will be issued grade sheet by the Institute. Apart from the semester wise marks memos, the institute will issue the provisional certificate subject to the fulfillment of all the academic requirements.

19.0 TERMINATION FROM THE PROGRAM

The admission of a student to the program may be terminated and the student may be asked to leave the institute in the following circumstances:

a) The student fails to satisfy the requirements of the program within the maximum period stipulated for that program.

b) The student fails to satisfy the norms of discipline specified by the institute from time to time.

20.0 WITH-HOLDING OF RESULTS

If the candidate has not paid any dues to the college / if any case of indiscipline / malpractice is pending against him/her, the results of the candidate will be withheld. The issue of the degree is liable to be withheld in such cases.

21.0 DISCIPLINE

Every student is required to observe discipline and decorum both inside and outside the institute and not to indulge in any activity which will tend to bring down the honor of the institute. If a student indulges in malpractice in any of the theory / practical examination, continuous assessment examinations he/she shall be liable for punitive action as prescribed by the Institute from time to time.

22.0 GRIEVANCE REDRESSAL COMMITTEE

The institute shall form a Grievance Redressal Committee for each course in each department with the Course Teacher and the HOD as the members. This Committee shall solve all grievances related to the course under consideration.

23.0 TRANSITORY REGULATIONS

23.1 A student who has been detained in any semester of previous regulations for not satisfying the attendance requirements shall be permitted to join in the corresponding semester of this regulation.

23.2 Semester End Examination in each course under the regulations that precede immediately these regulations shall be conducted three times after the conduct of last regular examination under those regulations. Thereafter, the failed students, if any, shall take examination in the equivalent papers of these regulations as suggested by the Chairman, BOS concerned.

24.0 REVISION OF REGULATIONS AND CURRICULUM

The Institute from time to time may revise, amend or change the regulations, scheme of examinations and syllabi if found necessary and on approval by the Academic Council and the Governing Body shall come into force and shall be binding on the students, faculty, staff, all authorities of the Institute and others concerned.

FAILURE TO READ AND UNDERSTAND
THE REGULATIONS IS NOT AN EXCUSE

INSTITUTE OF AERONAUTICALENGINEERING

(AUTONOMOUS)

ELECTRICAL POWER SYSTEMS

COURSE CATALOG – PG21

I SEMESTER

Course Code	Course Name	Subject Area	Category	Periods per week			Credits	Scheme of Examination Max. Marks		
				L	T	P		CIA	SEE	Total
THEORY										
BPSC01	Modern Power System Analysis	PCC	Core	3	0	0	3	30	70	100
BPSC02	Economic Operation of Power Systems	PCC	Core	3	0	0	3	30	70	100
	Professional Core Elective - I	PCE	Elective	3	0	0	3	30	70	100
	Professional Core Elective – II	PCE	Elective	3	0	0	3	30	70	100
	Audit Course	Audit - I	Audit	2	0	0	0	30	70	100
PRACTICAL										
BPSC11	Power System Computational Laboratory	PCC	Core	0	0	4	2	30	70	100
BPSC12	IoT Applications Laboratory	PCC	Core	0	0	4	2	30	70	100
TOTAL				**14**	**00**	**08**	**16**	**210**	**490**	**700**

II SEMESTER

Course Code	Course Name	Subject Area	Category	Periods per week			Credits	Scheme of Examination Max. Marks		
				L	T	P		CIA	SEE	Total
THEORY										
BPSC13	Digital Protection of Power System	PCC	Core	3	0	0	3	30	70	100
BPSC14	Power System Dynamics and Stability	PCC	Core	3	0	0	3	30	70	100
	Program Core Elective - III	PCE	Elective	3	0	0	3	30	70	100
	Program Core Elective - IV	PCE	Elective	3	0	0	3	30	70	100
	Audit Course	Audit - II	Audit	2	0	0	0	30	70	100
PRACTICAL										
BPSC23	Artificial Intelligence in Power System Laboratory	PCC	Core	0	0	4	2	30	70	100
BPSC24	Power Systems Laboratory	PCC	Core	0	0	4	2	30	70	100
BPSC25	Mini Project with Seminar	PCC	Core	0	0	4	2	30	70	100
TOTAL				**14**	**00**	**12**	**18**	**240**	**560**	**800**

III SEMESTER

Course Code	Course Name	Subject Area	Category	Periods per week			Credits	Scheme of Examination Max. Marks		
				L	T	P		CIA	SEE	Total
THEORY										
BHSC11	Research Methodology and IPR	PCC	Core	2	0	0	2	30	70	100
	Program Core Elective – V	PCE	Core	3	0	0	3	30	70	100
	Open Elective Courses	OEC	Elective	3	0	0	3	30	70	100
PROJECT										
BPSC31	Phase-I Dissertation	PCC	Major Project	0	0	20	10	30	70	100
TOTAL				**08**	**00**	**20**	**18**	**120**	**280**	**400**

IV SEMESTER

Course Code	Course Name	Subject Area	Category	Periods per week			Credits	Scheme of Examination Max. Marks		
				L	T	P		CIA	SEE	Total
BPSC32	Phase-II Dissertation	PCC	Major Project	0	0	32	16	30	70	100
TOTAL				**00**	**00**	**32**	**16**	**30**	**70**	**100**

PROGRAM ELECTIVE COURSES

PROGRAM ELECTIVE – I

Course Code	Course Title
BPSC03	HVDC Transmission and FACTS
BPSC04	Smart Grid Technologies
BPSC05	Internet of Things
BPSC06	Renewable Energy Systems

PROGRAMELECTIVE – II

Course Code	Course Title
BPSC07	Reactive Power Compensation and Management
BPSC08	Hybrid Electric Vehicles
BPSC09	Advanced Digital Signal Processing
BPSC10	Electrical Power Distribution System

PROGRAMELECTIVE – III

Course Code	Course Title
BPSC15	Swarm Intelligence Techniques in Power Systems
BPSC16	Industrial Load Modelling and Control
BPSC17	Cyber Security in Power System
BPSC18	Restructured Power Systems

PROGRAMELECTIVE – IV

Course Code	Course Title
BPSC19	AI Techniques in Power Systems
BPSC20	Power Quality
BPSC21	Data Science and Machine Learning for Modern Power Systems
BPSC22	High Frequency Magnetic Components

PROGRAMELECTIVE – V

Course Code	Course Title
BPSC26	SCADA System and Applications
BPSC27	Power System Reliability
BPSC28	Grid Instrumentation and Communication Systems
BPSC29	Electrical Transients in Power Systems

OPEN ELECTIVE COURSES

Course Code	Course Title
BAEC30	Elements of Aerospace Engineering
BCSC30	Data Analytics
BESC30	Real Time Operating Systems
BPSC30	Waste to Energy
BCCC30	Operations Research
BSTC30	Project Management and Planning

AUDIT COURSES

Course Code	Course Title
BHSC01	English for Research Paper Writing
BHSC02	Disaster Management
BHSC03	Sanskrit for Technical Knowledge
BHSC04	Value Education
BHSC05	Constitution of India
BHSC06	Pedagogy Studies
BHSC07	Stress Management by Yoga
BHSC08	Personality Development through Life Enlightenment Skills
BHSC09	Business Sustainability and Management
BHSC10	Business Ethics and Corporate Governance

SYLLABUS
(I – III SEMESTERS)

MODERN POWER SYSTEM ANALYSIS

I Semester: EPS								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BPSC01	**Core**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	0	0	3	30	70	100
Contact Classes: 45	**Total Tutorials: Nil**	**Total Practical Classes: Nil**				**Total Classes: 45**		

I. COURSE OVERVIEW:

Modern Power system analysis deals with planning and operation of power system, short circuit analysis, power flow analysis, contingency analysis and state estimation techniques. First the bus impedance matrices are formulated by various methods and their power flow analysis is performed using Newton Raphson method and gauss Seidal methods. Short circuit analysis performed for balanced and unbalanced networks. Different techniques used for contingency analysis also discussed in this course. This course also covers state estimation for power system which includes and identification of bad measurements, estimation of quantities not being measured, network observability.

II. COURSE OBJECTIVES:

The students will try to learn:

I. The basic components and restructuring of power systems.
II. The methods to rank the contingencies.
III. The need of state estimation and study simple algorithms for state estimation.
IV. Power flow analysis using various methods.
V. Fault analysis for balanced and unbalanced faults.

III. COURSE OUTCOMES:

After successful completion of the course, students will be able to:		
CO 1	**Utilize** the representation of basic components and single line diagram of power system for understanding there structuring of system	Understand
CO 2	**Examine**theoptimalpowerflowsolutionusingFACTSdevicestosolvepowerflowanalysisproblemsusingvariousmethods.	Apply
CO 3	**Analyse** the new bus voltages contingency by adding/removal of lines for illustrating the various techniques for contingency evaluation and analysis.	Apply
CO 4	**Evaluate** the operating states and security monitoring of power systems to describe its contingency analysis.	Apply
CO 5	**Understand** the importance of power flow analysis in planning and operation of power systems.	Understand
CO 6	**Apply** the various algorithms for state estimation to estimate different components and states of power systems.	Apply

IV. SYLLABUS

MODULE –I: PLANNING AND OPERATIONAL STUDIES OF POWR SYSTEMS (09)

Need for system planning and operational studies, basic components of a power system, introduction to restructuring, single line diagram, per phase and per unit analysis, generator, transformer, transmission line and load representation for different power system studies, primitive network, construction of Y-bus using inspection and singular transformation methods, Z-bus.

MODULE -II: POWER FLOW ANALYSIS (10)

Importance of power flow analysis in planning and operation of power systems, statement of power

flow problem, classification of buses, development of power flow model in complex variables form, iterative solution using Gauss-Seidel method, Q-limit check for voltage controlled buses, power flow model in polar form, iterative solution using Newton-Raphson method, decoupled and fast decoupled power flow solutions, DC power flow solution, power flow solution using FACTS devices, optimal power flow solution.

MODULE -III: SHORT CIRCUIT ANALYSIS (09)

Balanced faults: Importance of short circuit analysis, assumptions in fault analysis, analysis using Thevenin's theorem, Z-bus building algorithm, fault analysis using Z-bus, computations of short circuit capacity, post fault voltage and currents.

Unbalanced faults: Introduction to symmetrical components, sequence impedances, sequence circuits of synchronous machine, transformer and transmission lines, sequence networks analysis of single line to ground, line to line and double line to ground faults using Thevenin's theorem and Z-bus matrix.

MODULE -IV: CONTINGENCY ANALYSIS (09)

Contingency Evaluation: Operating states of a power system, concept of security monitoring, techniques for contingency evaluation, Importance of contingency analysis, addition / removal of one line, construction of a column of bus impedance matrix from the bus admittance matrix, calculation of new bus voltages due to addition / removal of one line, calculation of new bus voltages due to addition / removal of two lines.

MODULE -V: STATE ESTIMATION (09)

Power system state estimation, maximum likelihood weighted least squares estimation, matrix formulation, state estimation of AC network, state estimation by orthogonal decomposition, detection and identification of bad measurements, estimation of quantities not being measured, network observability and pseudo measurements.

V. Text Books:

1. J J Grainger, W D Stevenson, "Power system analysis", McGraw Hill, 1st Edition, 2003.
2. A R Bergen & Vijay Vittal, "Power System Analysis", Pearson, 2nd Edition, 2000.

VI. Reference Books:

1. K Umarao, "Computer techniques and models in power systems", I K International Pvt. Ltd.
2. HadiSaadat, "Power System Analysis", TMH. 2nd Edition, 2003.
3. Grainger and Stevenson, "Power System Analysis", Tata McGraw-Hill, 3rd Edition, 2011.
4. J Duncan Glover and M S Sarma., THOMPSON, "Power System Analysis and Design", 3rd Edition 2006

VII. Web References:

1. https://www.scribd.com/.../Computer-Methods-in-Power-System-Analysis-by-G-W-St...
2. https://www.academia.edu/8352160/Computer_Methods_and_Power_System_Analysis_Stagg
3. https://www.uploady.com/#!/download/ddC9obmVTiv/NwO1AnQrlmogeJjS

VIII. E-Text Books:

1. https://www.scribd.com/.../Computer-Methods-in-Power-System-Analysis-by-G-W-St...
2. https://www.academia.edu/8352160/Computer_Methods_and_Power_System_Analysis_Stagg
3. https://www.uploady.com/#!/download/ddC9obmVTiv/NwO1AnQrlmogeJjS

ECONOMIC OPERATION OF POWER SYSTEMS

I Semester: EPS								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BPSC02	**Core**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	0	0	3	30	70	100
Contact Classes: 45	**Total Tutorials: Nil**	**Total Practical Classes: Nil**				**Total Classes: 45**		

I. COURSE OVERVIEW:

This course will illustrate the difference between economic load dispatch and unit commitment problem and provide the mathematical platform to solve economic load scheduling (with and without network losses) and unit commitment problem, solve hydro-thermal scheduling problem This subject will also cover the analyze of single area and two area systems for frequency deviation and help students to solve the OPF problem using ac and dc load flow methods.

II. COURSE OBJECTIVES:

The students will try to learn:

I. Necessary conditions for economical load scheduling problem.
II. Various constraints, problem formulation and methods to solve the unit commitment problem.
III. Constraints related to hydel power plants, problem formulation and solution techniques for hydro-thermal scheduling problem.
IV. Necessity, factors governing the frequency control and analyze the uncontrolled and controlled LFC system.
V. Basic difference between ELS and OPF problem, formulation of the OPF problem and solution techniques.

III. COURSE OUTCOMES:

CO 1	**Solve the unit Commitment problem with various constraints using conventional optimization techniques and general transmission line loss formula**	Apply
CO 2	**Identify an optimal operation setup of power systemfor minimizes operation costs and meet desired needs**	Apply
CO 3	**Categorize single area load frequency control and two area load frequency controlto minimize the transient deviations and steady state error to zero**	Analyze
CO 4	**Analyse the importance of Reactive power control and Power Factor in power systems for efficient and reliable operation of power systems.**	Apply
CO 5	**Develop the appropriate control scheme for compensating reactive power**	Apply
CO 6	**Identify the different types of compensating equipment for reducing reactive power to improve system's efficiency**	Apply

IV. SYLLABUS

MODULE –I: ECONOMIC LOAD SCHEDULING (09)

Characteristics of steam turbine, variations in steam unit characteristics, economic dispatch with piecewise linear cost functions, Lambda iterative method, LP method, economic dispatch under composite generation production cost function, base point and participation factors, thermal system dispatching with network losses considered.

MODULE -II: UNIT COMMITMENT (10)

Unit Commitment, definition, constraints in unit commitment, unit commitment solution methods, priority, list methods, dynamic programming solution.

MODULE -III:HYDRO THERMAL SCHEDULING (08)

Characteristics of Hydroelectric units, introduction to hydrothermal coordination, long range and short-range hydro scheduling.

Hydroelectric plant models, hydrothermal scheduling with storage limitations, dynamic programming solution to hydrothermal scheduling.

MODULE -IV: LOAD FREQUENCY CONTROL (09)

Control of generation, models of power system elements, single area and two area block diagrams, generation control with PID controllers, implementation of Automatic Generation control (AGC), AGC features.

MODULE -V: OPTIMAL POWER FLOW (09)

Introduction to Optimal power flow problem, OPF calculations combining economic dispatch and power flow, OPF using DC power flow, algorithms for solution of the ACOPF, optimal reactive power dispatch.

V. Text Books:

1. J J Grainger & W DStevenson, "Power system analysis", McGraw Hill, 2nd Edition, 2003.
2. Allen JWood, Bruce F Wollenberg, Gerald B Sheblé, "Power Generation, Operation and Control", Wiley Inter science, 2nd Edition, 2013.

VI. Reference Books:

1. Olle, Elgerd, "Electric Energy Systems Theory an Introduction", TMH, 2nd Edition, 1983.

VII. Web References:

1. https://pdfs.semanticscholar.org/b99b/cedc7f9e06d8b21d910767bb886a6d038283.pdf
2. https://core.ac.uk/download/pdf/33363832.pdf

VIII. E-Text Books:

1. https://core.ac.uk/download/pdf/33363832.pdf
2. http://vbn.aau.dk/files/226382872/seyedmostafa_farashbashiastaneh.pdf

HVDC TRANSMISSION AND FACTS

PE-I: EPS								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
BPSC03	**Elective**	3	0	0	3	30	70	100
Contact Classes: 45	**Total Tutorials: Nil**	**Total Practical Classes: Nil**				**Total Classes: 45**		

I. COURSE OVERVIEW:

This subject deals with the importance of HVDC transmission, analysis of HVDC Converters, Harmonics and Filters, Reactive power control and Power factor improvements of the system. It also deals with basic FACTS concepts, static shunt and series compensation and combined compensation techniques.

II. COURSE OBJECTIVES:

The students will try to learn:

I. The fundamentals of FACTS Controllers,
II. The importance of controllable parameters and types of FACTS controllers & their benefits
III. Basics of HVDC Transmission system
IV. The control aspects of HVDC System

III.COURSE OUTCOMES:

After successful completion of the course, students will be able to:		
CO 1	**Explain** the basic fundamental of FACTS controllers	Understand
CO 2	**Interpret** the enhancement of stability using static shunt and series compensation	Understand
CO 3	**Model** and design of coordinating multiple FACTS controllers UPFC and IPFC using control techniques	Apply
CO 4	**Develop** the knowledge of HVDC transmission and HVDC converters and the applicability and advantage of HVDC transmission over conventional AC transmission.	Apply
CO 5	**Simplify** and solve mathematical problems related to rectifier and inverter control methods and learn about different control schemes as well as starting and stopping of DC links	Analyze

IV. SYLLABUS

MODULE –I:FACTS CONCEPTS(09)

Reactive power control in electrical power transmission, principles of conventional reactive power compensators. Introduction to FACTS, flow of power in AC parallel paths, meshed systems, basic types of FACTS controllers, definitions of FACTS controllers, brief description of FACTS controllers.

MODULE –II: STATIC SHUNT AND SERIES COMPENSATORS (09)

Shunt compensation – objectives of shunt compensation, methods of controllable VAR generation, static VAR compensators – SVC, STATCOM, SVC and STATCOM comparison. Series compensation – objectives of series compensation, thyristor switched series capacitors (TCSC), static series synchronous compensator (SSSC), power angle characteristics, and basic operating control schemes.

MODULE –III: COMBINED COMPENSATORS (09)

Unified power flow controller (UPFC) – Introduction, operating principle, independent real and reactive power flow controller and control structure.

Interline power flow controller (IPFC), Introduction to Active power filtering, Concepts relating to Reactive power compensation and harmonic current compensation using Active power filters.

MODULE –IV: HVDC TRANSMISSION(09)

HVDC Transmission system: Introduction, comparison of AC and DC systems, applications of DC transmission, types of DClinks, Layout of HVDC Converter station and various equipments. HVDC Converters, analysis of bridge converters with and without overlap, inverter operation, equivalent circuit representation of rectifier and inverter configurations

MODULE –V: CONTROL OF HVDC SYSTEM(09)

Principles of control, desired features of control, converter control characteristics, power reversal, Ignition angle control, current and extinction angle control. Harmonics introduction, generation, ac filters and dc filters. Introduction to multiterminal DC systems and applications, comparison of series and parallel MTDC systems, Voltage Source Converter based HVDC systems

V. Text Books:

1. JArrillaga, "High Voltage Direct Transmission", Peter Peregrinus Ltd. London, 1st Edition, 1983.
2. K R Padiyar, "HVDC Power Transmission Systems", Wiley Eastern Ltd., 1st Edition, 1990.

VI. Reference Books:

1. E. W. Kimbark, "Direct Current Transmission", Vol. I, Wiley Interscience, 1st Edition, 1971.
2. Erich Uhlmann, "Power Transmission by Direct Current", B.S. Publications, 1st Edition, 2004.
3. SN Singh, "Electric Power Generation, Transmission and Distribution, PHI, New Delhi, 2nd Edition, 2008.
4. V Kamaraju, "HVDC Transmission" Tata McGraw-Hill Education Pvt Ltd, New delhi, 2nd Edition, 2011.

VII. Web References:

1. https://www.rceroorkee.in/pdf/pdfo/tee033.pdf
2. https://www.books.google.com/books?id=e24fndv2aroc
3. https://www.nptel.ac.in/syllabus/108108033

VIII Web References:

1. https://www.rceroorkee.in/pdf/pdfo/tee033.pdf
2. https://www.books.google.com/books?id=e24fndv2aroc
3. https://www.nptel.ac.in/syllabus/108108033

XI. E-Text Books:

1. https://www.site.uottawa.ca
2. https://www.galerybooks.com
3. https://www.jntubook.com/

SMART GRID TECHNOLOGIES

PE-I: EPS								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BPSC04	**Elective**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	0	0	3	30	70	100
Contact Classes: 45	**Total Tutorials: Nil**	**Total Practical Classes: Nil**				**Total Classes: 45**		

I. COURSE OVERVIEW:

This course introduces concept of Smart Grid, the rationale for smart grid technology and its characteristics. This course focuses on monitoring, analysis, control and communication capabilities to the national electrical delivery system to maximize the throughput of the system while reducing the energy consumption. It also elaborates the integration of renewable energy resources and storage devices to achieve a more efficient and reliable grid, enable active participation of consumers with more environmental constraints.

II. COURSE OBJECTIVES:

The students will try to learn:

I. The challenging issues, architecture and policies in smart grid.
II. The role of renewable energy resources and Micro grid for smart generation
III. The concept of smart transmission with wide area measurement systems, phasor measurement units.
IV. The power quality issues and monitoring in smart grid.

III. COURSE OUTCOMES:

After successful completion of the course, students will be able to:		
CO 1	**Explain** the features smart grid to increase grid efficiency, self-healing, accessibility and reliability.	Understand
CO 2	**Analyze** the different energy storage solutions available for improving grid stability and security.	Analyze
CO 3	**Analyze** the dynamic behaviour of Microgrid and its grid integration issues to meet the load requirement effectively.	Analyze
CO 4	**Outline** the role of different renewable resources like PV, Wind, etc for improving the system dynamics performance.	Understand
CO 5	**Identify** the efficient management of power quality for compatibility between all the equipments connected to the grid.	Understand
CO 6	**Make use of** sensors, transducers, intelligent electronic devices and meter to improve the distribution system overall performance.	Apply

V. SYLLABUS:

MODULE –IINTRODUCTION TO SMART GRID (09)

Introduction to smart grid, evolution of electric grid, concept of smart grid, definitions, need of smart grid, concept of robust, self-healing grid present development & international policies in smart grid.

MODULE -IIAUTOMATION IN GRID MANAGEMENT (10)

Introduction to smart meters, real time prizing, smart appliances, automatic meter reading (AMR), outage management system (OMS), plug in hybrid electric vehicles (PHEV), vehicle to grid, smart sensors, home, building automation, smart substations, substation automation, feeder automation.

MODULE –III: GEOGRAPHIC INFORMATION SYSTEM(GIS)(09)

Intelligent Electronic Devices (IED), their application for monitoring, protection, smart storage like battery.

SMES, pumped hydro, compressed air energy storage, wide area measurement system (WAMS), phase measurement unit (PMU).

MODULE –IV: CONCEPT OF MICRO-GRID(08)

Need and applications of micro grid, formation of micro grid, issues of interconnection, protection, control of micro grid, plastic, organic solar cells, thin film solar cells, variable speed wind generators, fuel cells, micro turbines, captive power plants, integration of renewable energy sources.

MODULE –V: POWER QUALITY IN SMART GRIDS(09)

Power Quality, EMC in smart grid, power quality issues of grid connected renewable energy sources, power quality conditioners for smart grid, web-based power quality monitoring, power quality audit, advanced metering infrastructure (AMI) and various communication means and IP based protocols.

VI. Text Books:

1. Ali Keyhani, "Design of smart power grid renewable energy systems", Wiley IEEE, 2nd Edition, 2011.
2. Clark W Gellings, "The Smart Grid: Enabling Energy Efficiency and Demand Response", CRC Press, 2nd Edition, 2009.

VII. Reference Books:

1. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, "Smart Grid: Technology and Applications", Wiley, 1s Edition, 2012.
2. Stuart Borlase, "Smart Grid: Infrastructure, Technology and solutions "CRCPress, 2nd Edition, 2011.
3. A GPhadke, "Synchronized Phasor Measurement and their Applications",Springer, 2nd Edition, 2012.

VIII. Web References:

1. https://www.researchgate.net
2. https://www.aar.faculty.asu.edu/classes
3. https://www.facstaff.bucknell.edu/
4. https://www.electrical4u.com

IX. E-Text Books:

1. https://www.jntubook.com/
2. https://www.freeengineeringbooks.com

INTERNET OF THINGS

PE- I: EPS

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BPSC05	Elective	3	0	0	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

Prerequisite:

I. COURSE OVERVIEW:

The course provides a good understanding of IoT principles, and their policy and challenges and the protocols in Internet. It will also help students to understand the various modes of communications with internet and to learn to manage the resources in the Internet. This course will provide the environment to deploy the resources into business.

II. COURSE OBJECTIVE:

The students will try to learn:

I. Learn the basic issues, policy and challenges in the Internet.
II. Understand the components and the protocols in Internet.
III. Build a small low cost embedded system with the internet.
IV. Understand the various modes of communications with internet.

III. COURSE OUTCOMES

CO1	Explain internal building blocks of IOT for the evolution of Internet of Things	Understand
CO2	Understand the programming of microcontroller for the functional stack of IoT ecosystem.	Understand
CO3	Understand the concepts of data synchronization for agility and autonomy in protocols	Understand
CO4	Apply IEEE 802.11 protocol for topology and security in physical and MAC layers	Apply
CO 5	Identify the applications of IoT including home automation, smart cities, and smart environment to implement the real time applications.	Apply
CO 6	Make use of appropriate communication protocols to acquire the knowledge of programming with Raspberry PI.	Apply

IV. COURSE SYLLABUS:

MODULE-I: INTRODUCTION (9)

Definition – phases – Foundations – Policy– Challenges and Issues - identification - security – privacy. Components in internet of things: Control Units – Sensors – Communication modules – Power Sources – Communication Technologies – RFID – Bluetooth – Zigbee – Wifi – Rflinks – Mobile Internet – Wired Communication

MODULE-II: PROGRAMMING THE MICROCONTROLLER FOR IOT (9)

Ecosystem, embedded communications software, software partitioning, module and task decomposition: Partitioning case study , protocol software, debugging protocols, tables and other data structures, table access routines, buffer and timer management, management software, device and router management: CLI based management and HTTP based management, agent to protocol interface, device to manager communication, system setup, boot and post-boot configuration, saving and restoring the configuration.

MODULE-III: RESOURCE MANAGEMENT IN THE INTERNET OF THINGS (10)

Clustering - Software Agents - Data Synchronization - Clustering Principles in an Internet of Things Architecture - The Role of Context - Design Guidelines -Software Agents for Object. Data Synchronization

Types of Network Architectures - Fundamental Concepts of Agility and AutonomyEnabling Autonomy and Agility by the Internet of Things-Technical Requirements for Satisfying the New Demands in Production - The Evolution from the RFID-based EPC Network to an Agent based Internet of Things- Agents for the Behaviour of Objects.

MODULE-IV: BUSINESS MODELS FOR THE INTERNET OF THINGS (8)

The Meaning of DiY in the Network Society- Sensor-actuator Technologies and Middleware as a Basis for a DiY Service Creation Framework - Device Integration - MiddlewareTechnologies Needed for a DiY Internet of Things Semantic Interoperability as a Requirement for DiY Creation-Ontology- Value Creation in the Internet of Things-Application of Ontology Engineering in the Internet of Things-Semantic Web-Ontology - The Internet of Things in Context of EURIDICE - Business Impact

MODULE-V: FROM THE INTERNET OF THINGS TO THE WEB OF THINGS (9)

Resource-oriented Architecture and Best Practices- Designing REST ful Smart Things - Web- enabling Constrained Devices - The Future Web of Things - Set up cloud environment – send data from microcontroller to cloud – Case studies – Open Source e-Health sensor platform – Be Close Elderly monitoring – Other recent projects.

V. TEXT BOOKS

1. Charalampos Doukas , Building Internet of Things with the Arduino, Create space, April2002
2. Dieter Uckelmann et.al, “Architecting the Internet of Things”, Springer, 2011

VI. REFERENCE BOOKS:

Luigi Atzor et.al, “The Internet of Things: A survey, “, Journal on Networks,Elsevier Publications, October 2010.

VII. WEB REFERENCES:

1. https://mitpress.mit.edu/books/internet-things
2. http://atkinsapps.uncc.edu/etextbooks
3. https://cloud.oracle.com/iot?tabname=LearnMoreInfo&lmResID=1441186561464

VIII. E-TEXT BOOKS:

1. https://mitpress.mit.edu/books/internet-things
2. http://atkinsapps.uncc.edu/etextbooks
3. https://cloud.oracle.com/iot?tabname=LearnMoreInfo&lmResID=1441186561464

RENEWABLE ENERGY SYSTEMS

PE-I : EPS								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BPSC06	**Elective**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	0	0	3	30	70	100
Contact Classes: 45	**Total Tutorials: Nil**	**Total Practical Classes: Nil**				**Total Classes: 45**		

I. COURSE OVERVIEW:

This course envisages the renewable source of energy available in nature and to expose the students on sources of energy crisis, principle of operation of solar photo voltaic cell, different solar energy collectors and storage methods. It facilitates the study of wind turbines, geothermal energy, ocean, biomass, energy storage and distribution technologies. It concludes the knowledge of renewable energy resources for electrical applications.

II. COURSE OBJECTIVES:

The students will try to learn:

I. The environmental and economics related to renewable energy sources in comparison with fossil fuels
II. The basic characteristics of renewable energy sources and technologies for their utilization
III. The managerial skills to assess feasibility and drive strategies for alternative sources of energy

III. COURSE OUTCOMES:

After successful completion of the course, students will be able to:		
CO 1	**Understand** the need of energy conversion and the various methods of energy storage	Understand
CO 2	**Analyze** the major parameters of sun movement, solar radiation and tracking systems for calculation of solar insolation	Analyze
CO 3	**Identify** different concentrating collectors for conversion of solar energy into thermal energy	Apply
CO 4	**Explain** the concepts involved in wind energy conversion system using vertical and horizontal wind mills	Understand
CO 5	**Illustrate** the operational methods of ocean energy for electrical energy conversion	Understand
CO 6	**Utilize** the distribution technologies for renewable energy distribution and storage	Analyze

IV. SYLLABUS

MODULE –I: GLOBAL AND NATIONAL ENERGY SCENARIO(Classes: 09)

Over view of conventional & renewable energy sources, need and development of renewable energy sources, types of renewable energy systems, future of energy use, global and Indian energy scenario, renewable and non-renewable energy sources, energy for sustainable development, potential of renewable energy sources, renewable electricity and key elements, global climate change, CO2 reduction potential of renewable energy, concept of hybrid systems.

MODULE –II: SOLAR AND WIND ENERGY(Classes: 12)

Solar energy system: Solar radiation, availability measurement and estimation, solar thermal conversion devices and Storage, applications solar photovoltaic conversion, solar thermal applications of solar energy systems; Wind Energy Conversion: potential, wind energy potential measurement, site selection, types of wind turbines, wind farms, wind generation and control, nature of the wind, power in the wind, factors influencing wind, wind data and energy estimation, wind

speed monitoring, classification of wind, characteristics, applications of wind turbines, offshore wind energy, hybrid systems, wind resource assessment, Betz limit, site selection, wind energy conversion devices, wind mill component design, economics and demand side management, energy wheeling, energy banking concepts, safety and environmental aspects, wind energy potential and installation in India.

MODULE -IIIBIO GAS, TIDAL AND OCEAN ENERGY CONVERSION SYSTEMS (12)

Biogas: Properties of biogas (Calorific value and composition), Biogas plant technology and status, Bio energy system, design and constructional features, Biomass resources and their classification, Biomass conversion process, thermo chemical conversion, direct combustion, biomass gasification, pyrolysis and liquefaction, biochemical conversion, anaerobic digestion, types of biogas plants, applications, alcohol production from biomass, Bio diesel production, urban waste to energy conversion, Biomass energy programme in India.

Tidal Energy generation: Characteristics of tides, power generation schemes, components in tidal power plant, wave energy, principle of wave energy plant, wave energy conversion machines, Ocean thermal energy conversion: principle, cycles of operation, types of OTEC plants, applications.

MODULE -IVGEO-THERMAL ENERGY AND FUEL CELLS (06)

Geothermal Energy: Structure of earth's interior, geothermal fields, gradient, resources, geothermal power generation; Fuel cells: introduction, principle of operation, types of fuel cells, state of art fuel cells, energy output of a fuel cell operating characteristics of fuel cells, thermal efficiency, need for hybrid systems, types of hybrid systems.

MODULE -VENERGY SYSTEMS AND GRIDS (06)

Introduction, energy systems, distribution technologies, energy storage for grid electricity, social and environmental aspects of energy supply and storage, electricity grids(networks), dc grids, special challenges and opportunities for renewable electricity, power electronic interface with the grid

V. Text Books:

1. DP Kothari, K CSingal, RRanjan, "Renewable Energy Resources and Emerging Technologies", PHI 2nd Edition, 2011.
2. John Twidell and Tony Weir, "Renewable Energy Resources", CRC Press 2nd Edition, 2006.

VI. Reference Books:

1. Volker Quaschning "Understanding Renewable Energy Systems", by UK, 1st Edition, 2005.
2. Faner Lin Luo Honer Ye, "Renewable Energy Systems-Advanced Conversion, Technologies & Applications" by Taylor &Francisgroup CRC press, 1st Edition, 2000.
3. S P Sukhatme, "Solar Energy Principles of thermal collection and storage", 1st Edition, 1999.
4. J. A. Duffie and W A Beckman, "Solar Engineering of Thermal Processes", 1st Edition, 1995.
5. Anthony San Pietro, "Biochemical and Photosynthetic aspects of Energy Production",Academic Press, 1st Edition, 1980.
6. Bridgurater, AV, "Thermochemical processing of Biomass", Academic Press, 1st Edition, 1981.
7. Kreith, F and Kreider, J F, "Principles of Solar Engineering", McGraw-Hill, 1st Edition, 1978.
8. Bent Sorensen, "Renewable Energy", Elsevier Academic Press, 2011.
9. Rakosh Das Begamudre, "Energy conversion systems"- New Age International Publishers, New Delhi, 2nd Edition, 2000.
10. D. D. Hall and R. P. Grover, "Biomass Regenerable Energy", 1st Edition, 2000.

VII. Web References:

1. https://www.researchgate.net
2. https://www.aar.faculty.asu.edu/classes

3. https://www.facstaff.bucknell.edu/
4. https://www.electrical4u.com
5. https://www.iare.ac.in

VIII. E-Text Books:

1. https://www.jntubook.com/
2. https://www.freeengineeringbooks.com

REACTIVE POWER COMPENSATION AND MANAGEMENT

PE-II: EPS								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BPSC07	**Elective**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	0	0	3	30	70	100
Contact Classes: 45	**Total Tutorials: Nil**	**Total Practical Classes: Nil**				**Total Classes: 45**		

I. COURSE OVERVIEW:

The purpose of this course is to make the students understand about load compensation and how to select various types of reactive power compensation devices in transmission systems both during steady state and transient state operation. The course also enables the students about the management of reactive power on demand side, distribution side, and utility side of the power system.

II. COURSE OBJECTIVES:

The students will try to learn:

I. The objectives, specifications of reactive power compensation and the characteristics of compensation equipment used in power transmission system.
II. The use of series, shunt, passive, static and dynamic compensation equipment to maintain the reactive power under steady state operation of power system.
III. The reactive power coordination and management in demand side, distribution side and user side of power systems.

III. COURSE OUTCOMES:

After successful completion of the course, students will be able to:		
CO 1	**Discuss** the objectives and specifications of reactive compensation for designing the compensating equipment.	Apply
CO 2	**Describe** the characteristics of an uncompensated line and a compensated line which are used for evaluating the performance of lines.	Analyze
CO 3	**Examine** the mathematical modelling, operation planning and transmission benefits in reactive power coordination.	Analyze
CO 4	**Describe** the load patterns, power tariffs, flicker and harmonic voltage levels used in billing the power consumers.	Apply
CO 5	**Explain** the use of different types of capacitors, their characteristics which are used in user side reactive power management.	Analyze
CO 6	**Discuss** the impact of electric traction systems and furnaces on the reactive power and suggest the user side reactive power management techniques.	Analyze

IV. SYLLABUS

MODULE –I: LOAD COMPENSATION (09)

Objectives and specification: Reactive power characteristics, inductive and capacitive approximate biasing, load compensator as a voltage regulator, phase balancing and power factor correction of unsymmetrical loads examples.

MODULE –II: STEADYSTATE REACTIVE POWER COMPENSATION IN TRANSMISSION SYSTEM (09)

Uncompensated line: Types of compensation, passive shunt and series and dynamic shunt compensation, examples transient state reactive power compensation in transmission systems:

Characteristic time periods, passive shunt compensation, static compensations, series capacitor compensation, compensation using synchronous condensers, examples.

MODULE –III: REACTIVE POWER COORDINATION (09)

Objective, mathematical modeling, operation planning, transmission benefits, basic concepts of quality of power supply, disturbances steady, state variations.
Effects of under voltages, frequency, harmonics, radio frequency and electromagnetic interferences.

MODULE –IV: DEMAND SIDE MANAGEMENT (09)

Load patterns, basic methods load shaping, power tariffs KVAR based tariffs penalties for voltage flickers and Harmonic voltage levels; Distribution side reactive power management: System losses, loss reduction methods, examples, reactive power planning, objectives, economics planning capacitor placement, retrofitting of capacitor banks.

MODULE –V: USER SIDE REACTIVE POWER MANAGEMENT (09)

Requirements for domestic appliances, purpose of using capacitors, selection of capacitors, deciding factors, types of available capacitor, characteristics and Limitations; Reactive power management in electric traction systems and are furnaces: Typical layout of traction systems, reactive power control requirements, distribution transformers, Electric arc furnaces, basic operations- furnaces transformer, filter requirements, remedial measures, power factor of an arc furnace.

V. Text Books:

1. TJE Miller, "Reactive power control in Electric power systems", Wiely Publication, 1st Edition, 1982.
2. D MTagare, "Reactive power Management", by Tata McGraw Hill, 1st Edition, 2004.Science Press, New Delhi, 2nd Edition, 2010.

VI. Reference Books:

1. Wolfgang Hofmann, Jurgen Schlabbach, Wolfgang Just "Reactive Power Compensation: A Practical Guide", Wiely publication, 4th Edition, 2012.

VII. Web References:

1. http://www.academia.edu/9885014/SPECIAL_ELECTRICAL_MACHINES_NPTEL_NOTES
2. http://een.iust.ac.ir/profs/Arabkhabouri/Electrical%20Drives/Books/
3. https://ktu.edu.in/eu/att/attachments.htm?download=file&id=156232

III E-Text Books:

1. https://www.digital-library.theiet.org/content/books/po/pbpo022e
2. http://www.leeson.com/documents/PMAC_Whitepaper.pdf

HYBRID ELECTRIC VEHICLES

PE-II: EPS								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BPSC08	**Elective**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	0	0	3	30	70	100
Contact Classes: 45	**Total Tutorials: Nil**	**Total Practical Classes: Nil**				**Total Classes: 45**		

I. COURSE OVERVIEW:

This course will help students to acquire fundamental concepts and principles of hybrid electric vehicles (HEV). It will give an idea about design and analyze HEVs, electric machine and the internal combustion. It also covers the application of electric drives in vehicles / traction and strategies of energy management in HEVs

II. COURSE OBJECTIVES:

The students will try to learn:

I. Recognize EV/HEV technical and economic objectives.
II. The mechanism of battery and motors in terms of functionality, control and integration.
III. How to identify efficient EV/HEV architectures such as P1, P2, P3 and P4.
IV. The basic EV marketing strategy.

III. COURSE OUTCOMES:

After successful completion of the course, students will be able to:		
CO 1	Explain the basics of electric and hybrid electric vehicles, their architecture, technologies and fundamentals	Understand
CO 2	Analyze the use of different power electronics devices and electrical machines in hybrid electric vehicles.	Analyze
CO 3	Explain the use of different energy storage devices used for hybrid electric vehicles, their technologies and control and select appropriate technology	Understand
CO 4	Interpret working of different configurations of electric vehicles and its components, hybrid vehicle configuration, performance analysis and Energy Management strategies in HEVs.	Understand
CO 5	Developthe electric propulsion unit and its control for hybrid electric vehicles.	Apply

IV. SYLLABUS

MODULE –II:NTRODUCTION TO HYBRID AND ELECTRIC VEHICLES 09)

History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies, basics of vehicle performance, vehicle power source characterization transmission characteristics, mathematical models to describe vehicle performance.

MODULE –II: IHYBRID TRACTION (09)

Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive train topologies, fuel efficiency analysis.

MODULE –III:CONFIGURATION AND CONTROL OF DRIVES (09)

Introduction to electric components used in hybrid and electric vehicles, configuration and control of dc motor drives, configuration and control of introduction motor drives.
Configuration and control of permanent magnet motor drives configuration and control of switch

reluctance, motor drives, drive system efficiency.

MODULE –IV: ELECTRIC MACHINE AND THE INTERNAL COMBUSTION ENGINE (09)

Matching the electric machine and the internal combustion engine (ICE), sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, communications, supporting subsystems.

MODULE –V: ENERGY MANAGEMENT AND STRATEGIES (09)

Introduction to energy management and their strategies used in hybrid and electric vehicle, classification of different energy management strategies comparison of different energy management strategies Implementation issues of energy strategies.

VI. Text Books:

1. Sira Ramirez, R Silva Ortigoza, "Control Design Techniques in Power Electronics Devices" Springer, 1st Edition, 2004.
2. Siew-Chong Tan, Yuk-Ming Lai, Chi Kong Tse, "Sliding mode control of switching Power Converters", 1st Edition, 2002.

VII. Reference Books:

1. Iqbal Hussein, Electric and Hybrid Vehicles: Design fundamentals, CRC Press, 1st Edition 2003.
2. MehrdadEhsani, YimiGao, Sebastian E Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 1st Edition 2004.
3. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 1st Edition 2003.
4. Design of a Hybrid Electric Vehicle (HEV), Design of a Battery Electric Vehicle (BEV).

VIII. Web References:

1. https://www.ae.pwr.wroc.pl/filez/20110606092353_HEV.pdf
2. https://www.unep.org/transport/pcfv/PDF/HEV_Report.pdf
3. https://www.seai.ie/News_Events/Press_Releases/Costs_and_benefits.pdf

IX. E-Text Books:

1. https://www.onlinelibrary.wiley.com/book/10.1002/9781119998914
2. https://www.go2hev.com/hybrid-electric-vehicles-student-textbook.html
3. https://www.sciencedirect.com/science/book/9780444535658
4. https://www.accessengineeringlibrary.com/browse/hybrid-electric-vehicle-design-and-control-intelligent -omnidirectional-hybrids

ADVANCED DIGITAL SIGNAL PROCESSING

PE-II: EPS								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
BPSC09	**Elective**	3	0	0	3	30	70	100
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 45**		

Prerequisite: Signals and Systems, Digital Signal Processing

I. COURSE OVERVIEW:

The course provides a good understanding of DSP principles, and their implementation and equips students to put the ideas into practice and/or to tackle more advanced aspects of DSP. This course will provide a comprehensive grounding in DSP concepts and algorithms, plus practical information on the design and implementation of DSP systems

II. COURSE OBJECTIVES:

The students will try to learn:

I. The background and fundamental material for the analysis and processing of digital signals.
II. The fast computation of DFT and appreciate the FFT processing.
III. The designs and structures of digital (IIR and FIR) filters and analyze and synthesize for a given specifications.

III. COURSE OUTCOMES:

CO1	Demonstrate an understanding of the building blocks of basic and modern control systems by creating mathematical models of physical systems in input-output or transfer function form;	Understand
CO2	Organize state representations to satisfy design requirements using transformations and decompositions	Apply
CO3	Understand theory of prediction and solution of normal equations	Understand
CO 4	Assess a system for its stability, controllability, and observability properties leading to design of controller and observer in a feedback control system	Apply
CO 5	Aspire for pursuing a carrier in control, recognize the need to learn, to engage and to adapt in a world of constantly changing technology and play role of team leader or supporter of team.	Understand

IV. COURSE SYLLABUS:

MODULE-I: INTRODUCTION (9)

Discrete time systems, types of signals and their characteristics, types of systems and their behavior. analysis of discrete time linear invariant systems, convolution and correlation of discrete time systems ,z transforms and inverse z transform, Properties of z transform, ROC and its properties

MODULE-II: DISCRETE-TIME FOURIER TRANSFORM AND FAST FOURIER TRANSFORMS (9)

Discrete-time Fourier transform: Definition of Fourier transform (FT), important properties of FT, , The Discrete Fourier transforms, its properties and applications. Frequency domain sampling, properties of DFT, Computation of DFT: Over-Lap Add Method, Over-Lap Save Method, Relation between DTFT, DFS, DFT and Z- Transform. Fast Fourier Transforms: Fast Fourier Transforms (FFT) - Radix-2 Decimation-in-Time and Decimation-in-Frequency FFT Algorithms, Inverse FFT

MODULE-III: DIGITAL FILTER DESIGN (10)

IIR Filter: Designs based on analog filter approximation impulse invariant, Bilinear transformation, Time domain design techniques. Buttorworth, Chebyshev type I & II,

Properties and design of FIR filters: Properties, Design techniques - window technique, Frequency sampling

comparison of IIR and FIR filters.

MODULE-IV: POWER SPECTRUM ANALYSIS (8)
Power spectrum estimation, Non-parametric and parametric methods for power spectrum estimation. Period gram method, Blackman – Turkey method, fast correlation method. Autoregressive spectrum estimation.

MODULE-V: WAVELET TRANSFORMS (9)
Wavelet Transforms: Short Time Fourier Transform, introduction of Continuous Wavelet Transform, Discretization of the Continuous Wavelet Transform (DWT). Introduction to discrete and fast wavelet transforms.

IV. TEXT BOOKS

1. Discrete Time Signal Processing – A. V. Oppenheim and R.W. Schaffer, PHI, 2009
2. Digital Signal Processing, Principles, Algorithms, and Applications: John G. Proakis, Dimitris G. Manolakis, Pearson Education / PHI, 2007.
3. S.K. Mitra, Digital Signal Processing, A Computer-Based Approach, Tata Mc GrawHill, 1998

V. REFERENCE BOOKS:

1. Digital Signal Processing – Fundamentals and Applications – Li Tan, Elsevier, 2008
2. Fundamentals of Digital Signal Processing using MATLAB – Robert J. Schilling, Sandra L. Harris, Thomson, 2007
3. Digital Signal Processing – S. Salivahanan, A. Vallavaraj and C. Gnanapriya, TMH, 2009
4. Digital Signal Processing - A Practical approach, Emmanuel C. Ifeachor and Barrie W. Jervis, 2nd Edition, Pearson Education, 2009

VI. WEB REFERENCES:

1. https://www.researchgate.net
2. https://www.electrical4u.com
3. https://web.iitd.ac.in/~sumeet/WaveletTutorial.pdf
4. http://www-syscom.univ-mlv.fr/~zaidi/teaching/dsp-esipe-oc2/Course-Notes__Advanced-DSP.pdf

VII. E-TEXT BOOKS:

1. https://www.jntubook.com/
2. https://www.itseyeris.com/book/digital-signal-processing-a-practical-guide-for-engineers-and-scientists

ELECTRICAL POWER DISTRIBUTION SYSTEM

PE-II: EPS								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BPSC10	**Elective**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	0	0	3	30	70	100
Contact Classes: 45	**Total Tutorials: Nil**	**Total Practical Classes: Nil**				**Total Classes: 45**		

I. COURSE OVERVIEW:

Electric power distribution system plays an important role in the efficient operation of a modern industrial plant. Such a system includes high voltage circuit breakers, switchgear, transformers, motor control centers, electric motors, variable speed drive sheds' trouble-free electrical system is essential for an interruption-free plant operation. This course will cover all aspects of power distribution, including system planning, equipment selection and application, system grounding, protection and conformity with electrical code requirements, etc.

II. COURSE OBJECTIVES:

The students will try to learn:

I. The application of SCADA in power distribution systems.
II. The distribution management and distribution automation.
III. The Maintenance and AI techniques of automated distribution systems

III. COURSE OUTCOMES:

After successful completion of the course, students will be able to:		
CO 1	**Understand** the importance of load forecasting in Distribution system to meet the future electrical load demands	Understand
CO 2	**Apply** different types of power factor correction methods to increase the efficiency of the distribution system	Apply
CO 3	**Analyze** communication systems, remote metering, automatic meter for collecting the data that's needed for billing purposes	Analyze
CO 4	**Make use of** SCADA in distribution automation to maintain efficiency, process data for smarter decisions	Understand
CO 5	**Examine** placement of optimal switching devices for monitoring and to increase the efficiency of the distribution system	Evaluate
CO 6	**Apply** AI techniques in electrical distribution system to enhance efficiency, reliability, and quality of electric service.	Apply

IV.SYLLABUS

MODULE –IDISTRIBUTION OF POWER(09)

Distribution of power, management, power loads, load forecasting short-term and long-term, power system loading, technological forecasting

MODULE –II: ADVANTAGES OF DISTRIBUTION MANAGEMENT SYSTEM (10)

Advantages of distribution management system (D.M.S.): Distribution Automation, definition, restoration, reconfiguration of distribution network, different methods and constraints, power factor correction.

MODULE –III: INTERCONNECTION OF DISTRIBUTION(08)

Interconnection of distribution, control, communication systems, remote metering, automatic meter reading and its implementation; SCADA: Introduction, block diagram, SCADA applied to distribution automation.

Common Functions of SCADA: Advantages of distribution automation through SCADA.

MODULE –IV: OPTIMAL SWITCHING DEVICE PLACEMENT(09)

Calculation of optimum number of switches, capacitors, optimum switching device placement in radial, distribution systems, sectionalizing switches, types, benefits, bellman's optimality principle, remote terminal units, energy efficiency in electrical distribution, monitoring

MODULE –V: MAINTENANCE OF AUTOMATED DISTRIBUTION SYSTEMS (09)

Maintenance of automated distribution systems, difficulties in implementing distribution, automation in actual practice, urban, rural distribution, energy management, AI techniques applied to distribution automation.

V. Text Books:

1. AS Pabla, "Electric Power Distribution", Tata McGraw Hill Publishing Co. Ltd., 4thEdition, 2012.
2. MK Khedkar, GMDhole, "A Text Book of Electrical power Distribution Automation", University Science Press, NewDelhi, 2nd Edition, 2010.

VI. Reference Books:

1. Anthony J Panseni, "Electrical Distribution Engineering", CRCPress, 2nd Edition, 2010.
2. James Momoh, "Electric Power Distribution, automation, protection & control", CRC Press 2ndEdition, 2006.

VII. Web References:

1. https://www.nptelvideos.in/2012/11/distribution-automation.html
2. https://www.powersystem.org/distribution-automation
3. https://www.sciencedirect.com

VIII. E-Text Books:

1. https://www.schneider-electric.us/documents/customers/utility/br-distribution-feeder-automation.pdf
2. https://www.pdfs.semanticscholar.org/099e/bffd3b296af4aa0ef7b7777721f178be6b28.pdf

POWER SYSTEM COMPUTATIONAL LABORATORY

I Semester: EPS								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BPSC11	**Core**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		0	0	4	2	30	70	100
Contact Classes: Nil	**Total Tutorials: Nil**	**Total Practical Classes: 36**				**Total Classes: 36**		

I. COURSE OVERVIEW:

The main objective of the course is to provide a software-based power system analysis. This lab course will provide the computer-based formation of bus admittance matrix. It will also analyze the transient stability and load dispatch problem. It will also cover state estimation of power system and unit commitment problem.

II. COURSE OBJECTIVES:

The students will try to learn:

I. Y bus, Z bus for a n bus system and analyze various load flow studies.
II. Steady state, transient stability analysis and economic load dispatch problem.
III. State estimation of power system and unit commitment problem.

III. COURSE OUTCOME:

After successful completion of the course, students will be able to:		
CO 1	**Understand** the concept of Admittance matrix for the formulation of various inspection and transformation methods.	Understand
CO 2	**Develop** the programming for load flow algorithms.	Apply
CO 3	**Analyze** the characteristics of fast decoupled loaf flow methods for developing algorithm.	Analyze
CO 4	**Analyze** the features of various algorithms applicable for protection of Transformers and transmission lines.	Apply
CO 5	**Categorize** the transient and short circuit analysis for analysing the performance of the system.	Analyze
CO 6	**Analyze** the various iterative methods applicable for state estimation of the power system.	Analyze

III. LIST OF EXPERIMENTS:

EXPERIMENT –I: FORMATION OF BUS ADMITTANCE MATRIX

Develop program for Y_{bus}formation by direct inspection method.

EXPERIMENT –II: SINGULAR TRANSFORMATION

Develop program for Ybus formation by singular transformation method.

EXPERIMENT –III: GAUSS - SEIDAL LOAD FLOW METHOD

Develop program for G-S load flow algorithm

EXPERIMENT –IV: NEWTON - RAPHSON LOAD FLOW METHOD

Develop program for N-R load flow algorithm in polar coordinates.

EXPERIMENT –V: FAST DECOUPLED LOAD FLOW METHOD

Develop program for FDLF algorithm.

EXPERIMENT –VI: DC LOAD FLOW
Develop program for DC load flow algorithm.

EXPERIMENT –VII: BUILDING ALGORITHM
Develop Program for Z_{BUS} building algorithm

EXPERIMENT –VIII: SHORT CIRCUIT ANALYSIS
Develop program for short circuit analysis using Z_{BUS} algorithm.

EXPERIMENT – IX: TRANSIENT STABILITY
Develop program for transient stability analysis for single machine connected to infinite bus.

EXPERIMENT –X: LOAD DISPATCH PROBLEM
Develop program for economic load dispatch problem using lambda iterative method.

EXPERIMENT –XI: DYNAMIC PROGRAMMING METHOD
Develop program for unit commitment problem using forward dynamic programming method.

EXPERIMENT –XII: STATE ESTIMATION
Develop program for state estimation of power system.

V. Reference Books:

1. DP Kothari, B S Umre, "Lab manual for Electrical Machines", IK International Publishing House Pvt. Ltd, 1st Edition, 1996.
2. MariesaLCrow, "Computational Methods for Electric Power Systems (Electric Power Engineering Series)", CRC Press Publishers, 1st Edition, 1992.

VI. Web References:

1. https://www.ee.iitkgp.ac.in
2. https://www.citchennai.edu.in
3. https://www.iare.ac.in
4. https://www.deltaww.com

IoT APPLICATIONS LABORATORY

I Semester: EPS								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BPSC12	**Core**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		0	0	4	2	30	70	100
Contact Classes: Nil	**Total Tutorials: Nil**	**Total Practical Classes: 36**				**Total Classes: 36**		

I. COURSE OVERVIEW:

The goal of the lab to fundamental understands of IoT using Arduino programming for different electrical digital apparatus. It will also explain the interfacing of data, I/O devices with Arduino UNO like Bluetooth, sensors, Webpage etc. It will also cover the digital protection schemes. A goal of the lab is to develop test-beds and experimental facilities, demonstrating the effects of ubiquitous IoT technology.

II. COURSE OBJECTIVES:

The students will try to learn:

I. The IoT using Arduino programming.
II. Interfacing of data, I/O devices with Arduino UNO.
III. Digital protection schemes in power system relays.

III. COURSE OUTCOME:

After successful completion of the course, students will be able to:		
CO 1	**Understand** the concept of Internet of Things for implementation of digital measuring devices.	Understand
CO 2	**Develop** the Arduino programming for controlling lightning appliances.	Apply
CO 3	**Analyze** the characteristics of bluetooth modules for controlling the performance of appliances.	Analyze
CO 4	**Analyze** the features of various algorithms applicable for protection of Transformers and transmission lines.	Apply
CO 5	**Categorize** the digital relying algorithms for protection of three phase induction motor.	Analyze
CO 6	**Analyze** the various algorithms applicable for over current protection.	Analyze

IV. LIST OF EXPERIMENTS:

EXPERIMENT –I: ARDUINO BASED DIGITAL VOLTMETER, AMMETER
Design of digital voltmeter and ammeter using Arduino.

EXPERIMENT –II: ARDUINO BASED WATTMETER, ENERGY METER
Design of digital wattmeter and energy meter using Arduino.

EXPERIMENT –III: CONROLLING RGB LED
Programming for Controlling RGB LED using Arduino and Wi-Fi module.

EXPERIMENT –IV: IOT TO CONTROL REMOTE LED
Programming for Internet of things with Android and Arduino. Build an Arduino based IoT to control a remote LED.

EXPERIMENT –V: INTERFACING BLUETOOTH MODULE

Programming for how to interface HC-05 Bluetooth module with Arduino UNO for control of small dc motor.

EXPERIMENT –VI: INTERFACING TO TEMPERATURE SENSOR

Programming to Interface temperature sensor and monitoring the room temperature using IoT with Arduino Uno and display the digital value on LCD screen.

EXPERIMENT –VII: INTERFCAING IR SENSOR

Programming to Interface IR sensors and Bluetooth for detecting obstacle using Arduino with android Application.

EXPERIMENT –VIII: INTERFACE TO MOTION AND GAS SENSOR

Programming to interface a motion sensor to use GPIO pins with a Raspberry Pi

Programming to interface Gas sensor for detection and monitoring of harmful gases using Arduino and IoT.

EXPERIMENT – IX: SEND DATA FROM ARDUINO TO WEB PAGE

Programming for how to send data from Arduino to Webpage using Wi-Fi module.

EXPERIMENT –X: DIGITAL PROTECTION OF THREE PHASE INDUCTION MOTOR

Studying the ON / OFF control strategies of small dc motor using IoT.

EXPERIMENT–XI: DIGITAL PROTECTION OF TRANSFORMERS AND TRANSMISSION LINES

Study the protection schemes of three phase induction motor against over current and under voltage at remote location through IoT.

EXPERIMENT–XII: OVER CURRENT RELAY

Design of over current relay in distribution system and displaying the tripping status of the relay through IoT

V. Reference Books:

1. Mark Torvalds, “Arduino Programming: Step-by-step guide to mastering arduino hardware and software (Arduino, Arduino projects, Arduinouno, Arduino starter kit, Arduino ide, Arduinoyun, Arduino mega, Arduinonano) Kindle 2nd Edition, 2001.
2. Michael J Pont, “Embedded C”, Pearson Education, 2nd Edition, 2008.

VI. Web References:

1. https://www.ee.iitkgp.ac.in
2. https://www.citchennai.edu.in
3. https://www.iare.ac.in
4. https://www.deltaww.com

DIGITAL PROTECTION OF POWER SYSTEM

II Semester: EPS								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BPSC13	**Core**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	0	0	3	30	70	100
Contact Classes: 45	**Total Tutorials: Nil**	**Total Practical Classes: Nil**				**Total Classes: 45**		

I. COURSE OVERVIEW:

This course will provide the mathematical background of digital protection and understanding the importance of Digital Relays. It will also develop various protection algorithms. It will also cover the application of digital protection.

II. COURSE OBJECTIVES:

The students will try to learn:

I. The need of numerical relays and their importance in digital protection of the power system.
II. The mathematical approach towards designing algorithms for the protection of power system.
III. The methods of protection employed for the transformers and transmission lines.

III. COURSE OUTCOMES:

After successful completion of the course, students will be able to:		
CO 1	**Illustrate** the significance of protection systems and elements involved in protection of the power system	Understand
CO 2	**Develop** the structures, mathematical models and formulae of digital relays for mathematical analysis of the system	Apply
CO 3	**Identify** the basic components of digital relay and signal conditioning subsystems for implementation of digital protection.	Apply
CO 4	**Develop** the mathematical models for analysis of the relying algorithms to address the various types of faults in the power system	Apply
CO 5	**Categorize** the digital relying algorithms to minimize the transient deviations and steady state error to zero	Analyze
CO 6	**Analyze** the various algorithms applicable for protection of Transformers and transmission lines.	Analyze

IV. SYLLABUS

MODULE–I:MATHEMATICAL BACKGROUND TO DIGITAL PROTECTION (09)

Overview of static relays, transmission line protection, transformer protection, need for digital protection; performance and operational characteristics of digital protection, basic structure of digital relays, finite difference techniques, interpolation formulas, numerical differentiation, curve fitting and smoothing, Fourier analysis, Walsh function analysis, relationship between Fourier and Walsh coefficients.

MODULE -II: BASIC ELEMENTS OF DIGITAL PROTECTION (09)

Basic components of a digital relay, signal conditioning subsystems, conversion subsystem, digital relay subsystem, the digital relay as a unit

MODULE -III: DIGITAL RELAYING ALGORITHMS-I(10)

Sinusoidal wave-based algorithms: Sample and first derivative methods, first and second derivative methods, two sample technique, three sample technique, an early relaying scheme. Fourier analysis-based algorithms: Full cycle window algorithm, fractional-cycle window algorithms, Fourier-transform based algorithm. Walsh-function-based algorithms.

Unbalanced faults: Introduction to symmetrical components, sequence impedances, sequence circuits of synchronous machine, transformer and transmission lines, sequence networks analysis of single line to ground, line to line and double line to ground faults using Thevenin's theorem and Z-bus matrix.

MODULE -IV: DIGITAL RELAYING ALGORITHMS-II(09)

Least squares based methods: Integral LSQ fit, power series LSQ fit, multi-variable series LSQ technique, determination of measured impedance estimates; differential equation based techniques: representation of transmission lines with capacitance neglected, differential equation protection with selected limits, simultaneous differential equation techniques; travelling-wave based protection: fundamentals of travelling-wave based protection, Bergeron's-equation based protection scheme, ultra-high-speed polarity comparison scheme, ultra-high-speed wave differential scheme, discrimination function based scheme, superimposed component trajectory based scheme.

MODULE -V:DIGITAL PROTECTION OF TRANSFORMERS AND TRANSMISSION LINES (09)

Principles of transformer protection, digital protection of Transformer using FIR filter-based algorithm, least squares curve fitting based algorithms, Fourier-based algorithm, flux-restrained current differential relay; Digital Line differential protection: Current-based differential schemes, Composite voltage- and current- based scheme.

V. Text Books:

1. AG Phadke and J S Thorp, "Computer Relaying for Power Systems", Wiley/Research studies Press, 1st Edition, 2009.
2. AT Johns and S K Salman, "Digital Protection of Power Systems", IEEE Press, 1st Edition, 1999.

VI. Reference Books:

1. Gerhard Zeigler, "Numerical Distance Protection", Siemens Public Corporate Publishing, 1st Edition, 2006.
2. SRB hide "Digital Power System Protection" PHI Learning Pvt.Ltd. 3rd Edition, 2014.

VII. Web References:

1. https://www.sciencedireect.com
2. https://www.spinger.com
3. https://www.ieeexplore.ieee.org/Xplore/home.jsp

VII. E-Text Books:

1. https://www.nptel.ac.in/downloads/108105066/
2. https://www.minitorn.tlu.ee/~jaagup/kool/java/kursused/15/robootika/elektriopik.pdf

POWER SYSTEM DYNAMICS AND STABILITY

II Semester: EPS								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BPSC14	**Core**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	0	0	3	30	70	100
Contact Classes: 45	**Total Tutorials: Nil**	**Total Practical Classes: Nil**				**Total Classes: 45**		

I. COURSE OVERVIEW:

This course will illustrate to the development of mathematical models for synchronous machine, Exciter, Governor and Prime mover. It will also cover power system dynamic phenomena and the effects of exciter and governor control. This course will also provide the idea of power system stability and help the students to understand methods to improve dynamic stability.

II. COURSE OBJECTIVES:

The students will try to learn:

I. Mathematical models for synchronous machine, Exciter, Governor and Prime mover.
II. Power system dynamic phenomena and the effects of exciter and governor control.
III. The methods to improve dynamic stability

III. COURSE OUTCOMES:

After successful completion of the course, students will be able to:		
CO 1	**Illustrate** the significance of power system stability and approach for analysis of multi machine system.	Understand
CO 2	**Develop** the state space equations, unit conversions, equivalent circuits for mathematical analysis of the synchronous machines.	Apply
CO 3	**Develop** the basic components of digital relay and signal conditioning subsystems for implementation of digital protection.	Apply
CO 4	**Identify** the types of excitation and voltage control configurations to address the effects of voltage changes and reactive power.	Analyze
CO 5	**Explain** the methods to enhance the small signal stability of the power system.	Analyze

I. SYLLABUS

MODULE –I: POWER SYSTEM STABILITY: A CLASSICAL APPROACH (09)

Introduction, requirements of a reliable electrical power service, swing equation, power-angle curve, stability analysis of SMIB system, equal area criteria, classical model of a multi-machine system, shortcomings of the classical model, block diagram of one machine, system response to small disturbances: types of problems studied, the unregulated synchronous machine, modes of oscillation of an unregulated multi-machine system, regulated synchronous machine.

MODULE -II: SYNCHRONOUS MACHINE MODELING-I (09)

Introduction, Park's Transformation, flux linkage equations, voltage equations, formulation of state-space equations, current formulation, per unit conversion, normalizing the voltage and torque equations, equivalent circuit of a synchronous machine, the flux linkage state-space model, load equations, sub-transient and transient inductances and time constants, simplified models of the synchronous machine, turbine generator dynamic models.

MODULE -III: SYNCHRONOUS MACHINE MODELING-II (09)

Steady state equations and phasor diagrams, determining steady state conditions, evaluation of initial conditions, determination of machine parameters.

Digital simulation of synchronous machines, linearization and simplified linear model and state-space representation of simplified model.

MODULE -IV:EXCITATION AND PRIME MOVER CONTROL (09)

Simplified view of excitation control, control configurations, typical excitation configurations, excitation control system definitions, voltage regulator, exciter buildup, excitation system response, state-space description of the excitation system, computer representation of excitation systems, typical system constants, and the effects of excitation on generator power limits, transient stability and dynamic stability of the power system; Prime mover control: Hydraulic turbines and governing systems, steam turbines and governing systems.

MODULE -V: SMALL SIGNAL STABILITY ANALYSIS (09)

Fundamental concepts of stability of dynamic systems, Eigen properties of the state matrix, small-signal stability of a single-machine infinite bus system, effects of excitation system, power system stabilizer, system state matrix with amortizes, characteristics of small-signal stability problems.

V. Text Books:

1. P M Anderson & A A Fouad "Power System Control and Stability", Galgotia, New Delhi, 1st Edition, 1981.
2. J Machowski, J Bialek& J R W Bumby, "Power System Dynamics and Stability", John Wiley &Sons, 1st Edition, 1997.

VI. Reference Books:

1. P Kundur, "Power System Stability and Control", McGraw Hill Inc., 1st Edition, 1994.
2. E WKimbark,"Powersystemstability",Vol.I&III,JohnWiley&Sons,NewYork, 1st Edition, 2002.
3. L Leonard Grigsby (Ed.); "Power System Stability and Control", Second edition, CRC Press, 1st Edition, 2007

VII. Web References:

1. https://www.scribd.com/doc/27104147/Electric-Motor-Drives-Modeling-Analysis-And-Control-2001-R-Krishnan.

VIII. E-Text Books:

1. https://www.Bimal K. Bose-Modern power electronics and AC drives -Prentice Hall PTR (2002)
2. https://www.freebookcentre.nethttp://www.nptel.ac.in/courses/108105066/PDF/L-1(SSG)(PE)%20((EE)NPTEL).pdf

SWARM INTELLIGENCE TECHNIQUES IN POWER SYSTEMS

PE-III: EPS								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
BPSC15	**Elective**	3	0	0	3	30	70	100
Contact Classes: 45	**Total Tutorials: Nil**	**Total Practical Classes: Nil**				**Total Classes: 45**		

I. COURSE OVERVIEW:

This course gives a basic idea about the soft computing technique and also discuss about the discrimination of the capabilities of bio-inspired system and conventional methods in solving optimization problems and examine the importance of exploration and exploitation of swarm intelligent system to attain near global optimal solution. This course covers of various swarm intelligent systems like: Bee colony, ant colony etc. It will also help to employ various bio-inspired algorithms for power systems engineering applications.

II. COURSE OBJECTIVES:

The students will try to learn:

I. Evolutionary algorithms like GA, PSO, ANT Colony and BEE colony etc.
II. Evolutionary algorithms to solve power systems problems.
III. Solution of multi objective optimization using these algorithms.

III. COURSE OUTCOMES:

After successful completion of the course, students will be able to:		
CO 1	**Illustrate** the capabilities of bio-inspired system and conventional methods in solving optimisation problems	Understand
CO 2	**Analyze** the importance of exploration and exploitation of swarm intelligent system to attain near global optimal solution.	Apply
CO 3	**Distinguish** the functioning of various swarm intelligent systems for solving power system problems.	Apply
CO 4	**Develop** various bio-inspired algorithms for the power system engineering applications.	Apply
CO 5	**Categorize** the optimization problems using evolutionary techniques using genetic algorithms and particle swarm optimization.	Analyze
CO 6	**Analyze** the various search methods to for solving constrained and unconstrained optimization problems.	Analyze

IV. SYLLABUS:

MODULE –I: FUNDAMENTALS OF SOFT COMPUTING TECHNIQUES (09)

Definition classification of optimization problems unconstrained and constrained optimization optimality conditions Introduction to intelligent systems soft computing techniques conventional computing versus swarm computing classification of meta heuristic techniques single solution based and population based algorithms exploitation and exploration in population based algorithms, properties of Swarm intelligent Systems-application domain, discrete and continuous problems single objective and multi objective problems.

MODULE –II: GENETIC ALGORITHM AND PARTICLE SWARM OPTIMIZATION SYSTEM (09)

Genetic algorithms genetic algorithm versus conventional optimization techniques genetic representations and selection mechanisms, genetic operators' different types of crossover and mutation operators bird flocking and fish schooling anatomy of a particle equations based on

velocity and positions PSO topologies control parameters GA and PSO algorithms for solving ELD problems.

MODULE –III: ANT COLONY OPTIMIZATION AND ARTIFICIAL BEE COLONY ALGORITHMS (09)

Genetic algorithms genetic algorithm versus conventional optimization techniques genetic representations and selection mechanisms, genetic operators' different types of crossover and mutation operators bird flocking and fish schooling anatomy of a particle equations based on velocity and positions PSO topologies control parameters GA and PSO algorithms for solving ELD problems.

MODULE –IV: SHUFFLED FROGLEAPING ALGORITHM AND BAT OPTIMIZATION ALGORITHM (09)

Bat algorithm: Echolocation of bats behavior of micro bats acoustics of echolocation movement of virtual bats, Loudness and pulse Emission, Shuffled frog algorithm-virtual population of frogs-comparison of memes and genes memeplex formation, memeplex updation, BA and SFLA algorithms for solving ELD and optimal placement and sizing of the DG problem.

MODULE –V: MULTI OBJECTIVE OPTIMIZATION(Classes: 09)

Multi Objective optimization introduction concept of pare to optimality-non-dominant sorting technique pare to Fronts best compromise solution-min-max method-NSGA-II algorithm and applications to power systems.

V. Text Books:

1. Xin-She Yang, 'Recent Advances in Swarm Intelligence and Evolutionary Computation' Springer International Publishing, Switzerland, 4th Edition, 2015.
2. Kalyanmoy Deb, 'Multi-Objective Optimization using Evolutionary Algorithms', John Wiley & Sons, 2nd Edition, 2001.

VI. Reference Books:

1. James Kennedy and Russel E Eberheart, "Swarm Intelligence", The Morgan Kaufmann Series in Evolutionary Computation, 2nd Edition, 2001.
2. Eric Bonabeau, Marco Dorigo and Guy Theraulaz, 'Swarm Intelligence-From natural to Artificial Systems', Oxford university Press, 2nd Edition, 1999.
3. David Goldberg, 'Genetic Algorithms in Search, Optimization and Machine Learning', Pearson Education, 2nd Edition, 2007.
4. Konstantinos E. Parsopoulos and Michael N. Vrahatis, "Particle Swarm Optimization and Intelligence: Advances and Applications", Information Science reference, IGI Global, 2nd Edition, 2010.
5. N P Padhy, 'Artificial Intelligence and Intelligent Systems', Oxford University Press, 2nd Edition, 2005.

VII. Web References:

1. https://www.researchgate.net/publication/277571471
2. https://www.researchgate.net/publication/220834557

VIII. E-Text Books:

1. file.scirp.org/pdf/IJCCE_2013072414532965.pdf
2. rtpis.org/documents/mypaper/RTPIS_publication_1284584660.pdf

INDUSTRIAL LOAD MODELLING AND CONTROL

PE-III: EPS								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BPSC16	**Elective**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	0	0	3	30	70	100
Contact Classes: 45	**Total Tutorials: Nil**	**Total Practical Classes: Nil**				**Total Classes: 45**		

I. COURSE OVERVIEW:

This course deals with the Electrical energy scenario of Demand and load side management, Optimization and control algorithms and reactive power management of direct and interruptible load control, load profiling of cooling and heating loads and cool storage and control strategies, problem formulation, describe capacitive power units and power pooling, Illustrate optimal operating and control strategies of optimal operating condition and load management for industries.

II. COURSE OBJECTIVES:

The students will try to learn:

I. The Electric Energy Scenario - industrial load management and their implementation through various classical methods.
II. The necessity and power quality improvements of generation, transmission and distribution of electrical power for energy saving in industries.
III. The concepts of captive power units its operation, power pooling and industrial cogeneration with characteristics for real-world engineering problems and applications.
IV. the optimal operating strategies required on the system to meet the minute-to-minute variation of system demand and its significance in power system operation and control by maintaining the frequency and voltage as constant.

III. COURSE OUTCOMES:

After successful completion of the course, students will be able to:		
CO 1	**Apply** knowledge of engineering science including electrical circuits, control systems and electrical machines in industrial load modelling and control.	Apply
CO 2	**Determine** the industrial load management in a power system to supply specific amount of demand.	Understand
CO 3	**Outline** the interruptible load control, Direct load control, controls power quality impacts for minimising transmission line losses and energy saving in industries.	Apply
CO 4	**Analyse** the cooling and heating loads, cool storage, control strategies in an industrial power system.	Analyze
CO 5	**Design** a capitative power unit in industrial load for imparting knowledge of various controllers with its evolution, principle of operation and applications.	Apply
CO 6	**Determine** the optimal operating strategies of power capacitors for integrated load management and industries with economic justification.	Apply

III SYLLABUS:

MODULE –I: ELECTRIC ENERGY SCENARIO(09)

Electric Energy Scenario, Demand Side Management, Industrial Load Management, Load Curves, Load Shaping Objectives, Methodologies, Barriers, Classification of Industrial Loads, Continuous and Batch Processes, Load Modeling.

MODULE –II: DIRECT LOAD CONTROL INTERRUPTIBLE LOAD CONTROL (09)

Direct load control, interruptible load control, bottom-up approach, scheduling, formulation of load models, optimization and control algorithms, case studies, reactive power management in industries, controls power quality impacts, application of filters, energy saving in industries.

MODULE –III: COOLING AND HEATING LOADS LOAD PROFILING (09)

Cooling and heating loads, load profiling, modeling, cool storage, types.
Control strategies, optimal operation, problem formulation, case studies.

MODULE –IV: CAPTIVE POWER UNITS(Classes: 09)

Captive power units, operating and control strategies, power pooling, operation models, energy banking, industrial cogeneration.

MODULE –V: OPTIMAL OPERATING STRATEGIES(Classes: 09)

Selection of schemes, optimal operating strategies, peak load saving, constraints problem formulation, case study, integrated load management for industries.

IV. Text Books:

1. CO Bjork “Industrial Load Management - Theory, Practice and Simulations", Elsevier, the Netherlands, 1st Edition, 1989.
2. CW Gellings and S NTalukdar, “Load management concepts,” IEEE Press, New York, 2nd Edition, 1986.

V Reference Books:

1. Y. Manichaikul and F.C. Schweppe, "Physically based Industrial load", IEEE Trans. on PAS, April, 2nd Edition, 1981.
2. H. G. Stoll, "Least cost ElectricityUtility Planning”, Wiley Interscience Publication, USA, 2nd Edition, 1989.
3. I.J.Nagarath and DPKothari, .Modern Power System Engineering., Tata McGraw Hill publishers, New Delhi,1st Edition, 1995.
4. IEEE Bronze Book- “Recommended Practice for Energy Conservation and cost effective Planning in Industrial facilities”, IEEE Inc,USA.

VI Web References:

1. https://www.researchgate.net/publication/257725360_Modelling
2. https://www.ethesis.nitrkl.ac.in/5348/1/109EE0274.pd

VII E-Text Books:

1. https://www.pacontrol.com/.../Industrial-Automation-Pocket-Guide.pdf
2. https://www.matlabi.ir/wp-content/uploads/bank_papers/cpaper/c117.

CYBER SECURITY IN POWER SYSTEMS

PE-III: EPS								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
BPSC17	**Elective**	3	0	0	3	30	70	100
Contact Classes: 45	**Total Tutorials: Nil**	**Total Practical Classes: Nil**				**Total Classes: 45**		

I. COURSE OVERVIEW:

In this course will the following topics are dealt with: cyber security; power systems; industrial control system safety; next generation smart grid solution security; complex network protection; critical environment remote access; supply chain security; IT-operational technology integration; cyber-attacks; network advanced persistent threat attacker discovery; and cyber security in energy sector.

II. COURSE OBJECTIVES:

The students will try to learn:

I. The basic evolution of cyber threats.
II. Learn the cyber security requirements.
III. Understand the components of cyber security strategy and five step methodology.
IV. Evaluate privacy parameters of smart grid, research and development themes.

III. COURSE OUTCOMES:

After successful completion of the course, students will be able to:		
CO 1	**Relate** the need for cyber security and exploring of IT security background for power system	Understand
CO 2	**Demonstrate** the solutions for strengthening of the cyber security system in power generation, transmission, and distribution sectors against attackers, threats	Understand
CO 3	**Illustrate** the vulnerabilities in power system like attack on the computer monitoring and controlling devices, and attack on the SCADA network	Apply
CO 4	**Identify** the solutions, standards and guidelines, where to look further	Apply
CO 5	**Develop** a frame work for a cyber-security program to facilitate the development of Cyber Security Standards	Analyze

IV. SYLLABUS

MODULE –IINTRODUCTION TO CYBER SECURITY (Classes: 09)

Introduction to Cyber Security, Threats Harm, Risk Management, Vulnerabilities, Controls, Authentication, Information assurance: confidentiality, integrity and Access Control, Cryptography, Malware, Device and Network security, balancing cost, functionality, and security. Hands-on device security, Application of cyber security in power system

MODULE -IIINTRODUCTION TO SMART GRID(Classes: 09)

Need of computer control of power systems. Concept of energy control centre (or) load dispatch centre and the functions, system monitoring, Introduction to smart grid, evolution of electric grid, concept of smart grid, definitions, need of smart grid

MODULE -IIISMART GRID SYSTEM PERFORMANCE EVALUATION(Classes: 10)

Smart grid risks versus benefits , smart grid standards, laws, and industry guidance , Hands on relay threats and transient stability impact, smart grid operations, cost of maintenance and support , real time monitoring, analysis, visualization and evaluation of cyber-attacks, consumer's role in smart

grid, Measures for mitigation

MODULE -IVSMART GRID CYBERSECURITY(Classes: 09)

Advanced metering infrastructure security electric grid cyber-physical system: modeling, risk management and analysis, evaluation of cyber security threats, home area network, gateway, and neighborhood area network security, supervisory control and data acquisition system security, Modelling needs for cyber-physical security studies.

MODULE -VCYBER SECURITY IN THE ENERGY SECTOR (Classes: 09)

Overview on strategic priorities, areas and recommended actions, Cyber Response Framework, Reflection of Strategic Areas to the Energy Subsectors, Reflection of Strategic Areas to the Energy Subsectors

V. Text Books:

1. Eric D. Knapp, Raj Samani .Applied Cyber Security and the Smart Grid: Implementing Security Controls into the Modern Power Infrastructure, 2013.
2. Cyber Security for Industrial Control Systems: SCADA, DCS, PLC, HMI, and SIS, Tyson Mcculay, Bryan.L. Singer,Auerbach Publications; 1st Edition, 2012.

VI. Reference Books:

1.Blaabjerg, Sahoo &Dragicevic , Cyber Security for Microgrids, IET, ISBN: 978-1-83953-331-0

2. Salman, Digital Protection for Power Systems. 2nd Edition, IET Power system.

VII Web References:

1. https://cip.gmu.edu/2016/06/07/cyber-security-energy-systems-institutional-challenges
2. https://ec.europa.eu/energy/sites/ener/files/documents/eecsp_report_final.pdf
3. https://www.slideshare.net/jishnupradeep/cyber-security-of-power-grids
4. IET Cyber Security in Modern Power Systems

VIII E-Text Books:

1. https://ec.europa.eu/energy/sites/ener/files/documents/eecsp_report_final.pdf

Cyber security in modern power systems defending the grid, IET

RESTRUCTURED POWER SYSTEMS

PE-IV:EPS								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
BPSC18	**Elective**	3	0	0	3	30	70	100
Contact Classes: 45	**Total Tutorials: Nil**	**Total Practical Classes: Nil**				**Total Classes: 45**		

I. COURSE OVERVIEW:

This course introduces the differences between conventional power system and restructured power system. The course provides restructuring experiences of different countries with special focus on Indian power system. It elaborates the design of power markets, market architectural aspects, changes in operational aspects with new operational challenges like congestion management. It provides an insight to develop economically efficient power system.

II. COURSE OBJECTIVES:

The students will try to learn:

I. The role of the different types of organizations that operate in the various market structures
II. The consumer and supplier behavior, various components of production cost and tariff setting principles.
III. The deregulation of various power systems and the methods of congestion management.
IV. The pricing mechanism and power exchange in Indian power market.

III. COURSE OUTCOMES:

After successful completion of the course, students will be able to:		
CO 1	**Explain** deregulation of electric utilities in view of technical and economic issues in power industry.	Understand
CO 2	**Analyze** the consumer and supplier behavior with the principle of demand and supply elasticity	Analyze
CO 3	**Interpret** the restructured power systems across the world based on market architecture.	Understand
CO 4	**Analyze** the different pricing mechanisms to encourage efficient economic behavior	Analyze
CO 5	**Examine** transmission network usage pricing and loss allocation methods to ensure reliable and secure operation of power system.	Analyze
CO 6	**Interpret** congestion in transmission network with respect to ATC, TTC, TRM and CBM	Understand

IV SYLLABUS

MODULE –I: OVERVIEW OF RESTRUCTURED POWER SYSTEM (09)

Regulation and deregulation, vertically integrated and deregulated power industry, market models, Market Clearing Price (MCP), Independent System Operator (ISO), role of ISO, Ancillary service management, deregulation in Power Industry (Technical and Economic Issues).

MODULE –II: ECONOMIC CONSIDERATIONS IN RESTRUCTURED POWER SYSTEM (09)

Introduction, Consumer and Supplier behavior, Demand elasticity, Supply elasticity, Short-run and Long-run costs, various costs of production. Electricity pricing: Electricity pricing in generation, transmission and distribution, Introduction to Marginal cost, opportunity Costs, Dynamic pricing mechanism (ABT), Price elasticity of demand, Tariff setting principles, Distribution tariff for HT and LT consumers.

MODULE -IIIGLOBAL AND INDIAN MODELS OF RESTRUCTURED POWER SYSTEM (10)

Global models of restructured power system: Market evolution and deregulation in UK, USA, South America, Nordic pool, China, PJM ISO, and New York market.

Indian power market evolution: Electricity Act 2003 and various national policies and guidelines, Ministry of Power, Role of CEA, CERC, state ERC, load dispatch centers etc., implications of ABT tariff on Indian power sector, introduction to Indian power exchange.

MODULE -IVTRANSMISSION PRICING AND CONGESTION MANAGEMENT (08)

Transmission price components, various transmission pricing mechanisms, tracing of power, network usage and loss allocation; Introduction to congestion in transmission network, methods of congestion management.

MODULE -VOASIS (09)

Introduction of OASIS, Structure of OASIS, Pooling of information, transfer capability on OASIS and various concepts like ATC, TTC, TRM, and CBM.

V. Text Books:

1. Mohammad Shahidehpour, Muwaffaq Alomoush, "Restructured electrical power systems: operation, trading and volatility", Marcel Dekker. 2nd Edition, 1998.
2. Prayas Energy Group, Pune,"Know Your Power", A citizens Primer on the Electricity Sector, 2nd Edition, 2002.

VI. Reference Books:

1. Daniel Kirschen, GoranStrbac, "Fundamentals of Power System Economics", John Wiely& Sons Ltd. 2004
2. Kankar Bhattacharya, Jaap E Daadler, Math H J Boolen, "Operation of restructured power systems", Kluwer Academic Pub., 1st Edition, 2001.
3. Steven Stoft, "Power system economics: designing markets for electricity", John Wiley and Sons, 1st Edition, 2002.
4. Sally Hunt, "Making competition work in electricity", John Wiely& Sons, Inc., 1st Edition, 2002
   Loi Lei Lai, "Power System Restructuring and Deregulation" John Wiley and Sons, 1st Edition, 2001.

VII. Web References:

1. https://www.nptel.ac.in/courses/108101005
2. https://epdf.tips/restructured-electrical-power-systems-power**.**

VIII. E-Text Books:

1.shodhganga.inflibnet.ac.in/bitstream/10603/17295/13/13_chapter3.**pdf**

AI TECHNIQUES IN POWER SYSTEMS

PE-IV:EPS								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BPSC19	**Core**	**L**	**T**	**P**	**C**	**CIE**	**SEE**	**Total**
		3	0	0	3	30	70	100
Contact Classes: 45	**Total Tutorials: Nil**	**Total Practical Classes: Nil**				**Total Classes: 45**		

I. COURSE OVERVIEW:

This course introduces the differences between conventional power system and restructured power system. The course provides restructuring experiences of different countries with special focus on Indian power system. It elaborates the design of power markets, market architectural aspects, changes in operational aspects with new operational challenges like congestion management. It provides an insight to develop economically efficient power system.

II. COURSE OBJECTIVES:

The students will try to learn:

I. The role of the different types of organizations that operate in the various market structures
II. The consumer and supplier behavior, various components of production cost and tariff setting principles.
III. The deregulation of various power systems and the methods of congestion management.
IV. The pricing mechanism and power exchange in Indian power market.

III. COURSE OUTCOMES:

After successful completion of the course, students will be able to:		
CO 1	**Understand** the concepts of biological foundations of artificial neural networks for learning techniques	Understand
CO 2	**Analyze** the associative models in neural networks for correlations between data cases in the space of models.	Analyze
CO 3	**Identify** the neural networks control schemes for closed-loop performance in terms of small tracking errors and bounded controls.	Apply
CO 4	**Evaluate** fuzzy logic and its controllersforfuzzy rule base, data base and inference engine.	Evaluate
CO 5	**Analyze**the knowledge of genetic algorithm for for solving both constrained and unconstrained optimization problems	Analyze
CO 6	**Develop** applications of AI Techniques in electrical engineering for power generation, control, and transmission devices used by electric utilities.	Apply

IV. SYLLABUS

MODULE –I: OVERVIEW OF RESTRUCTURED POWER SYSTEM (09)

Regulation and deregulation, vertically integrated and deregulated power industry, market models, Market Clearing Price (MCP), Independent System Operator (ISO), role of ISO, Ancillary service management, deregulation in Power Industry (Technical and Economic Issues).

MODULE –II: ECONOMIC CONSIDERATIONS IN RESTRUCTURED POWER SYSTEM (09)

Introduction, Consumer and Supplier behavior, Demand elasticity, Supply elasticity, Short-run and Long-run costs, various costs of production. Electricity pricing: Electricity pricing in generation, transmission and distribution, Introduction to Marginal cost, opportunity Costs, Dynamic pricing mechanism (ABT), Price elasticity of demand, Tariff setting principles, Distribution tariff for HT and LT consumers

MODULE –III: GLOBAL AND INDIAN MODELS OF RESTRUCTURED POWER SYSTEM (10)

Global models of restructured power system: Market evolution and deregulation in UK, USA, South America, Nordic pool, China, PJM ISO, and New York market.

Indian power market evolution: Electricity Act 2003 and various national policies and guidelines, Ministry of Power, Role of CEA, CERC, state ERC, load dispatch centers etc., implications of ABT tariff on Indian power sector, introduction to Indian power exchange.

MODULE –IV: TRANSMISSION PRICING AND CONGESTION MANAGEMENT (08)

Transmission price components, various transmission pricing mechanisms, tracing of power, network usage and loss allocation; Introduction to congestion in transmission network, methods of congestion management.

MODULE –V: OASIS (09)

Introduction of OASIS, Structure of OASIS, Pooling of information, transfer capability on OASIS and various concepts like ATC, TTC, TRM, and CBM.

V. Text Books:

1. Mohammad Shahidehpour, Muwaffaq Alomoush, "Restructured electrical power systems: operation, trading and volatility", Marcel Dekker. 2nd Edition, 1998.
2. Prayas Energy Group, Pune, "Know Your Power", A citizens Primer on the Electricity Sector, 2nd Edition, 2002.

VI. Reference Books:

1. Daniel Kirschen, GoranStrbac, "Fundamentals of Power System Economics", John Wiely& Sons Ltd. 2004
2. Kankar Bhattacharya, Jaap E Daadler, Math H J Boolen, "Operation of restructured power systems", Kluwer Academic Pub., 1st Edition, 2001.
3. Steven Stoft, "Power system economics: designing markets for electricity", John Wiley and Sons, 1st Edition, 2002.
4. Sally Hunt, "Making competition work in electricity", John Wiely& Sons, Inc., 1st Edition, 2002
5. Loi Lei Lai, "Power System Restructuring and Deregulation" John Wiley and Sons, 1st Edition, 2001.

VII. Web References:

3. https://www.nptel.ac.in/courses/108101005
4. https://epdf.tips/restructured-electrical-power-systems-power.

VIII. E-Text Books:

1. shodhganga.inflibnet.ac.in/bitstream/10603/17295/13/13_chapter3.**pdf**

POWER QUALITY

PE-IV:EPS								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
BPSC20	**Elective**	3	0	0	3	30	70	100
Contact Classes: 45	**Total Tutorials: Nil**	**Total Practical Classes: Nil**				**Total Classes: 45**		

I. COURSE OVERVIEW:

This course deals with the basic concepts power quality problems, mitigation techniques used to improve power quality in distribution system. This course is designed to construct study of characterization of voltage sag magnitude and three phase unbalanced voltage sag. This course also concludes with the behavior of power electronics loads, induction motors and synchronous motors.

II. COURSE OBJECTIVES:

The students will try to learn:

I. Power quality issues in distribution and transmission system.
II. The characterization of voltage unbalance in three phase system.
III. The power quality improvement in different load conditions.

III. COURSE OUTCOMES:

After successful completion of the course, students will be able to:		
CO 1	**Identify** the Power Quality problem by applying the techniques to mitigate them.	Apply
CO 2	**Analyze** the methodology to improve the power qualityfor sensitive loads by various custom power devices.	Analyze
CO 3	**Analyze** the difference between failure, outage and Interruptions for reliability evaluation to power quality	Analyze
CO 4	**Analyze** the voltage sag and swell basedpower quality problem in Single phase and three phase system for deenergization of large load.	Analyze
CO 5	**Identify** the Power Quality problems in Industry power systems for harmonic distortions in the nonlinear loads.	Apply
CO 6	**Evaluate** power quality monitoring and classification mitigating techniques for the quality of voltage and current produced by a power plant.	Evaluate

IV. SYLLABUS

MODULE –I: INTRODUCTION (09)

Introduction of the power quality (PQ): Problem, terms used in PQ voltage, sag, swell, surges, harmonics, over voltages, spikes, voltage fluctuations, transients, interruption, overview of power quality phenomenon, remedies to improve power quality, power quality monitoring.

MODULE –II: LONG AND SHORT INTERRUPTIONS (10)

Interruptions: Definition, difference between failures, outage, interruptions, causes of long interruptions , origin of interruptions, limits for the interruption frequency, limits for the interruption duration, costs of interruption, overview of reliability evaluation to power quality, comparison of observations and reliability evaluation; Short Interruptions: Definition, origin of short interruptions, basic principle, fuse saving, voltage magnitude events due to re-closing, voltage during the interruption, monitoring of short interruptions, difference between medium and low voltage systems, multiple events, single phase tripping, voltage and current during fault period, voltage and current at

post fault period, stochastic prediction of short interruptions

MODULE –III: SINGLE AND THREE-PHASE VOLTAGE SAG CHARACTERIZATION (09)

Voltage sag: Definition, causes of voltage sag, voltage sag magnitude, and monitoring, theoretical calculation of voltage sag magnitude, voltage sag calculation in non-radial systems, meshed systems, and voltage sag duration.

Three phase faults: Phase angle jumps, magnitude and phase angle jumps for three phase unbalanced sags, load influence on voltage sags.

MODULE –IV: POWER QUALITY CONSIDERATIONS IN INDUSTRIAL POWER SYSTEMS (08)

Voltage sag; Equipment behavior of power electronic loads, induction motors, synchronous motors, computers, consumer electronics, adjustable speed AC drives and its operation, mitigation of ac drives, adjustable speed dc drives and its operation, mitigation methods of dc drives.

MODULE –V: MITIGATION OF INTERRUPTIONS AND VOLTAGE SAG (09)

Overview of mitigation methods: From fault to trip, reducing the number of faults, reducing the fault clearing time changing the power system, installing mitigation equipment, improving equipment immunity, different events and mitigation methods; System equipment interface: Voltage source converter, series voltage controller, shunt controller, combined shunt and series controller.

V. Text Books:

1. Math H J Bollen,"Understanding Power Quality Problems", IEEE Press, 1st Edition, 2007.
2. SastryVedam Mulukutla S Sarma, "Power Quality VAR Compensation in Power Systems", R,CRC Press, 1st Edition, 2004.

VI. Reference Books:

1. G T Heydt, "Electric Power Quality", (West Lafayette, IN, Stars in a circle Publications, 1st Edition, 1994.
2. A Ghosh, G Ledwich, "Power Quality Enhancement Using Custom Power Devices", Kluwer Academic, 1st Edition, 2002.

VII. Web References:

1. https://www.researchgate.net
2. https://www.aar.faculty.asu.edu/classes
3. https://www.facstaff.bucknell.edu/
4. https://www.electrical4u.com

VIII. E-Text Books:

1. https://www.jntubook.com/
2. https://www.freeengineeringbooks.com

DATA SCIENCE AND MACHINE LEARNING FOR MODERN POWER SYSTEMS

PE-IV:EPS								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BPSC21	**Elective**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	0	0	3	30	70	100
Contact Classes: 45	**Total Tutorials: Nil**	**Total Practical Classes: Nil**				**Total Classes: 45**		

I. COURSE OVERVIEW:

This subject will explain how data is generated in power systems and how are new technologies impacting the amount and quality of datasets. It will also help the students to understand popular data processing and analytic techniques. This course also provides the fundamental of machine learning and their application in modern power system operations. Writing term paper will help students to choose appropriate methods based on objective and dataset.

II. COURSE OBJECTIVES:

The students will try to learn:

I. Fundamentals of Data Science and its application in power system.
II. Data regression state estimation and forecasting.
III. The application of machine learning in power system.
IV. How to formulate the case study.

III. COURSE OUTCOMES:

After successful completion of the course, students will be able to:		
CO 1	**Summarize** the basics of power system and smart grid technology for understanding the performance of data driven system	Understand
CO 2	**Make use of** Singular Value Decomposition (SVD), and Monte Carlo simulation for state estimation and detection of anomalies in power system	Apply
CO 3	**Examine** data regression, data fitting and chi-square test by using the statistical studies for complex power analysis	Analyze
CO 4	**Analyze** the statistical proficiency and model identification for interference ofdata-based models of power system.	Analyze
CO 5	**Evaluate** the performance of smart grid/renewable energy/power system to study different data models.	Evaluate
CO 6	**Adapt the** operation, control and maintenance work for addressing the real time problems in the field of Power system/smart grid	Analyze

IV. SYLLABUS

MODULE –I: INTRODUCTION (09)

Phasor Analysis of basic circuits, Conservation of Power, Complex Power calculation, Introduction of Smart Grid, Cyber security and Cyber-attack, model-based system, data driven system, Neural Nets, Error calculation, Challenges and Opportunities in the Power System

MODULE –II: DATA SCIENCE IN POWER SYSTEM (09)

Introduction to Data Availability in Power Systems, Dimension of the variable, High Dimensional Space, Singular Value Decomposition (SVD), Application of SVD in Power System Anomaly Detection, Application of SVD in Bad Data Processing for State Estimation, Monte Carlo simulation.

MODULE –III: DATA REGRESSION, STATE ESTIMATION, FORE CASTING (10)

Definition of Data Regression, State Estimation, Forecasting, Types of regression, Linear Regression with Least Squares, Data fitting, state estimation, Chi-square test, Forecasting, Demand forecasting.

Types of forecasting, Statistical Time Series, Application of Time Series Analysis in Renewable Energy Forecasting, Application of Time Series Analysis in Distribution Systems, Model Identification

MODULE –IV: MACHINE LEARNING IN POWER SYSTEMS Classes (08)

Importance of machine learning in Power system, examples of machine learning in power system forecasting, Support vector machine (SVM) and kernels, kernel optimization, Model selection, Model selection criteria, Description length, feature selection, Combining classifiers, Boosting, margin, and complexity, Margin and generalization, mixture models, Mixtures and the expectation maximization (EM) algorithm, EM, regularization, Clustering, Spectral clustering, Markov models, Bayesian networks, Learning Bayesian networks, Probabilistic inference.

MODULE –V: MACHINE LEARNING APPLICATIONS IN POWER SYSTEMS (09)

Introduction for Energy Disaggregation, Human Behavior Feature Extraction-Time-dependent State Transition Probability Matrix, Individual Load Tracking, Case study, Residential Customer Baseline Load Estimation, Contribution of Machine learning in CBL.

V. Text Books:

1. Mohamed A. El-Sharkawi “Electric Energy: An Introduction”.
2. Glover, Sarma and Overbye, “Power System Analysis and Design”.
3. Kutner, Nachtsheim and Neter, “Applied Linear Regression Models”.

VI. Reference Books:

1. Goodfellow, Bengio and Courville, “Deep Learning”.

VII. Web References:

1. https://smartgridcenter.tamu.edu/index.php/data-science-and-machine-learning-for-modern-power-systems-online-video-course/

VIII. E-Text Books:

1.https://scholar.smu.edu/cgi/viewcontent.cgi?article=1049&context=engineering_electrical_etds

HIGH FREQUENCY MAGNETIC COMPONENTS

PE-IV:EPS								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
BPSC22	**Elective**	3	0	0	3	30	70	100
Contact Classes: 45	**Total Tutorials: Nil**	**Total Practical Classes: Nil**				**Total Classes: 45**		

I. COURSE OVERVIEW:

This course will cover topics in the area of high-frequency power magnetic components, such as inductors and transformers. Concepts that will be studied: such as complex permeability, eddy currents, skin effect, proximity effect, winding losses, Dowell's equation, core losses, self-capacitance, area-product method, core-geometry method, integrated inductors. Optimization of conductor dimensions will be performed. Design procedures of high-frequency inductors and transformers will be presented.

II. COURSE OBJECTIVES:

The students will try to learn:

I. The fundamentals of magnetic devices and the different materials used for magnetic cores.
II. The causes of skin and proximity effects in windings.
III. The Nature of Winding Resistance at High Frequencies.
IV. The computation of inductance for different types of integrated inductors.
V. Calculation of self-capacitance for different kinds of conductors.

III. COURSE OUTCOMES:

After successful completion of the course, students will be able to:		
CO 1	**Demonstrate** the different materials and their properties used for magnetic cores.	Apply
CO2	**Explain** the concept of skin effect and proximity effect for different types of conductors.	Analyze
CO 3	**Calculate** the winding resistance for different types of conductors.	Apply
CO 4	**Estimate** the winding power loss for current with harmonics.	Evaluate
CO 5	**Analyze** the self capacitance components of different conductors.	Analyze
CO 6	**Estimate** the self capacitance of Parallel-Plate Capacitor, Two Parallel Round Conductors etc.	Evaluate

IV. SYLLABUS

MODULE –I: FUNDAMENTALS OF MAGNETIC DEVICES AND MAGNETIC CORE (09)

Introduction, Magnetic Relationships, Magnetic Circuits, Magnetic Laws, Eddy Currents, Core Saturation, Volt-Second Balance, Inductance, Inductance Factor, Magnetic Energy, Self-Resonant Frequency, Classification of Power Losses in Magnetic Components, Non-inductive Coils. Magnetic Cores: Introduction, Properties of Core Materials, Magnetic Dipoles, Magnetic Domains, Curie Temperature, Magnetization, Magnetic Materials, Hysteresis, Core Permeability, Core Geometries, Iron Alloy Cores, Amorphous Alloy Cores, Nickel–Iron and Cobalt–Iron Cores, Ferrite Cores, Powder Cores, Nano-crystalline Cores, Superconductors, Hysteresis Core Loss, Eddy-Current Core Loss, Total Core Loss, Complex Permeability.

MODULE –II: SKIN EFFECT & PROXIMITY EFFECT (10)

Introduction, Magnet Wire, Wire Insulation, Skin Depth, Ratio of AC to DC Winding Resistance, Skin Effect in Long Single Round Conductor, Current Density in Single Round Conductor, Impedance of Round Conductor, Magnetic Field Intensity for Round Wire, Other Methods of Determining the Round Wire Inductance, Power Density in Round Conductor, Skin Effect on Single Rectangular Plate. Proximity and Skin Effects in Two Parallel Plates, Anti-proximity and Skin Effects in Two Parallel Plates, Proximity Effect in Multiple-Layer Inductor, Appendix: Derivation of Proximity Power Loss.

MODULE –III: WINDING RESISTANCE AT HIGH FREQUENCIES (09)

Introduction, Winding Resistance, Square and Round Conductors, Winding Resistance of Rectangular Conductor, Winding Resistance of Square Wire, Winding Resistance of Round Wire, Leakage Inductance, Solution for Round Conductor Winding in Cylindrical Coordinates, Litz Wire,

Winding Power Loss for Inductor Current with Harmonics, Effective Winding Resistance for Non-sinusoidal Inductor Current, Thermal Model of Inductors.

MODULE –IV: INTEGRATED INDUCTORS (08)

Introduction, Resistance of Rectangular Trace, Inductance of Straight Rectangular Trace, Construction of Integrated Inductors, Meander Inductors, Inductance of Straight Round Conductor, Inductance of Circular Round Wire Loop, Inductance of Two-Parallel Wire Loop, Inductance of Rectangle of Round Wire, Inductance of Polygon Round Wire Loop, Bond-wire Inductors, Single-Turn Planar Inductor, Inductance of Planar Square Loop, Planar Spiral Inductors.

MODULE –V: SELF-CAPACITANCE (09)

Introduction, High-Frequency Inductor Model, Self-Capacitance Components, Capacitance of Parallel-Plate Capacitor, Self-Capacitance of Foil Winding Inductors, Capacitance of Two Parallel Round Conductors, Capacitance of Round Conductor and Conducting Plane, Self-Capacitance of Single-Layer Inductors, Self-Capacitance of Multi-layer Inductors, Capacitance of Coaxial Cable.

V. Text Books:

1. "Design of Magnetic Components for Switched Mode Power Converters, Umanand L., Bhat, S.R., ISBN: 978-81-224-0339-8, Wiley Eastern Publication, 1992.

VI. Reference Books:

1. Marian K. Kazimierczuk, "High-Frequency Magnetic Components", ISBN: 978-0-470-71453-9 John Wiley & Sons, Inc.
2. G. C. Chryssis, "High Frequency Switching Power Supplies, McGraw Hill, 2nd Edition, 1989
3. Eric Lowdon, Practical Transformer Design Handbook, Howard W. Sams& Co., Inc., 1980

VII. Web References:

1. https://www.researchgate.net
2. https://www.aar.faculty.asu.edu/classes
3. https://www.facstaff.bucknell.edu/
4. https://www.electrical4u.com

VIII. E-Text Books:

1. https://www.jntubook.com/
2. https://www.freeengineeringbooks.com

ARTIFICIAL INTELLIGENCE IN POWER SYSTEM LABORATORY

II Semester: EPS								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BPSC23	**Core**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		-	-	4	2	30	70	100
Contact Classes: Nil	**Tutorial Classes: Nil**	**Practical Classes: 36**				**Total Classes: 36**		

I. COURSEOVERVIEW:

This course deals with the load flow analysis, state estimation and other power system problems. It will also evaluate the economic dispatch of coordinated thermal unit. This course also concludes with artificial intelligence technique like fuzzy logic artificial neural networks and GA algorithms.

II. COURSE OBJECTIVES:

The students will try to learn:

I. Different state estimation techniques.
II. Artificial intelligence technique for a given Power System problem.
III. Economic dispatch of coordinated thermal unit
IV. Modern tools like fuzzy logic, artificial neural networks and ANFIS for power system problems
V. Various evolutionary algorithms to power system problems.

III. COURSE OUTCOMES:

After successful completion of the course, students will be able to:		
CO 1	**Develop** a neural network based model for Load flow analysis.	Apply
CO2	**Analyze** the state estimations using neural network.	Analyze
CO 3	**Analyze** contingency technique to predict the effect of outages like failures of equipment, transmission line using ANN	Analyze
CO 4	**Apply** the power system security using neural network.	Apply
CO 5	**Determine** automatic Generation Control for single are a system and two area systems using Fuzzy Logic Method.	Understand
CO 6	**Analyze** the transient and small signal stability analysis of Single-Machine-Infinite Bus (SMIB) system using Fuzzy Logic	Analyze

IV. LIST OF EXPERIMENTS

EXPERIMENT –I: LOAD FLOW ANALYSIS

Load flow analysis using neural network.

EXPERIMENT –II: STATE ESTIMATIONS

State estimations using neural network.

EXPERIMENT –III: CONTINGENCY ANALYSIS

Contingency analysis using neural network.

EXPERIMENT –IV: POWER SYSTEM SECURITY

Power system security using neural network.

EXPERIMENT –V: AGC - SINGLE AREA SYSTEM / TWO AREA SYSTEM

Fuzzy logic based AGC for single area system and two area systems.

EXPERIMENT –VI: SMALL SIGNAL STABILITY ANALYSIS
Fuzzy logic based small signal stability analysis.

EXPERIMENT –VII: ECONOMIC DISPATCH THERMAL UNITS
Economic dispatch of thermal units using conventional and ANN algorithms.

EXPERIMENT –VIII: ECONOMIC DISPATCH THERMAL UNITS
Economic dispatch of thermal units using conventional and GA algorithms.

EXPERIMENT –IX: ECONOMIC DISPATCH THERMAL UNITS
Economic dispatch of thermal units using conventional and Fuzzy logic.

EXPERIMENT –X: ECONOMIC DISPATCH OF THERMAL PLANTS

EXPERIMENT –XI: ECONOMIC DISPATCH OF THERMAL PLANTS
Economic dispatch of thermal plants using conventional and GA algorithms.
Economic dispatch of thermal plants using conventional and ANN algorithms.

EXPERIMENT –XII: ECONOMIC DISPATCH OF THERMAL PLANTS
Economic dispatch of thermal plants using conventional and Fuzzy logic.

V. References:

1. Chakrabarti, Abhijit, "Power System Dynamics and Simulation", PHI Learning, 2nd Edition, 2012.
2. Barret J P, "Power System Simulation", Chapman and Hall, 2nd Edition, 2013.

VI. Web Reference:

1. http://www.iare.ac.in

POWER SYSTEMS LABORATORY

II Semester: EPS								
Course Code	**Category**	**Hours / Week**			**Credit**	**Maximum Marks**		
BPSC24	**Core**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		-	-	4	2	30	70	100
Contact Classes: Nil	**Tutorial Classes: Nil**	**Practical Classes: 36**				**Total Classes: 36**		

I. COURSEOVERVIEW:

The main objective of the course is to provide an overview of the principles of basic protection circuits such as earth tester, different type of relays, breakdown strength of air gap, soil resistivity, millivolt drop test. It will also help students to formulate different type of protection scheme.

II. COURSE OBJECTIVES:

The students will try to learn:

I. Parameters, surge impedance loading and reactive power compensation of transmission lines
II. Concept of various transmission line protection schemes.
III. How Simulate and study feeder protection and generator protection circuits.

III. COURSE OUTCOMES:

After successful completion of the course, students will be able to:		
CO 1	**Determine** earth resistance by using crank type earth tester.	Analyze
CO 2	**Explain** the concept of electrical integrity of connections and contacts in a circuit breaker using milli-volt drop test.	Analyze
CO 3	**Apply** the concept of soil resistivity as function of salinity and time.	Apply
CO 4	**Analyze** internal fault protection of single-phase transformer using merz price protection.	Analyze
CO 5	**Examine** the alternator during over voltage, under voltage, over and under frequency by using respective relays.	Analyze

IV LIST OF EXPERIMENTS

EXPERIMENT –I: EARTH TESTER

Determination of earth resistance by using crank type earth tester.

EXPERIMENT –II: MILLI VOLT DROP TEST

Measurement of contact resistances of different combinations of test objects.

EXPERIMENT –III: SOIL RESISTIVITY

Measurement of soil resistivity as a function of salinity and time.

EXPERIMENT –IV: MICROPROCESSOR BASED OVER CURRENT RELAY

Determination of performance characteristics of microprocessor based over current relay.

EXPERIMENT –V: ELECTROMECHANICAL OVER CURRENT RELAY

Determination of performance characteristics of electromechanical over current relay.

EXPERIMENT –VI: BREAKDOWN STRENGTH OF AIR BY HORN GAP

Determination of breakdown voltage of air using horn gap apparatus at atmospheric conditions.

EXPERIMENT –VII: POWER ANGLE CHARACTERISTICS OF SYNCHRONOUS MACHINE

Study the power angle characteristics of synchronous machine by synchronizing to the grid.

EXPERIMENT –VIII: MERZ PRICE PROTECTION IN SINGLE PHASE TRANSFORMER

Study the Merz price protection of single-phase transformer and determine the characteristics of percentage biased relay.

EXPERIMENT –IX: DIFFRENTIAL PROTECTION SCHEME IN SYNCHRONOUS GENERATOR

Study of differential protection in three phase ac generator.

EXPERIMENT –X: NEGATIVE SEQUENCE PROTECTION IN ALTERNATOR

Study the numerical type negative sequence protection in a given alternator.

EXPERIMENT –XI:OVER FREQUENCY AND UNDER FREQUENCY PROTECTION

Study the generator protection during over and under frequency cases with suitable relays.

EXPERIMENT –XII: PERFORMANCE OF ALTERNATOR AGAINST INTERNAL FAULTS

Study the performance of synchronous machine and its protection scheme during internal faults.

V. Reference Books:

1. Paithankar, S RBhide, “Fundamentals of Power System Protection”, PHI, 1st Edition, 2003.
2. CLWadhwa, “Electrical Power Systems”, New Age international (P) Limited, 6th Edition, 2010.
3. VK Mehta, “Principles of power systems”, S Chand Publications, 4th Edition, 2009.

VI. Web References:

1. https://www.ee.iitkgp.ac.in
2. https://www.citchennai.edu.in
3. https://www.iare.ac.in
4. https://www.deltaww.com

MINI PROJECT WITH SEMINAR

II Semester: EPS								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
BPSC25	**Core**	0	0	4	2	30	70	100
Contact Classes: Nil	**Tutorial Classes: Nil**	**Practical Classes: 45**				**Total Classes:45**		

I. COURSE OBJECTIVES:

The student will try to learn:

I. How to identify various engineering problems and reviewing available literature.
II. The different techniques used to analyze the complex structural systems.
III. Work on the solutions given and present solution by using his/her technique applying engineering principles.

Guidelines to be followed

Mini Project will have mid semester presentation and end semester presentation. Mid semester presentation will include identification of the problem based on the literature review on the topic referring to latest literature available.

End semester presentation should be done along with the report on identification of topic for the work and the methodology adopted involving scientific research, collection and analysis of data, determining solutions highlighting individuals' contribution.

Continuous assessment of Mini Project at Mid Sem and End Sem will be monitored by the

Departmental committee.

RESEARCH METHODOLOGY AND IPR

III Semester: CSE, ES, CAD/CAM, AE, ST, PEED								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
BHSC11	**Core**	2	-	-	2	30	70	100
Contact Classes: 30	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes:30**		

I. COURSE OVERVIEW:

This course imparts research methodology and philosophy of intellectual property rights, including basic concepts employed in quantitative and qualitative research methods, Patents, Copyrights, and Trademarks. It provides the research framework, research methodology research design, and formulation hypothesis, sampling techniques, data analysis and report writing. It implies on research skills and intellectual property rights to encourage new creations, including technology, artwork, and inventions, that might increase economic growth.

II. COURSE OBJECTIVES:

The students will try to learn:

I. The Knowledge on formulate the research problem, characteristics of a good research and interpretation of collected data.

II. The importance of research ethics while preparing literature survey and writing thesis to achieve plagiarism free report.

III. The intellectual property rights such as patent, trademark, geographical indications and copyright for the protection of their invention done.

III. COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO1	**Interpret** the technique of determining a research problem for a crucial part of the research study.	**Remember**
CO2	**Examine** the way of methods for avoiding plagiarism in research.	**Apply**
CO3	**Apply** the feasibility and practicality of research methodology for a proposed project.	**Apply**
CO4	**Make use of** the legal procedure and document for claiming patent of invention.	**Understand**
CO5	**Identify** different types of intellectual properties, the right of ownership, scope of protection to create and extract value from IP.	**Understand**
CO6	**Defend** the intellectual property rights throughout the world with the involvement of world intellectual property organization	**Apply**

IV. SYLLABUS:

MODULE – I: INTRODUCTION (9)

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.

MODULE – II: RESEARCH ETHICS 9)

Effective literature studies approaches, analysis Plagiarism, Research ethics.

MODULE – III: RESEARCHPROPOSAL
Effective technical writing, how to write report, Paper Developing a Research Proposal.

Format of research proposal, presentation and assessment by iare view committee

MODULE – IV: PATENTING (9)
Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

MODULE – V: PATENT RIGHTS (9)
Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

V. TEXT BOOKS:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering student".
2. Wayne Goddard and Stuart Melville ,"Research Methodology: An Introduction"
3. RanjitKumar, "Research Methodology: A Step by Step Guide for beginners". 2nd Edition, 2007.

VI. REFERENCE BOOKS:

1. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd, 2007.
2. Mayall, "Industrial Design", McGraw Hill, 1992.
3. Niebel, "Product Design", McGraw Hill, 1974.
4. Asimov, "Introduction to Design", Prentice Hall, 1962.

VII. WEB REFERENCES:

1. Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age", 2016.
2. T.Ramappa,"Intellectual Property Rights Under WTO",S.Chand, 2008.

VIII. E-TEXT BOOKS:

1. http://nptel.ac.in/courses/107108011/

SCADA SYSTEM AND APPLICATIONS

III Semester: EPS								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BPSC26	**Elective**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	0	0	3	30	70	100
Contact Classes: 45	**Total Tutorials: Nil**	**Total Practical Classes: Nil**				**Total Classes: 45**		

I. COURSE OVERVIEW:

This course provides an exposure to technology of automation and control as widely seen across a typical power system network. It contains a wide range of topics from typical SCADA system Architecture, Communication requirements, Desirable Properties of SCADA system, features and other devices used for interfacing with real time systems. The course also includes the applications of SCADA systems in monitoring, control and management of energy in transmission and distribution networks of a power system and other industries.

II. COURSE OBJECTIVES:

The students will try to learn:

I. The fundamentals of SCADA systems including its architecture, components and communication protocols.
II. The control aspects of power system network and energy management using automation.
III. The substantial applications of SCADA systems and analyze industrial problems from an automation perspective.

III. COURSE OUTCOMES:

After successful completion of the course, students will be able to:		
CO 1	**Demonstrate** the basic functionality, merits and demerits of PLC and SCADA systems for supervisory control of an industrial system	Understand
CO 2	**Develop** the ladder diagram and functional block diagrams for interfacing PLC with SCADA system.	Apply
CO 3	**Identify** the typical components of SCADA systems used for interfacing with real time systems	Apply
CO 4	**Analyze** the different types of architectures and communication technologies ofa typical SCADA system	Analyze
CO 5	**Make use of** SCADA systems for controlling, security and energy management of a power system networks	Apply
CO 6	**Appraise** the superiority of SCADA systems in operation, controlling, and monitoring of oil, gas, water and power industries.	Evaluate

IV. SYLLABUS

MODULE –I: INTRODUCTION TO SCADA AND PLC (09)

Data acquisition system, evaluation of SCADA, communication technologies, monitoring and supervisory functions; PLC: Block diagram, programming languages, ladder diagram, functional block diagram, applications, interfacing of PLC with SCADA

MODULE –II: SCADA SYSTEM COMPONENTS (09)

Industries SCADA system components: Schemes, remote terminal unit (RTU), intelligent electronic devices (IED), communication network, SCADA server, SCADA / HMI systems.

MODULE –III: SCADA ARCHITECTURE AND COMMUNICATION (09)

SCADA architecture: Types, advantages and disadvantages of each system, single unified standard architecture-IEC 61850.

SCADA Communication: Various industrial communication technologies, wired and wireless methods, fiber optics, open standard communication protocols.

MODULE –IV: OPERATION AND CONTROL (09)

SCADA Operation and Control: Operation and control of interconnected power system, automatic substation control, SCADA configuration, energy management system, system operating states, system security, state estimation unit.

MODULE –V: SCADA APPLICATIONS (09)

SCADA Applications: Utility applications, transmission and distribution sector operations, monitoring, analysis and improvement, industries, oil, gas and water, case studies, implementation, simulation exercises. Control of generation, models of power system elements, single area and two area block diagrams, generation control with PID controllers, implementation of Automatic Generation control (AGC), AGC feature

V. Text Books:

1. Stuart A. Boyer: "SCADA-Supervisory Control and Data Acquisition", Instrument Society of America Publications, USA, 2004.
2. Gordon Clarke, Deon Reynders: "Practical Modern SCADA Protocols: DNP3, 60870.5 and Related Systems", Newness Publications, Oxford, UK, 2004.

VI. Reference Books:

1. William T. Shaw, "Cyber Security for SCADA systems", Penn Well Books, 2006.
2. David Bailey, Edwin Wright, "Practical SCADA for industry", Newness, 2003.
3. Sunil S Rao, "Switchgear and protections", Khanna Publications, 2nd Edition, 2000.
4. Michael Wiebe, "A guide to utility automation: AMR, SCADA, and IT systems for electric power", PennWell1999.

VII. Web References:

1. https://www.as.wiley.com/WileyCDA/WileyTitle/productCd-1118634039.html.
2. https://www.academia.edu/3409546/Power_Electronics_Application_in_Renewable_Energy_System.
3. https://www.springer.com/us/book/9788132221180.
4. https://www.springer.com/us/book/9781447151036.

VIII. E-Text Books:

1. https://www.ijtra.com/view/role-of-power-electronics-in-non-renewable-and-renewable-energy-systems.pdf.
2. https://www.nitgoa.ac.in/News_files/STC.pdf.
3. https://www.jee.ro/covers/art.php?issue=WN1438788776W55c22ca867606.
4. https://www.magnelab.com/wp-content/uploads/2015/01/Role-of-power-electronics-in-renewable- energy-systems.pdf.

POWER SYSTEM RELIABILITY

III Semester: EPS								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
BPSC27	**Elective**	3	0	0	3	30	70	100
Contact Classes: 45	**Total Tutorials: Nil**	**Total Practical Classes: Nil**				**Total Classes: 45**		

I. COURSE OVERVIEW:

The Power system reliability course will provide students with a fundamental knowledge on the reliability evaluation of engineering systems with emphasis on electric power systems. Models and methodologies for power systems reliability assessment will be studied. Application of probability theory for design and management of power generation, transmission and distribution systems using SCADA.

II. COURSE OBJECTIVES:

The students will try to learn:

I. How to Estimate loss of load and energy indices for generation systems model.
II. Merging generation and load models.
III. Various indices for distribution systems.
IV. Reliability of interconnected systems.
V. Illustrate the basic concepts and techniques of modern reliability engineering tools.

III. COURSE OUTCOMES:

After successful completion of the course, students will be able to:		
CO 1	**Apply** concepts of the probability theory for power systems reliability evaluation	Apply
CO 2	**Apply** probability methods to formulate and probabilistically simulate simple electric energy systems for computing reliability indices and production costs	Apply
CO 3	**Evaluate** generation capacities by pooling all sources of generation with all loads	Analyze
CO 4	**Analyze** distribution system networks with indices to improve power system performance	Analyze
CO 5	**Illustrate** optimal solutions for improvising power transfer capability, enhancing power quality and reliability	Apply
CO 6	**Justify** the basic tasks of Supervisory Control Systems (SCADA)as well as their typical applications in industries	Evaluate

IV SYLLABUS

MODULE –I: BASIC PROBABILITY THEORY (09)

Elements of probability, probability distributions, Random variables, Density and Distribution functions- Binomial distribution- Expected value and standard deviation - Binomial distribution, Poisson distribution, normal distribution, exponential distribution, Weibull distribution. Definition of Reliability: Definition of terms used in reliability, Component reliability, Hazard rate, derivation of the reliability function in terms of the hazard rate. Hazard models - Bath tub curve, Effect of preventive maintenance. Measures of reliability: Mean Time to Failure and Mean Time between Failure

MODULE –II: GENERATING SYSTEM RELIABILITY ANALYSIS (09)

Generation system model – capacity outage probability tables – Recursive relation for capacitive model building – sequential addition method – unit removal –Evaluation of loss of load and energy indices–Examples. Frequency and Duration methods –Evaluation of equivalent transitional rates of identical and non -identical units – Evaluation of cumulative probability and cumulative frequency of non-identical generating units–2-level daily load representation-merging generation and load models– Examples.

MODULE –III: RELIABILITY EVALUATION (09)

Basic concepts - risk indices – PJM methods – security function approach– rapid start and hot reserve units– Modeling using STPMapproach, Bulk Power System Reliability Evaluation: Basic configuration – conditional probability approach – system and load point reliability indices – weather effects on transmission lines –Weighted average rate and Markov model – Common mode failures.

Inter Connected System Reliability Analysis: Probability array method – Two inter connected systems with independent loads – effects of limited and unlimited tie capacity - imperfect tie – Two connected Systems with correlated loads – Expression for cumulative probability and cumulative frequency.

MODULE –IV: DISTRIBUTION SYSTEM RELIABILITY ANALYSIS (09)

Basic Techniques – Radial networks –Evaluation of Basic reliability indices, performance indices – load point and system reliability indices – customer oriented, loss and energy-oriented indices – Examples. Basic concepts of parallel distribution system reliability

MODULE –V: SUBSTATIONS AND SWITCHING STATIONS Classes: 09

SCADA Applications: Utility applications, transmission and distribution sector operations, monitoring, analysis and improvement, industries, oil, gas and water, case studies, implementation, simulation exercises.

V. Text Books:

1. R. Billinton, R.N. Allan, “Reliability Evaluation of Power systems”, BS Publications, 2007.
2. J. Endrenyi, “Reliability Modeling in Electric Power Systems”, John Wiley and Sons, 1978

VI. Reference Books:

1. Alessandro Birolini, “Reliability Engineering: Theory and Practice”, Springer Publications.
2. Charles Ebeling, “An Introduction to Reliability and Maintainability Engineering”, TMH Publications.
3. E. Balaguruswamy, “Reliability Engineering”, TMH Publications.
4. Elsayed A. Elsayed, “Reliability Engineering”, Prentice Hall Publications.

VII. Web References:

1. https://www.researchgate.net
2. https://www.aar.faculty.asu.edu/classes
3. https://www.facstaff.bucknell.edu/
4. https://www.electrical4u.com

VIII. E-Text Books:

1. https://www.jntubook.com/
2. https://www.freeengineeringbooks.com

GRID INSTRUMENTATION AND COMMUNICATION SYSTEMS

III Semester: EPS

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BPSC28	Elective	3	0	0	3	30	70	100
Contact Classes: 45	Total Tutorials: Nil	Total Practical Classes: Nil				Total Classes: 45		

I. COURSE OVERVIEW:

Smart Grid evolution is the need for fundamental changes in electrical grid technologies and their management This subject will help students to learn about enable enhanced grid operations with the help of the control and instrumentation arena. This course requires integration between the measurement, operations, control and IT systems to derive the necessary operational and business intelligence—thus making the grids smarter, safer, more efficient, and ever more resilient.

II. COURSE OBJECTIVES:

The students will try to learn:

I. Different grid instrumentation and communication.
II. Different learning algorithms and their applications to data analysis.
III. Monitoring, control, acquisition and information processing of power system data.
IV. The methods of information processing.

III. COURSE OUTCOMES:

CO 1	**Know** the digital voltage, frequency, time measurements and digital displays with A/D & D/A circuits operation along with their drawbacks.	Understand
CO 2	**Explore** data acquisition systems along with emergency and preventive control to know their importance.	Understand
CO 3	**Analyze** signal and system analyzers to know their application to data analysis.	Analyze
CO 4	**Illustrate** about PMU to know their application in computer control.	Understand
CO 5	**Interpret** the PLC programming languages to know their application in smart grid.	Understand
CO 6	**Understand** SCADA components and its interfaces, security in smart grid.	Understand

IV.SYLLABUS

MODULE –I: DIGITAL INSTRUMENTATION (09)

Introduction, Basic measurement system. Digital voltage measurement, Frequency measurement, Time measurement, Digital phase meter, Digital multi-meter. Digital displays. A/D and D/A circuits and their operation, errors.

MODULE –II: ON-LINE COMPUTER CONTROL (09)

Distributed digital control. Data acquisition systems. Emergency control, preventive control, system wide optimization. Signal and system Analyzers. Time-error and inadvertent interchange correction techniques. system wide optimization. Introduction to PMUs, technology and their placement. Applications.

MODULE –III: COMPONENTS OF CONTROL SYSTEMS (09)

Components of control systems, supervisory control and Data acquisition PLC: Block diagram, programming languages, ladder diagram, functional block diagram, applications, SCADA systems: components of SCADA Systems, communication media, interfaces and security; SCADA in power systems, Regional Grid and DCS based SCADA systems. interfacing of PLC with SCADA.

MODULE –IV: COMMUNICATION TECHNOLOGY FOR SMART GRID OPERATIO (09)

Analog vs digital communications, ISO/OSI layer model, Physical layer: power line carrier, wired, wireless, Protocols and interfaces: TCP/IP, Mbus, Field buses and remote communications.

MODULE –V: INFORMATION PROCESSING (09)

SCADA and DCS systems, Advance control methods. Distribution management systems. Data aggregation, data centres and clearing houses. Role of State Estimation. Fault detection and diagnosis. Dependability aspects. Cyber security aspects, Privacy aspects..

V. Text Books:

1. H S Kalsi, "Electronic Instrumentation", Tata Mc Graw Hill, 2010.
2. Mini S. Thomas, John D. McDonald, "Power System SCADA and smart grids", CRC Press, Taylor and Francis.

VI. Reference Books:

1. Hendrik c. Ferreira, et al, "Power Line Communication- Theory and Applications for narrow band and broad communication over power lines", Willy Publications.

VII. Web References:

1. https://intra.ece.ucr.edu/~hamed/Smart_Grid_Topic_3_Communications.pdf
2. https://www.slideshare.net/syedmustafablr/grid-computing-notes

VIII. E-Text Books:

1. https://onlinelibrary.wiley.com/doi/book/10.1002/9781118820216
2. https://books.google.co.uk/books/about/Grid_Enabled_Remote_Instrumentation.html?id=X3JnVa56ibAC&utm_source=gb-gplus-shareGrid

ELECTRICAL TRANSIENTS IN POWER SYSTEMS

III Semester: EPS								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
BPSC29	**Core**	3	0	0	3	30	70	100
Contact Classes: 45	**Total Tutorials: Nil**	**Total Practical Classes: Nil**				**Total Classes: 45**		

I. COURSE OVERVIEW:

The purpose of this course to enable the students about different types of power system transients, their phenomena and protective equipment used. The course mainly focus on the behavior of travelling waves for lines terminated by different conditions, lightning, switching and temporary over voltages, modelling of overhead lines, parameters of underground cables and the computation of power system transients using the Electro Magnetic Transient Program (EMTP).

II. COURSE OBJECTIVES:

The students will try to learn:

I. The reasons for occurrence of transients in a power system.
II. The change in parameters like voltage & frequency during transients.
III. Lightning phenomenon and its effect on power system.
IV. About the various protective devices against transients.

III. COURSE OUTCOMES:

After successful completion of the course, students will be able to:		
CO 1	Discuss the behavior of travelling waves for a line terminated by open circuit, short circuit and lumped reactive elements to find the reflection and refraction coefficients.	Analyze
CO 2	Use the Bewley's lattice diagram in travelling wave analysis under different loading conditions to design the protective equipment's for lines.	Apply
CO 3	Discuss the energizing transients and methods to control the over voltages, line dropping and rejection.	Analyze
CO 4	Compute the resistance, inductance and capacitance of a transmission lineusing the concepts of Geometric Mean Radius (GMR) and Geometric Mean Distance (GMD).	Analyze
CO 5	Compute the cable series impedance and shunt admittance of self-contained single core and three core cables.	Analyze
CO 6	Examine the power system transients using Electro Magnetic Transient Program (EMTP)	Analyze

IV. SYLLABUS

MODULE –I: REVIEW OF TRAVELLING WAVE PHENOMENA (09)

Lumped and Distributed Parameter: Wave equation, reflection, refraction, behavior of travelling waves at the line terminations, lattice diagrams, attenuation and distortion.

MODULE –II: LIGHTNING, SWITCHING AND TEMPORARY OVERVOLTAGES (09)

Lightning over voltages: interaction between lightning and power system ground wire voltage and voltage across insulator; switching overvoltage: short line or kilometric fault, energizing transients - closing and re-closing of lines, methods of control; temporary over voltages: line dropping, load rejection; voltage induced by fault; very fast transient overvoltage (VFTO).

MODULE –III:PARAMETERS AND MODELLING OF OVERHEAD LINES (09)

Review of line parameters for simple configurations: series resistance, inductance and shunt capacitance; bundle conductors: Equivalent GMR and equivalent radius.

Modal propagation in transmission lines: modes on multiphase transposed transmission lines, α-β-0 transformation and symmetrical components transformation, modal impedances; analysis of modes on transposed lines; effect of ground return and skin effect; transposition schemes.

MODULE –IV: PARAMETERS OF UNDERGROUND CABLES (09)

Distinguishing features of underground cables: technical features, electrical parameters, overhead lines versus underground cables; cable types: Series impedance and shunt admittance of single core self-contained cables, impedance and admittance matrices for three phase system formed by three single coreself contained cables, approximate formulas for cable parameters.

MODULE –V: COMPUTATION OF POWER SYSTEM TRANSIENTS – EMTP (09)

Digital computation of line parameters: Why line parameter evaluation programs; Salient features of mt line: Constructional features of that affect transmission line parameters, elimination of ground wires bundling of conductors; Principle of digital computation of transients: features and capabilities of EMTP; steady state and time step solution modules: basic solution methods.

V. Text Books

1. Allan Greenwood, "Electrical Transients in Power System", Wiley& Sons Inc. New York, 1st Edition, 1991.
2. Harold A Peterson,"Transient in Power Systems", McGraw Hill,1st Edition, 1966.

VI. Reference Books:

1. Kuffel and Abdullah, "High Voltage Engineering", PHI, 1st Edition, 2000.
2. Rakesh D Begamudre, "EHV AC Transmission Engineering", PHI, 1st Edition, 2006.
3. Naidu M S and Kamaraju V, "High Voltage Engineering", Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2nd Edition, 2004.
4. Hermann W. Dommel, EMTP Theory Book, second Edition, Microtran Power System Analysis Corporation, Vancouver, British Columbia, Canada, May 1992, Last Update: April 1999.

VII. Web References:

1. https://www.EMTP Literature from www.microtran.com
2. https://www.smartech.gatech.edu/bitstream/handle/1853/14488
3. https://www.weibull.com/basics/reliability.htm

VIII. E-Text Books:

1. https://www.download.springer.com/static/pd
2. https://www.web.mit.edu/energylab/www/pubs/el99-005wp.pdf

ELEMENTS OF AEROSPACE ENGINEERING

III Semester: COMMON FOR ALL BRANCHES								
Course Code	**Category**	**Hours /Week**			**Credits**	**Maximum Marks**		
BAEC30	**Elective**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	30	70	100
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 45**		

I. COURSE OVERVIEW:

Aeronautical engineering is the specialized branch of engineering and study of science that deals with design, construction, maintenance of various aircrafts and their components. Candidates who have an inclination towards airplanes and their mechanisms can opt to study aeronautical engineering.

II. COURSE OBJECTIVES:

The students will try to learn:

I. The Historical evaluation of Airplanes
II. The different component systems and functions
III. The various types of power plants used in aircrafts

III. COURSE OUTCOMES:

After successful completion of the course, students will be able to:

CO 1	**Learn** the history of aircraft & developments over the years	Understand
CO 2	**Understand** ability to identify the types & classifications of components and control systems	Understand
CO 3	**Understand** the basic concepts of flight & Physical properties of Atmosphere	Understand
CO 4	**Understand** the different Newtonian law and its application in aerospace domain	Understand
CO 5	**Explain** the Different types of Engines and principles of Rocket	Understand
CO 6	**Understand** ability to differentiate the types of fuselage and constructions	Understand

IV. COURSE SYLLABUS:

MODULE-I: HISTORY OF FLIGHT (07)

Balloon flight-ornithopers-Early Airplanes by Wright Brothers, biplanes and monoplanes, Developments in aerodynamics, materials, structures and propulsion over the years.

MODULE-II: AIRCRAFT CONFIGURATIONS AND ITS CONTROLS (08)

Different types of flight vehicles, classifications-Components of an airplane and their functions-Conventional control, powered control- Basic instruments for flying-Typical systems for control actuation.

MODULE-III: BASICS OF AERODYNAMICS (06)

Physical Properties and structures of the Atmosphere, Temperature, pressure and altitude relationships, Newton's Law of Motions applied to Aeronautics-Evolution of lift, drag and moment. Aerofoils, Mach number, Maneuvers.

MODULE-IV: BASICS OF PROPULSION (06)

Basic ideas about piston, turboprop and jet engines – use of propeller and jets for thrust production-Comparative merits, Principle of operation of rocket, types of rocket and typical applications, Exploration into space.

MODULE-V: BASICS OF AIRCRAFT STRUCTURES (06)

General types of construction, Monocoque, semi-monocoque and geodesic constructions, typical wing and fuselage structure. Metallic and non-metallic materials. Use of Aluminium alloy, titanium, stainless steel and composite materials. Stresses and strains-Hooke's law- stress-strain diagrams-elastic constants-Factor of Safety.

V. TEXT BOOKS:

1. Anderson, J.D., Introduction to Flight, McGraw-Hill; 8th Edition, 2015
2. Stephen.A. Brandt, Introduction to aeronautics: A design perspective, AIAA Education Series, 2nd Edition 2004.

VI. REFERENCE BOOKS:

Kermode, A.C. "Flight without Formulae", Pearson Education, 11th Edition, 2011.

VII. WEBREFERENCES:

1. http://memberfiles.freewebs.com/94/47/55224794/documents/airport%20planning%20and%20management.pdf
2. https://books.google.co.in/books?id=RYR6cu4YSBcC&dq=Planning%20and%20Design%20of%20Airports&source=gbs_similarbooks

VIII. E-TEXTBOOKS:

https://nptel.ac.in/courses/101/101/101101079/

DATA ANALYTICS

III Semester: COMMON FOR ALL BRANCHES								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BCSC30	**Elective**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	30	70	100
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 45**		

I. COURSE OVERVIEW:

This course covers the fundamentals of data analysis, such as data gathering or data mining .this course covers concepts of data analysis, regression analysis, organization structures, forecasting techniques and decision analysis. The *data analytics* tools help in the data mining processes from loading to transformation, aggregation, automated parameter, and process optimization.

II. COURSE OBJECTIVES

The students will try to learn:

I. The role of business analytics within an organization.
II. The relationships between the underlying business processes of an organization.
III. To gain an understanding of how managers use business analytics to formulate

III COURSE OUTCOMES:

After successful completion of the course, students will be able to:

CO1	Analyze data using statistical and business analytics technology	Analyze
CO2	Solve business problems and to support managerial decision making	Apply
CO3	Choose business decision Strategies with the without outcome probabilities	Apply
CO4	Perform statistical analysis on variety of data	Apply
CO5	Experiment Data using Business Analytics Technology	Apply

IV. COURSE SYLLABUS:

MODULE – I: BUSINESS ANALYTICS (09)

Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organization, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modeling, sampling and estimation methods overview.

MODULE – II: REGRESSION ANALYSIS (09)

Trendiness and Regression Analysis: Modeling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.

MODULE – III: ORGANIZATION STRUCTURES (09)

Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes.

Descriptive Analytics, predictive analytics, predicative Modeling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modeling, nonlinear Optimization.

MODULE – IV: FORCASTING TECHNIQUES (09)

Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models.

Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.

MODULE – V: DECISION ANALYSIS (09)

Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making. Recent Trends in: Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.

V. TEXT BOOKS

1. James Evans, "Business Analytics", Persons Education.

VI. REFERENCE BOOKS

1. Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, "Business Analytics Principles, Concepts, and Applications", Pearson FT Press.

VII. WEB REFERENCES

1.http://nptel.ac.in/courses/110107092/

VIII. E-TEXT BOOKS

1.http://nptel.ac.in/downloads/110107092/

REAL TIME OPERATING SYSTEMS

III Semester: COMMON FOR ALL BRANCHES								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BESC30	**Elective**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	30	70	100
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes:45**		

I. COURSE OVERVIEW:

This course is to introduce students with the basic concepts and approaches in the design and analysis of real-time operating systems. It covers design considerations of real time operating systems, task scheduling, threads, multitasking, task communication and synchronization. Applications of the course include real time operating systems in image processing, fault tolerant applications and control systems.

II. COURSE OBJECTIVES:

The students will try to learn:

I. The concepts of operating systems and principles of real time operating system, implementation aspects of real time concepts in embedded systems.
II. The design of real time operating system by using the concepts of Timers, I/O subsystem and Memory management units.
III. Software development process and tools like Vxworks and muCOS for real timeoperating system applications.

III. COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO1	**Recall** real time operating system to provide resource managementand synchronization for communication systems.	Understand
CO2	**Compare** soft real-time operating system and hard real-timeoperating systems for the priority based task scheduling.	Analyze
CO 3	**Outline** the components of real time operating systems for the designof reliable embedded system.	Understand
CO 4	**Analyze** finite state machine for the task scheduling and execution inkernel models.	Analyze
CO 5	**Develop** a semaphore token for the execution of one or more threadsin mutual exclusion.	Create
CO 6	**Interpret** message queue in asynchronous communications protocolfor send and receive messages simultaneously.	Understand

IV. SYLLABUS:

MODULE – I: REAL TIME OPERATING SYSTEM PRINCIPLES (10)

History of operating systems, defining RTOS, classification of real-time systems, The scheduler, objects, services and key characteristics of RTOS, Tasks: Defining a task, task states and scheduling, typical task operations, typical task structure.

MODULE – II: REAL TIME KERNEL OBJECTS (09)

Semaphores: Defining semaphores, typical semaphore operations, typical semaphore use; Message Queues: Defining message queues, message queue states, message queue content, message queue storage, typical message queue operations; Typical message queue use other kernel objects: Pipes, event registers, signals, condition variables.

MODULE – III: RTOS DESIGN CONSIDERATIONS (08)
Timer and Timer Services: Real-time clocks and system clocks, programmable interval timers, timer interrupt service routines, model for implementing the soft-timer handling facility, timing wheels.
I/O sub system: Basic I/O concepts, the I/O sub system; Memory management: Dynamic memory allocation, fixed-size memory management, blocking vs. Non-blocking memory functions, hardware memory management units.

MODULE – IV: TASKS COMMUNICATION AND SYNCHRONIZATION (08)
Synchronization and Communication: Synchronization, communication, resource synchronization methods, common practical design patterns; common design problems: Resource classification, deadlocks, priority inversion.

MODULE – V: RTOS APPLICATION DOMAINS (10)
Comparison and study of RTOS: Vxworks and COS, Case studies: RTOS for image processing, embedded RTOS for voice over IP, RTOS for fault tolerant applications, RTOS for control systems.

V. TEXT BOOKS:

1. Andrew Troelsen,"Pro C and the .NET 4 Platform, Springer (India) Private Limited, New Delhi, India, 5th Edition, 2010.
2. David Chappell, "Understanding .NET – A Tutorial and Analysis", Addison Wesley, 2nd Edition, 2002.
3. S. Thamarai Selvi, R. Murugesan, A Textbook on C, Pearson Education, 1st Edition, 2003.

VI. REFERENCE BOOKS:

1. Raymond J.A.Bhur, Donald L.Bailey, "An Introduction to Real Time Systems", PHI, 1st Edition, 1999.
2. Wayne Wolf, "Computers as Components: Principles of Embedded Computing System Design", Kindle Publishers, 2nd Edition, 2005.
3. Tanenbaum, "Modern Operating Systems", Pearson Edition, 3rd Edition, 2007.

VII. WEB REFERENCES:

1. https://www.jntumaterials.co.in
2. http://www.inf.ed.ac.uk/teaching/courses/es/PDFs/RTOS.pdf
3. https://nptel.ac.in/courses/106108101/pdf/Lecture_Notes/Mod%208_LN.pdf
4. http://wwww.iare.ac.in

VIII. E-TEXT BOOKS:

1. http://www.bookzz.org/
2. http://www.jntubook.com
3. http://www.4shared.com/web/preview/pdf/BhrrT3m0
4. http://www.archive.org

WASTE TO ENERGY

III Semester: COMMON FOR ALL BRANCHES								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
BPSC30	**Core**	3	0	0	3	30	70	100
Contact Classes: 45	**Total Tutorials: Nil**	**Total Practical Classes: Nil**				**Total Classes: 45**		

I. COURSE OVERVIEW:

The course is designed to create environmental awareness and consciousness among the present generation to become environmental responsible citizens. The course will discuss on the municipal solid waste composition, characteristics and to improve the methods to minimize municipal solid waste generation. This course deals with methods of disposal of solid waste by thermal biochemical processes and production of energy from different types of waste sand to know the environmental impacts of all types of municipal waste.

II. COURSE OBJECTIVES:

The students will try to learn:

I. The principles of solid waste management in reducing and eliminating dangerous impacts of waste materials on human health and the environment to contribute economic development and superior quality of life.
II. The insight of the design and operations of a municipal solid waste landfill by collection, transfer and transportation of municipal solid waste for the final disposal.
III. The insight of the design and operations of a municipal solid waste landfill by collection, transfer and transportation of municipal solid waste for the final disposal.

III COURSE OUTCOMES:

After successful completion of the course, students will be able to:

CO 1	**Identify** the different sources and types of solid waste by the properties of municipal solid waste for segregation and collection of waste.	Apply
CO 2	**Illustrate** the classification, preliminary design considerations of landfill and methods of landfill disposal of solid to control greenhouse gases.	Understand
CO 3	**Understand** the Composition, characteristics of leachate to control the emission of gases by monitoring the movement of landfill leachate.	Understand
CO 4	**Outline** the Biochemical conversion of biomass for energy generation by anaerobic digestion of solid waste.	Understand
CO 5	**Apply** the knowledge in planning and operations of waste to Energy plants by following legal legislation related to solid waste management.	Apply
CO 6	**Illustrate** the thermo-chemical conversion of Biogas by using Gasification process for energy generation.	Understand

IV. SYLLABUS

MODULE –I: WASTE SOURCES & CHARACTERIZATION (09)

Waste production in different sectors such as domestic, industrial, agriculture, postconsumer, waste etc. Classification of waste – agro based, forest residues, domestic waste, industrial waste (hazardous and non-hazardous). Characterization of waste for energy utilization. Waste Selection criteria.

MODULE –II: TECHNOLOGIES FOR WASTE TO ENERGY (09)

Biochemical Conversion – Energy production from organic waste through anaerobic digestion and fermentation. Thermo-chemical Conversion – Combustion, Incineration and heat recovery, Pyrolysis, Gasification; Plasma Arc Technology and other newer technologies.

MODULE –III: WASTE TO ENERGY & ENVIRONMENTAL IMPLICATIONS (09)

Environmental standards for Waste to Energy Plant operations and gas clean-up. Savings on non-renewable fuel resources.

Carbon Credits: Carbon foot calculations and carbon credits transfer mechanisms.

MODULE –IV: THERMO-CHEMICAL CONVERSION (09)

Biogas production, land fill gas generation and utilization, thermo-chemical conversion: Sources of energy generation, gasification of waste using gasifies briquetting, utilization and advantages of briquetting, environmental benefits of bio-chemical and thermo- chemical conversion, comparison of various thermo-chemical conversion.

MODULE –V: E- CENTRALIZED AND DECENTRALIZED WASTE TO ENERGY PLANTS (09)

Waste activities – collection, segregation, transportation and storage requirements. Location and Siting of 'Waste to Energy' plants. Industry Specific Applications – In-house use – sugar, distillery, pharmaceuticals, Pulp and paper, refinery and petrochemical industry and any other industry. Centralized and Decentralized Energy production, distribution and use. Comparison of Centralized and decentralized systems and its operations.

V. TEXT BOOKS:

3. Nicholas P Cheremisinoff, "Handbook of Solid Waste Management and Waste Minimization Technologies", An Imprint of Elsevier, New Delhi, 2003.
4. Paul Breeze, "Energy from Waste", An Imprint of Elsevier, New Delhi, 2018.
5. P Aarne V esilind, William A Worrell and Debra R Reinhart, "Solid Waste Engineering", 2nd Edition 2002.

VI. REFERENCE BOOKS:

3. Challal, D S, "Food, Feed and Fuel from Biomass", IBH Publishing Co. Pvt. Ltd., 1st Edition, 1991.
4. C Y Were Ko-Brobby and E. B. Hagan, "Biomass Conversion and Technology", John Wiley & Sons, 1st Edition, 1996.
5. C Parker and T Roberts (Ed), "Energy from Waste", An Evaluation of Conversion Technologies, Elsevier Applied Science, London, 1985.
6. KL Shah, "Basics of Solid and Hazardous Waste Management Technology", Prentice Hall, Reprint Edition, 2000.
7. M Datta, "Waste Disposal in Engineered Landfills", Narosa Publishing House, 1997

VII. WEB REFERENCES:

1. https://www.e-waste Management: From waste to Resource Klaus Hieronymi, RamzyKahnat, Eric williams Tech. &Engg.-2013 (Publisher: Earthscan 2013)
2. https://www.What is the impact of E-waste: Tamara Thompson
3. https://www. E-waste poses a Health Hazard: SairudeenPattazhy

VIII. E-TEXT BOOKS:

4. https://www.e-waste Management: From waste to Resource Klaus Hieronymi, RamzyKahnat, Eric williams Tech. &Engg.-2013 (Publisher: Earthscan 2013)
5. https://www.What is the impact of E-waste: Tamara Thompson
6. https://www. E-waste poses a Health Hazard: SairudeenPattazhy

OPERATIONS RESEARCH

III Semester: COMMON FOR ALL BRANCHES								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
BCCC30	**Elective**	3	-	-	3	30	70	100
Contact Classes: 45	**Tutorials Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 45**		

I. COURSE OVERVIEW:

Operations Research (OR) is a discipline that helps to make better decisions in complex scenarios by the application of a set of advanced analytical methods. It couples theories, results and theorems of mathematics, statistics and probability with its own theories and algorithms for problem solving. Applications of OR techniques spread over various fields in engineering, management and public systems. This course includes the following topics : Linear Programming, Transportation problems, Assignment and Theory of games problems. Advanced topics on waiting line and simulation.

II. COURSE OBJECTIVES:

The students will try to learn:

I. The description, characteristics of operation research and mathematical model of real time problem for optimization.
II. Establish the problem formulation by using linear, dynamic programming, game theory and queuing models.
III. Apply stochastic models for discrete and continuous variables to control inventory.
IV. Visualize the computer-based manufacturing simulation models.

III. COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO1	Recall the basics of operation research	Remember
CO2	Explain the characteristics and scope of OR	Understand
CO3	Select optimal problems solving techniques for a given problem using LP	Apply
CO4	Solve transportation, travelling sales man and Assignment problems	Apply
CO5	Demonstrate and solve simple models of Game theory.	Understand
CO6	Choose appropriate simulation model for practical application	Apply

IV. COURSE SYLLABUS:

MODULE -I: INTRODUCTION AND ALLOCATION (09)

Development, definition, characteristics and phases, types of operation research models, applications; Allocation: linear programming, problem formulation, graphical solution, simplex method, artificial variables techniques, two–phase method, big-M method.

MODULE -II: TRANSPORTATION AND ASSIGNMENT PROBLEM (09)

Transportation problem: Formulation, optimal solution, unbalanced transportation problem, degeneracy; Assignment problem, formulation, optimal solution, variants of assignment problem, traveling salesman problem.

MODULE -III: SEQUENCING AND REPLACEMENT (09)

Sequencing: Introduction, flow, shop sequencing, n jobs through two machines, n jobs through three machines, job shop sequencing, two jobs through “m” machines.

Replacement: Introduction: Replacement of items that deteriorate with time, when money value is not counted and counted, replacement of items that fail completely, group replacement.

MODULE -IV: THEORY OF GAMES AND INVENTORY (09)

Theory Of Games: Introduction, minimax (maximin) criterion and optimal strategy, solution of games with saddle points, rectangular games without saddle points, dominance principle, mx2 and 2xn games, graphical method; Inventory: Introduction, single item, deterministic models, purchase inventory models with one price break and multiple price breaks, shortages are not allowed, stochastic models, demand may be discrete variable or continuous variable, instantaneous production, instantaneous demand and continuous demand and no set up cost, single period model.

MODULE -V: WAITING LINES AND SIMULATION (09)

Waiting Lines: Introduction, single channel, poisson arrivals , exponential service times, with infinite population and finite population models, multichannel, poisson arrivals, exponential service times with infinite population single channel Poisson arrivals; Simulation: Definition, types of simulation models, phases of simulation, applications of simulation, inventory and queuing problems, advantages and disadvantages, brief Introduction of simulation languages.

V. TEXT BOOKS:

1. J. K. Sharma, "Operations Research", Macmillan, 5th Edition, 2012.
2. R. Pannerselvan, "Operations Research", PHI Publications, 2nd Edition, 2006.

VI. REFERENCE BOOKS:

1. A. M. Natarajan, P. Balasubramani, A. Tamilarasi, "Operations Research", Pearson Education, 1st Edition, 2013.
2. Maurice Saseini, ArhurYaspan, Lawrence Friedman, "Operations Research: Methods & Problems", 1st Edition, 2013.
3. Hamdy A. Taha, "Introduction to O.R", PHI, 8th Edition, 2013.
4. Harvey M.Wagner, "Operations Research", PHI Publications, 2nd Edition, 2013.

VII. WEB REFERENCES:

1. http://people.brunel.ac.uk/~mastjjb/jeb/or/contents.html
2. https://pe.gatech.edu/degrees/online-masters-degrees/operations-research
3. http://nptel.ac.in/courses/112106134/1

VIII. E-TEXT BOOKS:

1. http://www.pondiuni.edu.in/storage/dde/downloads/mbaii_qt.pdf 2_
2. http://www.ggu.ac.in/download/Class-Note14/Operation%20Research07.04.14.pdf

PROJECT MANAGEMENT AND PLANNING

III Semester: COMMON FOR ALL BRANCHES								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BSTC30	**Elective**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	0	0	3	30	70	100
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 45**		

I. COURSE OVERVIEW:

Construction project planning and administration the art of directing and coordinating human and material resources throughout the life of a project by using modern management techniques to achieve predetermined objectives of scope, cost, time, quality and participation satisfaction. Teaching these requirements by the designed course content.

II. COURSE OBJECTIVES:

The student will try to learn:

I. The construction project schedules, documents for planning and management of construction processes.
II. The various types of planning tools like bar chart, CPM networks and PERT analysis
III. The different methods of project delivery, roles and responsibilities of all constituencies involved in the design and construction process.
IV. The various types of construction contracts, their legal aspects and provisions.

III. COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO1	Apply the knowledge of management functions like planning, scheduling, executing and controlling of projects for completion of project within given time.	Apply
CO2	Apply the knowledge of network analysis of construction activities and optimize resources by using bar chart, CPM networks.	Apply
CO3	Apply the knowledge of modern construction practices and techniques to achieve quality of work in projects	Apply
CO4	Identify the resource planning and management in construction to improve the performance management and organizational effectiveness.	Apply
CO5	Understand the computer based models adopted in construction industry for optimization of cost and schedule of a project	Understand
CO6	Identify the different types of contracts in construction, arbitration, legal aspects and provision to safe guard the labor and human rights.	Apply

IV. SYLLABUS

MODULE –I: PROJECT MANAGEMENT (09)

Introduction, Project planning, scheduling, controlling, Role of decision in project management, Project management Process and role of Project Manager.

MODULE –II: PROJECT PLANNING TOOLS (09)

Bar Charts and Milestones Chart: Introduction, Development of bar chart, Short comings and remedial measures, Milestone charts.CPM & PERT: Elements of network, Time estimates, frequency distribution, mean, variance and standard deviation, probability distribution. Network Analysis: Slack, Float, Critical path, crashing of activity.

MODULE –III: COST ANALYSIS & UPDATING (09)

Introduction, Projects cost: Direct cost, Indirect cost, slope of direct cost curve, total project cost and optimum duration, cost optimization.

Project Updating: Introduction, updating process, data required for updating, steps in process updating.

MODULE –IV: RISK ANALYSIS AND RESOURCE ALLOCATION (09)

Certainty, risk and uncertainty, risk management, identification and nature of construction risks, contractual allocation of risk, types of risks, minimizing risks and mitigating losses, use of expected values, utility in investment decisions, decision trees, sensitivity analysis. Resource Allocation: Resource usage profiles, Resource smoothing and levelling.

MODULE –V: CONSTRUCTION EQUIPMENT (09)

Types of compaction Equipment's, Types of Excavation and digging Equipment's, Types of hoisting equipment's, Types of Material handling Equipment's and Types of heavy earth moving equipment's.

V. TEXT BOOKS:

1. B. C. Punmia, K.K. Khandelwal, Project Planning and Control with PERT and CPM, Laxmi Publications, 2005.
2. Sharma S.C. "Construction Equipment and Management, Khanna Publishers, New Delhi, 2002.

VI. REFERENCE BOOKS:

1. Peurifoy,R.L, Ledbetter.W.B and schexnayder,C, "Construction Planning and Equipment methods, McGraw Hill, Singapore, 1993.
2. Callahan,M.T., Quackenbush,D.G.,and rowing,J.E., "Construction Project Scheduling, McGraw Hill, New York, 1998.
3. Cleland, D.I. and Ireland, L.R., "Project Management: Strategic Design and Implementation, McGraw Hill, New York, 2002.

VII. WEB REFERENCES:

1. https://nptel.ac.in/courses/105/106/105106149/
2. https://onlinecourses.nptel.ac.in/noc19_mg30/preview

VIII. E-TEXT BOOKS:

https://books.google.co.in/books/about/Project_Management_Planning_and_Control.html?id=BQa8wudi6AAC&redir_esc=y

ENGLISH FOR RESEARCH PAPER WRITING

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BHSC01	Audit	2	-	-	0	30	70	100
Contact Classes: 24	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 24		

I. COURSE OVERVIEW:

In this course, students will be equipped with the necessary tools to effectively communicate their research findings in a scholarly manner. They will develop the ability to write clear, concise, and well-structured research papers that adhere to academic standards. These skills will not only benefit them in their academic pursuits but also in their future professional careers as researchers, scholars, and professionals in various fields

II. COURSE OBJECTIVES:

The students will try to learn:

I. How to improve the writing skills and level of readability.
II. The methodology that what to write in each section
III. The skills needed when writing a Title Ensure the good quality of paper at very first-time submission.

III. COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	Interpret the technique of determining a research problem for a crucial part of the research study	Apply
CO 2	Examine the way of methods for avoiding plagiarism in research	Understand
CO 3	Apply the feasibility and practicality of research methodology for a proposed project.	Apply
CO 4	Make use of the legal procedure and document for claiming patent of invention.	Apply
CO 5	Identify different types of intellectual properties, the right of ownership, scope of protection to create and extract value from IP	Apply

IV. SYLLABUS:

MODULE – I: PLANNING AND PREPARATION (04)

Planning and Preparation, Word Order, breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

MODULE – II: ABSTRACT (05)

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction

MODULE – III: DISCUSSION AND CONCLUSIONS (05)

Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature.

MODULE – IV: DISCUSSION AND CONCLUSIONS (05)

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions.

MODULE – V: QUALITY AND TIME MAINTENANCE (05)

Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission.

V. TEXT BOOKS:

1. Goldbort R, "Writing for Science", Yale University Press. 2011.
2. Adrian Wallwork, "English for Writing Research Papers", Springer New York Dordrecht Heidelberg London, 2011.

VI. REFERENCE BOOKS:

1. Highman N, "Handbook of Writing for the Mathematical Sciences", SIAM Highman's Book.

VII. WEB REFERENCES:

1. http://saba.kntu.ac.ir/eecd/ecourses/Seminar90/2011%20English%20for%20Writing%20Research%20Papers.pdf

VIII. E-TEXT BOOKS:

1. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press.

DISASTER MANAGEMENT

Course Code	Category	Hours / Week			Credits	Maximum Marks		
BHSC02	Audit	L	T	P	C	CIA	SEE	Total
		2	-	-	0	30	70	100
Contact Classes: 24	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 24		

I. COURSE OVERVIEW:

In the course on disaster management, students will explore a range of important topics and gain valuable knowledge and skills to effectively address and mitigate the impact of disasters and covers areas like Repercussions of Disasters and Hazards, Disaster-Prone Areas in India, Risk Assessment and Disaster Mitigation

II. COURSE OBJECTIVES:

The students will try to learn:

I. How to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
II. How critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
III. The understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
IV. The strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in.

III. COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	Understand to describe the basic types of Environmental hazards and disasters. Understand how to react effectively to natural, manmade, and technological threats.	Understand
CO 2	Understand how to react effectively to natural, manmade, and planetary hazards	Understand
CO 3	Explore the history of the field and comprehend how past events are earthquake, landslides, and volcanic hazards.	Analyze
CO 4	Describe the basic concepts of the emergency management cycle mitigation, preparedness, response, and recovery	Understand
CO 5	Recognizes the stakeholders in disaster management system, their jurisdiction and responsibilities	Remember

IV. SYLLABUS

MODULE – I: INTRODUCTION (04)

Disaster: Definition, Factors and Significance; Difference Between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types And Magnitude.

MODULE – II: REPERCUSSIONS OF DISASTERS AND HAZARDS (05)

Economic Damage, Loss Of Human And Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

MODULE – III: DISASTER PRONE AREAS IN INDIA (05)

Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And

Epidemics.

MODULE – IV: DISASTER PREPAREDNESS AND MANAGEMENT (05)

Preparedness: Monitoring of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.

MODULE – IV: RISK ASSESSMENT & DISASTER MITIGATION (05)

Disaster Risk: Concept And Elements, Disaster Risk Reduction, Global And National Disaster Risk Situation. Techniques Of Risk Assessment, Global Co-Operation In Risk Assessment And Warning, People's Participation In Risk Assessment. Strategies for Survival. Disaster Mitigation: Meaning, Concept And Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India.

V. TEXT BOOKS:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies", New Royal Book Company.

VI. REFERENCE BOOKS:

1. Sahni, PardeepEt.Al, "Disaster Mitigation Experiences and Reflections", Prentice Hall Of India, New Delhi.
2. Goel S. L. "Disaster Administration and Management Text and Case Studies", Deep & Deep Publication Pvt. Ltd., New Delhi.

VII. WEB REFERENCE:

1. http://nptel.ac.in/courses/105101010/downloads/Lecture37.pdf

VIII. E-TEXT BOOKS:

1. Disaster management by Vinod k. Sharma

SANSKRIT FOR TECHNICAL KNOWLEDGE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BHSC03	Audit	2	-	-	0	30	70	100
Contact Classes: 24	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 24		

I. COURSE OVERVIEW:

In this course, Studying Sanskrit enhances students' analytical thinking and problem-solving abilities. The intricate grammar and logical structure of Sanskrit nurture their analytical skills, enabling them to dissect complex concepts and extract profound insights. This heightened analytical thinking can be applied across different technical disciplines, fostering innovative solutions to contemporary challenges

II. COURSE OBJECTIVES:

The students will try to learn:

I. A working knowledge in illustrious Sanskrit, the scientific language in the world.
II. The Sanskrit to improve brain functioning.
III. The Sanskrit language to develop the logic in mathematics, science & other subjects enhancing the memory power.
IV. The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature.

III. COURSE OUTCOMES:

After successful completion of the course, students should be able to

CO 1	Understand the basic Sanskrit grammar	Understand
CO 2	Formulate simple sentences	Apply
CO 3	Apply order and roots	Apply
CO 4	Understand Ancient Sanskrit literature about science & technology	Understand
CO 5	Develop logical thinking being a logical language in technical concepts	Apply

IV. SYLLUBUS:

MODULE – I: INTRODUCTION (06)

Alphabets in Sanskrit, Past/Present/Future Tense.

MODULE – II: SENTENCES (04)

Simple Sentences

MODULE – III: ROOTS (04)

Order, Introduction of roots

MODULE – IV: SANSKRIT LITERATURE (04)

Technical information about Sanskrit Literature

MODULE – V: TECHNICAL CONCEPTS (06)

Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

V. TEXT BOOKS:

1. Suresh Soni, “India’s Glorious Scientific Tradition”, Ocean books (P) Ltd., New Delhi.

VI. REFERENCE BOOKS:

1. Dr.Vishwas, “Abhyaspustakam”, Samskrita-Bharti Publication, New Delhi.

VII. WEB REFERENCES:

1. http://learnsanskritonline.com/

VIII. E-TEXT BOOKS:

1. Prathama Deeksha-Vempati Kutumb Shastri, “Teach Yourself Sanskrit”, Rashtriya Sanskri Sansthanam, New Delhi Publication.

VALUE EDUCATION

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BHSC04	Audit	2	-	-	0	30	70	100
Contact Classes: 24	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 24		

I. COURSE OVERVIEW:

In the course on value education, students emerge with a heightened sense of self-awareness, a strong moral foundation, and the skills necessary for personal and professional success. They are equipped with the knowledge and tools to navigate ethical challenges, contribute positively to society, and lead a purposeful and fulfilling life based on their core values and principles.

II. COURSE OBJECTIVES:

The students will try to learn:

I. The value of education and self- development.
II. Imbibe good values in students.
III. The importance of character.

III. COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	Understand the significance of ethical human conduct and self-development	Understand
CO 2	Adopt value-based living and holistic technologies to save nature	Apply
CO 3	Inculcate positive thinking, dignity of labor and religious tolerance	Apply
CO 4	Develop the overall Character and Competence through self-management	Analyze
CO 5	Practice Self-control. Honesty through Studying effectively all religious messages	Apply

IV. SYLLABUS:

MODULE – I: VALUES AND SELF-DEVELOPMENT (04)

Values and self-development. Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non- moral valuation. Standards and principles. Value judgments.

MODULE – II: CULTIVATION OF VALUES (06)

Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature, Discipline.

MODULE – III: PERSONALITY AND BEHAVIOR DEVELOPMENT (06)

Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labor. Universal brotherhood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature.

MODULE – IV: CHARACTER AND COMPETENCE (04)

Character and Competence –Holy books vs Blind faith. Self-management and Good health. Science of reincarnation. Equality, Nonviolence, Humility, Role of Women.

MODULE – V: SELF CONTROL (04)

All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively.

V. TEXT BOOKS:

1. Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi.

VI. WEB REFERENCES:

1. http://www.best-personal-development-books.com/personal-value-development.html
2. http://nptel.ac.in/courses/109104068/

VII. E-TEXT BOOKS:

1. R.P. Shukla, “Value education and human rights”.

CONSTITUTION OF INDIA

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BHSC05	Audit	2	-	-	0	30	70	100
Contact Classes: 24	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 24		

I. COURSE OVERVIEW:

The course on the Constitution of India provides students with a comprehensive understanding of the historical context, principles, and structure of the Indian Constitution. It explores the journey and philosophy behind the making of the Indian Constitution, highlighting the vision and ideals of the founding fathers.

II. COURSE OBJECTIVES:

The students will try to learn:

I. The premises informing the twin themes of liberty and freedom from a civil right perspective.
II. The growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
III. The role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

III. COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	Describe historical background of the constitution making and its importance for building a democratic India.	Understand
CO 2	Understand the Constitutional Rights and and duties	Understand
CO 3	Explain the functioning of three wings of the government i.e., executive, legislative and judiciary	Understand
CO 4	Analyse the decentralization of power between central, state and local self-government.	Analyze
CO 5	Apply the knowledge in strengthening of the constitutional institutions like CAG, Election Commission and UPSC for sustaining democracy	Apply

IV. SYLLABUS:

MODULE – I: HISTORY OF MAKING OF THE INDIAN CONSTITUTION & PHILOSOPHY OF THE INDIAN CONSTITUTION (08)

History of Making of the Indian Constitution: History, Drafting Committee, (Composition & Working)
Philosophy of the Indian Constitution: Preamble, Salient Features.

MODULE – II: CONTOURS OF CONSTITUTIONAL RIGHTS & DUTIES (04)

Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

MODULE – III: ORGANS OF GOVERNANCE (04)

Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive President, Governor, Council of Minister.

Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions

MODULE – IV: LOCAL ADMINISTRATION (04)

District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Pachayati raj: Introduction, PRI: Zila Pachayat. Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy.

MODULE – V: ELECTION COMMISSION (04)

Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.

V. TEXT BOOKS:

1. Dr. S. N. Busi, "Dr. B. R. Ambedkar framing of Indian Constitution", 1st Edition, 2015.
2. M. P. Jain, "Indian Constitution Law", Lexis Nexis, 7th Edition, 2014.

VI. REFERENCE BOOKS:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. D.D. Basu, "Introduction to the Constitution of India", Lexis Nexis, 2015.

VII. WEB REFERENCES:

1. http://www.constitution.org/cons/india/p18.html

VIII. E-TEXT BOOKS:

1. https://www.india.gov.in/my-government/constitution-india/constitution-india-full-text

PEDAGOGY STUDIES

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BHSC06	Audit	2	-	-	0	30	70	100
Contact Classes: 24	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 24		

I. COURSE OVERVIEW:

In this course in pedagogy studies, students gain a solid foundation in educational principles and practices. They develop a deep understanding of effective teaching and learning strategies, empowering them to create engaging and meaningful learning experiences for their future students. Whether pursuing a career in teaching or any other field that involves knowledge transfer, students emerge with the knowledge and skills to inspire and facilitate learning, making a positive impact on the lives of others.

II. COUSE OBJECTIVES:

The students will try to learn:

I. Review existing evidence on the review topic to inform program design and policy making undertaken by the DFID, other agencies and researchers.
II. The critical evidence gaps to guide the development.

III. COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	Identify the Methodology and conceptual framework of teachers education	Understand
CO 2	Understand pedagogical practices are being used by teachers in formal and informal classrooms in developing countries	Understand
CO 3	Interpret the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners	Understand
CO 4	Classify the importance of class room practice, curriculum and learning in Professional Development.	Understand
CO 5	Summarize teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy	Understand

IV. SYLLABUS:

MODULE – I: INTRODUCTION (04)

Introduction And Methodology: Aims and rationale, Policy background, Conceptual framework and terminology. Theories of learning, Curriculum, Teacher education. Conceptual framework, Research questions**.** Overview of methodology and Searching.

MODULE – II: THEMATIC OVERVIEW (04)

Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education.

MODULE – III: PEDAGOGICAL PRACTICES (06)

Evidence on the effectiveness of pedagogical practices. Methodology for the in-depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Theory of change.

Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.

MODULE – IV: PROFESSIONAL DEVELOPMENT (05)

Professional Development: alignment with classroom practices and follows up Support. Peer support. Support from the head teacher and the community. Curriculum and assessment Barriers to learning: limited resources and large class sizes.

MODULE – V: RESEARCH GAPS (05)

Research gaps and future directions, Research design**,** Contexts**,** Pedagogy**.** Teacher education**.** Curriculum and assessment**.** Dissemination and research impact.

V. TEXT BOOKS:

1. Ackers J, Hardman F, "Classroom interaction in Kenyan primary schools", Compare, 31 (2), 245-261.
2. Agrawal M, "Curricular reform in schools: The importance of evaluation", Journal of Curriculum Studies, 36 (3): 361-379.

VI. REFERENCE BOOKS:

1. AkyeampongK, "Teacher training in Ghana - does it count?" Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
2. Akyeampong K, Lussier K, Pryor J, Westbrook J, "Improving Teaching and Learning of Basic Maths and Rreading in Africa: Does teacher preparation count?" International Journal Educational Development, 33 (3): 272–282.

VII. WEB REFERENCE:

1. www.pratham.org/images/resource%20working%20paper%202.pdf.
2. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education Oxford and Boston: Blackwell

VIII. E-TEXT BOOKS:

1. www.pratham.org/images/resource%20working%20paper%202.pdf.

STRESS MANAGEMENT BY YOGA

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BHSC07	Audit	2	-	-	0	30	70	100
Contact Classes: 24	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 24		

I. COURSE OVERVIEW:

In a course on stress management by yoga, engineering students learn a variety of yoga techniques and principles that promote physical, mental, and emotional well-being. These techniques include yoga postures (asanas), breathing exercises (pranayama), meditation, and relaxation techniques.

II. COURSE OBJECTIVES:

The students will try to learn:

I. How to achieve overall health of body and mind.
II. How to overcome stress.

III. COURSE OUTCOMES:

After successful completion of the course, students should be able to: (Same as R18)

CO 1	Understand Ashtanga yog and its impartance	Understand
CO 2	Identify the Dos and Do nots of Life by practicing the Yam and Niyam	Analyze
CO 3	Interpret the Shaucha and its components	Understand
CO 4	Make use of breathing techniques and Asan and Pranayam	Understand
CO 5	Develop healthy mind in a healthy body thus improving social health also	Apply

IV. SYLLABUS:

MODULE – I: INTRODUCTION (06)

Definitions of Eight parts of yog. (Ashtanga)

MODULE – II: YAM AND NIYAM (04)

Yam and Niyam. Do`s and Don't's in life. Ahinsa, satya, astheya, bramhacharya and aparigraha.

MODULE – III: SHAUCHA (05)

Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

MODULE – IV: ASAN AND PRANAYAM (05)

Asan and Pranayam. Various yog poses and their benefits for mind & body

MODULE – V: BREATHING TECHNIQUES (04)

Regularization of breathing techniques and its effects-Types of pranayam

V.TEXT BOOKS:

1. Swami Vivekananda, "Rajayoga or conquering the Internal Nature", Advaita Ashrama (Publication Department), Kolkata.

VI.REFERENCE BOOKS:

1. Janardan Swami, "Yogic Asanas for Group Tarining-Part-I", Yogabhyasi Mandal, Nagpur.

VII. WEB REFERENCES:

1. https://americanyoga.school/course/anatomy-for-asana/
2. https://www.yogaasanasonline.com/

VIII. E-TEXT BOOKS:

1. Todd A. Hoover, M. D. D., Ht, “Stress Management by Yoga”.

PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BHSC08	Audit	2	-	-	0	30	70	100
Contact Classes: 24	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 24		

I. COURSE OVERVIEW:

In this course, students delve into various aspects of personal development and self-awareness. They learn techniques to improve self-confidence, self-esteem, and self-awareness, which are vital for thriving in their engineering careers. Students explore their strengths, weaknesses, values, and beliefs, enabling them to develop a clearer understanding of themselves and their goals.

II. COURSE OBJECTIVES:

The students will try to learn:

I. How to achieve the highest goal happily.
II. How a person become with stable mind, pleasing personality and determination.
III. Awaken wisdom in students.

III. COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Summarize** steps to develop personality with stable mind, pleasing manners and determination.	Understand
CO 2	**Identify** day to day work and duties for developing peace and prosperity as depicted in Geeta.	Analyze
CO 3	**Formulate** the daily life style by depicting the verses from Bhagavatgeetha.	Analyze
CO 4	**Outline** the verses of Shrimad Bhagavad Geetha for holistic development.	Create
CO 5	Demonstrates personality development by verses of Bhagavatgeetha.	Create

IV. SYLLUBUS:

MODULE – I: HOLISTIC DEVELOPMENT (08)

Neetisatakam-Holistic development of personality, Verses- 19,20,21,22 (wisdom), Verses- 29,31,32 (pride & heroism), Verses- 26,28,63,65 (virtue),Verses- 52,53,59 (dont's),Verses- 71,73,75,78 (do's)

MODULE – II: BHAGWAD GEETA (04)

Approach to day to day work and duties. Shrimad BhagwadGeeta: Chapter 2-Verses 41, 47,48. Chapter 3- Verses 13, 21, 27, 35.

MODULE – III: BHAGWAD GEETA (04)

Shrimad BhagwadGeeta: Chapter 6-Verses 5, 13, 17, 23, 35, Chapter 18-Verses 45, 46, 48.

MODULE – IV: BASIC KNOWLEDGE (04)

Statements of basic knowledge. Shrimad BhagwadGeeta: Chapter2-Verses 56, 62, 68. Chapter 12 - Verses 13, 14, 15, 16,17, 18

MODULE – V: ROLE MODEL (04)

Personality of Role model. Shrimad BhagwadGeeta: Chapter2-Verses 17, Chapter 3-Verses 36,37,42,

Chapter 4-Verses 18, 38,39. Chapter18 – Verses 37,38,63

V. TEXT BOOKS:

1. P.Gopinath, "Bhartrihari's Three Satakam (Niti-sringar-vairagya)", Rashtriya Sanskrit Sansthanam, New Delhi.

VI. REFERENCE BOOKS:

1. Swami Swarupananda, "Srimad Bhagavad Gita", Advaita Ashram (Publication Department), Kolkata.

VII. WEB REFERENCES:

1. http://openlearningworld.com/section_personality_development.html

VIII. E-TEXT BOOKS:

1. http://persmin.gov.in/otraining/UNDPProject/undp_UNITs/Personality%20Dev%20N%20DLM.pdf

BUSINESS SUSTAINABILITY MANAGEMENT

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BHSC09	Audit	2	-	-	0	30	70	100
Contact Classes: 24	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 24		

I. COURSE OVERVIEW:

In this course student will be able to learn sustainability management, business sustainability dimensions, paradigms of business sustainability, sustainability management knowledge and methods.

II. COURSE OBJECTIVES:

The students will try to learn:

I. The sustainability challenges and opportunities in the global economy.
II. The design, technology and planning for sustainability.
III. The regulatory environment and international policies for sustainability.
IV. The contemporary paradigms of business sustainability.
V. The design, technology and planning for sustainability management.

III. COURSE OUTCOMES:

After successful completion of the course, students shouldbe able to:

CO 1	Understand sustainability challenges and opportunities in the global economy	Understand
CO 2	explore opportunities for value creation through stakeholder and partner collaboration	Understand
CO 3	Investigate the potential of technology, design, and innovation to enable or limit sustainable business practices.	Understand
CO 4	Understand product sustainability life cycle and management	Understand
CO 5	Develop proactive plans for enhancing sustainability and resilience of Corporate firms.	Apply

IV. SYLLABUS:

MODULE – I: INTRODUCTION TO SUSTAINABILITY MANAGEMENT (06)

Definition, nature and characteristics of sustainability management, history of sustainability management, future of sustainability management, sustainability and environmental management, emerging trends in sustainability.

MODULE – II: BUSINESS SUSTAINABILITY DIMENSIONS (04)

Dimensions of Sustainability, Challenges Facing Business, Stakeholders and Stakeholder Management Issues in Sustainability management, sustainability management approaches.

MODULE – III: EMERGING PARADIGMS OF BUSINESS SUSTAINABILITY (06)

Managing sustainability – functional responses, strategy and leadership issues, linkages with External Stakeholders.
Reporting, Measurements and Standards, Emerging Business Issues in Sustainability.

MODULE – IV: PRODUCT SUSTAINABILITY MANAGEMENT (04)

Life Cycle Thinking, Environmental Life Cycle Assessment, Life Cycle Costing Sustainable Procurement, Supply Chain Sustainability, Product Stewardship, Extended Producer Responsibility.

MODULE – V: SUSTAINABILITY MANAGEMENT KNOWLEDGE AND METHODS (04)

Sustainability Business Modeling and the Circular Economy, Impact measurement and Valuation, Digitalization, Data and Sustainability, Sustainability communication, Corporate sustainability management.

V. TEXT BOOKS:

1. Margaret Robertson, "Dictionary of Sustainability", Routledge, 16th May 2017.
2. Jane Penty, "Product Design and Sustainability Strategies, Tools and Practice", Routledge, 27th August, 2019.
3. John Blewitt, "Understanding Sustainable Development", Routledge, 22nd December 2017.

VI. REFERENCE BOOKS:

1. Margaret Robertson, "Sustainability Principles and Practices", Routledge, 10th February, 2021.
2. RikiTherivel, Graham Wood, "Methods of Environmental and Social Impact Assessment", Routledge, 14th September, 2017.
3. NikoRooda, "Fundamentals of Sustainability Development", Routledge, 30th September, 2020.

VII. WEB REFERENCES:

1. https://www.slideshare.net/PresentationLoad/sustainability-management-ppt-slide-template
2. https://www.slideshare.net/szl/sustainable-development-management
3. https://www.slideshare.net/eccinternational/corporate-sustainability-management

VIII. E-TEXT BOOKS:

1. https://about.jstor.org/librarians/books/sustainability/
2. http://www. ebooktake.in/pdf/title/sustainability management
3. http://all4ryou.blogspot.in/2012/06/becg-sustanability development
4. http://books.google.com/books/about/ corporate sustainability management

BUSINESS ETHICS AND CORPORATE GOVERNANCE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BHSC10	Audit	2	-	-	0	30	70	100
Contact Classes: 24	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 24		

I. COURSE OVERVIEW

In this course students will be able to learn business ethics, ethical value system, conceptual framework of corporate governance, corporate social responsibility

II. COURSE OBJECTIVES:

The students will try to learn:

I. The Business Ethics and to provide best practices of business ethics codes.
II. The values and implement in their careers to guide beliefs, attitudes, and behaviors.
III. The corporate social responsibilities and practice in practical and professional life.
IV. The ethical issues in corporate governance and to adhere to the ethical.
V. The legal framework to protect the ethical practices of organizations.

III. COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	understand the business ethics and explore the relationship between ethics and business and economics across different cultural traditions.	Understand
CO 2	Comprehend the relationship between ethics, morals and values in the workplace.	Understand
CO 3	Analyze and understand various ethical philosophies to explain how they contribute to current management practices.	Analyze
CO 4	Analyze the reasons of systematic failure of corporate governance that could spread from individual firms to entire markets or economies.	Analyze
CO 5	Analyze corporate social Responsibility	Analyze

IV. SYLLABUS:

MODULE – I: INTRODUCTION TO BUSINESS ETHICS (06)

Meaning, Principles of Business Ethics, Characteristics of Ethical Organization, Ethics, Ethics of Corporate Governance, Globalization and Business Ethics, Stakeholders' Protection, Corporate Governance and Business Ethics.

MODULE – II: THE ETHICAL VALUE SYSTEM (04)

Universalism, Utilitarianism, Distributive Justice, Social Contracts, Individual Freedom of Choice, Professional Codes; Culture and Ethics – Ethical Values in different Cultures, Culture and Individual Ethics.

MODULE – III: LAW AND ETHICS (06)

Relationship between Law and Ethics, Other Bodies in enforcing Ethical Business Behavior, Impact of Laws on Business Ethics; Social Responsibilities of Business.

Environmental Protection, Fair Trade Practices, Fulfilling all National obligations under various Laws, Safeguarding Health and wellbeing of Customers.

MODULE – IV: CONCEPTUAL FRAMEWORK OF CORPORATE GOVERNANCE (04)

Meaning, Governance vs. Good Corporate Governance, Corporate Governance vs. Corporate Excellence, Insider Trading, Rating Agencies, Benefits of Good Corporate Governance, Corporate Governance Reforms, and Initiatives in India.

MODULE – V: CORPORATE SOCIAL RESPONSIBILITY (04)

Meaning, CSR and Corporate Sustainability, CSR and Business Ethics, CSR and Corporate Governance, Environmental Aspect of CSR, CSR Models.

V. TEXT BOOKS:

1. J. P. Sharma, "Corporate Governance, Business Ethics & CSR", Ane Books Pvt. Ltd., New Delhi.
2. Bhanu Murthy, K. V. and Usha Krishna, "Politics Ethics and Social Responsibilities of Business", Pearson Education, New Delhi.
3. D Geeta Rani & R K Mishra, "Corporate Governance-Theory and Practice", Excel Books, New Delhi

VI. REFERENCE BOOKS:

1. Christine A Mallin, "Corporate Governance (Indian Edition)", Oxford University 46 Press, New Delhi.
2. Bob Tricker, "Corporate Governance-Principles, Policies, and Practice (Indian Edition)", Oxford University Press, New Delhi.
3. Andrew Crane Dirk Matten, "Business Ethics (Indian Edition)", Oxford University Press, New Delhi.

VII. WEB REFERENCES:

1. https:// www.slideshare.net/glory1988/business-ethics-corporate -governance
2. https:// thenthata.web4kurd.net/mypdf/ethics-corporate-governance
3. https:// bookshallcold. link/pdfread/business-ethics-corporate-governance
4. https:// www.gvpce.ac.in/syllabi/corporate social responsibility/

VIII. E-Text Books:

1. https:// books.google.co.in/books/about/business ethics and corporate governance
2. http://www. ebooktake.in/pdf/title/laws and ethics
3. http://all4ryou.blogspot.in/2012/06/becg-business ethics
4. http://books.google.com/books/about/business corporate governance

FREQUENTLY ASKED QUESTIONS AND ANSWERS ABOUT AUTONOMY

1. Who grants Autonomy? UGC, Govt., AICTE or University

In case of Colleges affiliated to a university and where statutes for grant of autonomy are ready, it is the respective University that finally grants autonomy but only after concurrence from the respective state Government as well as UGC. The State Government has its own powers to grant autonomy directly to Govt. and Govt. aided Colleges.

2. Shall IARE award its own Degrees?

No. Degree will be awarded by Jawaharlal Nehru Technological University, Hyderabad with a mention of the name IARE on the Degree Certificate.

3. What is the difference between a Deemed University and an Autonomy College?

A Deemed University is fully autonomous to the extent of awarding its own Degree. A Deemed University is usually a Non-Affiliating version of a University and has similar responsibilities like any University. An Autonomous College enjoys Academic Autonomy alone. The University to which an autonomous college is affiliated will have checks on the performance of the autonomous college.

4. How will the Foreign Universities or other stake – holders know that we are an Autonomous College?

Autonomous status, once declared, shall be accepted by all the stake holders. The Govt. of Telangana mentions autonomous status during the First Year admission procedure. Foreign Universities and Indian Industries will know our status through our website.

5. What is the change of Status for Students and Teachers if we become Autonomous?

An autonomous college carries a prestigious image. Autonomy is actually earned out of our continued past efforts on academic performances, our capability of self- governance and the kind of quality education we offer.

6. Who will check whether the academic standard is maintained / improved after Autonomy? How will it be checked?

There is a built in mechanism in the autonomous working for this purpose. An Internal Committee called Academic Programme Evaluation Committee, which will keep a watch on the academics and keep its reports and recommendations every year. In addition the highest academic council also supervises the academic matters. The standards of our question papers, the regularity of academic calendar, attendance of students, speed and transparency of result declaration and such other parameters are involved in this process.

7. Will the students of IARE as an Autonomous College qualify for University Medals and Prizes for academic excellence?

No. IARE has instituted its own awards, medals, etc. for the academic performance of the students. However for all other events like sports, cultural on co-curricular organized by the University the students shall qualify.

8. Can IARE have its own Convocation?

No. Since the University awards the Degree the Convocation will be that of the University, but there will be Graduation Day at IARE.

9. Can IARE give a provisional degree certificate?

Since the examinations are conducted by IARE and the results are also declared by IARE, the

college sends a list of successful candidates with their final Grades and Grade Point Averages including CGPA to the University. Therefore with the prior permission of the University the college will be entitled to give the provisional certificate.

10. Will Academic Autonomy make a positive impact on the Placements or Employability?
Certainly. The number of students qualifying for placement interviews is expected to improve, due to rigorous and repetitive classroom teaching and continuous assessment. Also the autonomous status is more responsive to the needs of the industry. As a result therefore, there will be a lot of scope for industry oriented skill development built-in into the system. The graduates from an autonomous college will therefore represent better employability.

11. What is the proportion of Internal and External Assessment as an Autonomous College?
Presently, it is 70 % external and 30% internal. As the autonomy matures the internal assessment component shall be increased at the cost of external assessment.

12. Is it possible to have complete Internal Assessment for Theory or Practicals?
Yes indeed. We define our own system. We have the freedom to keep the proportion of external and internal assessment component to choose.

13. Why Credit based Grade System?
The credit based grade system is an accepted standard of academic performance the world over in all Universities. The acceptability of our graduates in the world market shall improve.

14. What exactly is a Credit based Grade System?
The credit based grade system defines a much better statistical way of judging the academic performance. One Lecture Hour per week of Teaching Learning process is assigned One Credit. One hour of laboratory work is assigned half credit. Letter Grades like A, B,C,D, etc. are assigned for a Range of Marks. (e.g. 91% and above is A+, 80 to 90 % could be A etc.) in Absolute Grading System while grades are awarded by statistical analysis in relative grading system. We thus dispense with sharp numerical boundaries. Secondly, the grades are associated with defined Grade Points in the scale of 1 to 10. Weighted Average of Grade Points is also defined Grade Points are weighted by Credits and averaged over total credits in a Semester. This process is repeated for all Semesters and a CGPA defines the Final Academic Performance

15. What are the norms for the number of Credits per Semester and total number of Credits for UG/PG programme?
These norms are usually defined by UGC or AICTE. Usually around 25 Credits per semester is the accepted norm.

16. What is a Semester Grade Point Average (SGPA)?
The performance of a student in a semester is indicated by a number called SGPA. The SGPA is the weighted average of the grade points obtained in all the courses registered by the student during the semester.

$$SGPA = \sum_{i=1}^{n} (C_i G_i) / \sum_{i=1}^{n} C_i$$

Where, C_i is the number of credits of the i^{th} course and $G_i$is the grade point scored by the student in the i^{th} course and $i$represent the number of courses in which a student registered in the concerned semester. SGPA is rounded to two decimal places.

17. What is a Cumulative Grade Point Average (CGPA)?

An up-to-date assessment of overall performance of a student from the time of his first registration is obtained by calculating a number called CGPA, which is weighted average of the grade points obtained in all the courses registered by the students since he entered the Institute.

$$CGPA = \sum_{j=1}^{n} (C_i S_i) / \sum_{j=1}^{n} C_i$$

Where,S_i is the SGPA of the i^{th}semester and $C_i$is the total number of credits in that semester and $j$represent the number of courses in which a student's is registered upto the semester. CGPA is rounded to two decimal places.

18. Is there any Software available for calculating Grade point averages and converting the same into Grades?

Yes, The institute has its own MIS software for calculation of SGPA,CGPA,etc.

19. Will the teacher be required to do the job of calculating SGPAs etc. and convert the same into Grades?

No. The teacher has to give marks obtained out of whatever maximum marks as it is. Rest is all done by the computer.

20. Will there be any Revaluation or Re-Examination System?

No. There will double valuation of answer scripts. There will be a make up Examination after a reasonable preparation time after the End Semester Examination for specific cases mentioned in the Rules and Regulations. In addition to this, there shall be a 'summer term' (compressed term) followed by the End Semester Exam, to save the precious time of students.

21. How fast Syllabi can be and should be changed?

Autonomy allows us the freedom to change the syllabi as often as we need.

22. Will the Degree be awarded on the basis of only final year performance?

No. The CGPA will reflect the average performance of all the semester taken together.

23. What are Statutory Academic Bodies?

Governing Body, Academic Council, Examination Committee and Board of Studies are the different statutory bodies. The participation of external members in everybody is compulsory. The institute has nominated professors from IIT, NIT, University (the officers of the rank of Pro-vice Chancellor, Deans and Controller of Examinations) and also the reputed industrialist and industry experts on these bodies.

24. Who takes Decisions on Academic matters?

The Governing Body of institute is the top academic body and is responsible for all the academic decisions. Many decisions are also taken at the lower level like Boards of Studies. Decisions taken at the Board of Studies level are to be ratified at the Academic Council and Governing Body.

25. What is the role of Examination committee?

The Examinations Committee is responsible for the smooth conduct of internal, End Semester and make up Examinations. All matters involving the conduct of examinations, spot valuations, tabulations and preparation of Grade Cards etc fall within the duties of the Examination Committee.

26. Is there any mechanism for Grievance Redressal?

The institute has grievance redressal committee, headed by Dean - Student affairs and Dean - IQAC.

27. How many attempts are permitted for obtaining a Degree?
All such matters are defined in Rules & Regulation

28. Who declares the result?
The result declaration process is also defined. After tabulation work wherein the SGPA, CGPA and final Grades are ready, the entire result is reviewed by the Moderation Committee. Any unusual deviations or gross level discrepancies are deliberated and removed. The entire result is discussed in the Examinations and Result Committee for its approval. The result is then declared on the institute notice boards as well put on the web site and Students Corner. It is eventually sent to the University.

29. Who will keep the Student Academic Records, University or IARE?
It is the responsibility of the Dean, Academics of the Autonomous College to keep and preserve all the records.

30. What is our relationship with the JNT University?
We remain an affiliated college of the JNT University. The University has the right to nominate its members on the academic bodies of the college.

31. Shall we require University approval if we want to start any New Courses?
Yes, It is expected that approvals or such other matters from an autonomous college will receive priority.

32. Shall we get autonomy for PG and Doctoral Programmes also?
Yes, presently our PG programs also enjoying autonomous status

MALPRACTICES RULES

DISCIPLINARY ACTION FOR / IMPROPER CONDUCT IN EXAMINATIONS

S. No	Nature of Malpractices/Improper conduct	Punishment
	If the candidate:	
1. (a)	Possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, cell phones, pager, palm computers or any other form of material concerned with or related to the subject of the examination (theory or practical) in which he is appearing but has not made use of (material shall include any marks on the body of the candidate which can be used as an aid in the subject of the examination)	Expulsion from the examination hall and cancellation of the performance in that subject only.
(b)	Gives assistance or guidance or receives it from any other candidate orally or by any other body language methods or communicates through cell phones with any candidate or persons in or outside the exam hall in respect of any matter.	Expulsion from the examination hall and cancellation of the performance in that subject only of all the candidates involved. In case of an outsider, he will be handed over to the police and a case is registered against him.
2.	Has copied in the examination hall from any paper, book, programmable calculators, palm computers or any other form of material relevant to the subject of the examination (theory or practical) in which the candidate is appearing.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the subjects of that Semester/year. The Hall Ticket of the candidate is to be cancelled and sent to the Controller of Examinations.
3.	Impersonates any other candidate in connection with the examination.	The candidate who has impersonated shall be expelled from examination hall. The candidate is also debarred and forfeits the seat. The performance of the original candidate, who has been impersonated, shall be cancelled in all the subjects of the examination (including practicals and project work) already appeared and shall not be allowed to appear for examinations of the remaining subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all semester end examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. If the imposter is an outsider, he will be handed over to the police and a case is registered against him.

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

9.	If student of the college, who is not a candidate for the particular examination or any person not connected with the college indulges in any malpractice or improper conduct mentioned in clause 6 to 8.	Student of the colleges expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat. Person(s) who do not belong to the College will be handed over to police and, a police case will be registered against them.
10.	Comes in a drunken condition to the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year.
11.	Copying detected on the basis of internal evidence, such as, during valuation or during special scrutiny.	Cancellation of the performance in that subject and all other subjects the candidate has appeared including practical examinations and project work of that semester/year examinations.
12.	If any malpractice is detected which is not covered in the above clauses 1 to 11 shall be reported to the University for further action to award suitable punishment.	

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad - 500 043

UNDERTAKING BY STUDENT/PARENT

"To make the students attend the classes regularly from the first day of starting of classes and be aware of the College regulations, the following Undertaking Form is introduced which should be signed by both student and parent. The same should be submitted to the Dean, Academic".

I, Mr./Ms ---------- joining I Semester for the academic year 2021-2022 in Institute of Aeronautical Engineering, Hyderabad, do hereby undertake and abide by the following terms, and I will bring the ACKNOWLEDGEMENT duly signed by me and my parent and submit it to the Dean, Academic.

1. I will attend all the classes as per the timetable from the starting day of the semester specified in the institute Academic Calendar. In case, I do not turn up even after two weeks of starting of classes, I shall be ineligible to continue for the current academic year.
2. I will be regular and punctual to all the classes (theory/practical/drawing) and secure attendance of not less than 80% in every course as stipulated by Institute. I am fully aware that an attendance of less than 70% in more than three courses will make me lose one year.
3. I will compulsorily follow the dress code prescribed by the college.
4. I will conduct myself in a highly disciplined and decent manner both inside the classroom and on campus, failing which suitable action may be taken against me as per the rules and regulations of the institute.
5. I will concentrate on my studies without wasting time in the Campus / Hostel / Residence and attend all the tests to secure more than the minimum prescribed Class / Sessional marks in each course. I will submit the assignments given in time to improve my performance.
6. I will not use Mobile Phone in the institute premises and also, I will not involve in any form of ragging inside or outside the campus. I am fully aware that using mobile phone to the institute premises is not permissible and involving in Ragging is an offence and punishable as per JNTUH/UGC rules and the law.
7. I declare that I shall not indulge in ragging, eve-teasing, smoking, consuming alcohol drug abuse or any other anti-social activity in the college premises, hostel, on educational tours, industrial visits or elsewhere.
8. I will pay tuition fees, examination fees and any other dues within the stipulated time as required by the Institution / authorities, failing which I will not be permitted to attend the classes.
9. I will not cause or involve in any sort of violence or disturbance both within and outside the college campus.
10. If I absent myself continuously for 3 days, my parents will have to meet the concerned HOD / Principal.
11. I hereby acknowledge that I have received a copy of PG21 Academic Rules and Regulations, Syllabus copy and hence, I shall abide by all the rules specified in it.

ACKNOWLEDGEMENT

I have carefully gone through the terms of the undertaking mentioned above and I understand that following these are for my/his/her own benefit and improvement. I also understand that if I/he/she fail to comply with these terms, shall be liable for suitable action as per Institute/JNTUH/AICTE/UGC rules and the law. I undertake that I/he/she will strictly follow the above terms.

Signature of Student with Date

Signature of Parent with Date
Name & Address with Phone Number