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 CATALOGUE AND SYLLABI
MT23

M.Tech Regular Two Year Degree Program
(for the batches admitted from the academic year 2023 - 2024)

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 - PROGRAM OUTCOMES (PO's)

Upon completion of M.Tech - Electrical Power Systems, 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 the area as per the specialization of the program. The mastery should be at a level of higher than the requirements in the appropriate bachelor program.
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.

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 institute 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 Aerospace Engineering, Computer Science and Engineering, Embedded Systems, Electrical Power Systems, CAD/CAM, Structural Engineering 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

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 "MT23" 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.

PREFACE

Dear Students,

The focus at IARE is to deliver value-based education with academically well qualified faculty and infrastructure. It is a matter of pride that IARE continues to be the preferred destination for students to pursue an engineering degree.

In the year 2015, IARE was granted academic autonomy status by University Grants Commission, New Delhi under Jawaharlal Nehru Technology University Hyderabad. From then onwards, our prime focus is on developing and delivering a curriculum which caters to the needs of various stakeholders. The curriculum has unique features enabling students to develop critical thinking, solve problems, analyze socially relevant issues, etc. The academic cycle designed on the basis of Outcome Based Education (OBE) strongly emphasizes continuous improvement and this has made our curriculum responsive to current requirements.

The curriculum at IARE has been developed by experts from academia and industry and it has unique features to enhance problem solving skills apart from academic enrichment. The curriculum of M.Tech program has been thoroughly revised as per AICTE / UGC / JNTUH guidelines and have incorporated unique features such as competency training / coding, industry driven elective, internship and many more. The curriculum is designed in a way so as to impart engineering education in a holistic approach towards Excellence.

I hope you will have a fruitful stay at IARE.

Dr. L V Narasimha Prasad
Principal

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

ACADEMIC REGULATIONS

M.Tech. Regular Two Year Degree Program
(for the batches admitted from the academic year 2023 – 24)

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.

I. CHOICE BASED CREDIT SYSTEM

The Indian Higher Education Institutions (HEI's) are changing from the conventional course structure to Choose 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. 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. 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. 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. TYPES OF COURSES

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

5.1 Core Courses:

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 Courses:

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 Courses:

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 Mandatory Audit Courses:

The student may opt for audit courses, starting in first semester onwards. Audit courses can help the student to get awareness of different issues which make impact on human lives and enhance their skill sets to improve their employability. List of audit courses offered in each semester is provided in curriculum. Student can choose one audit course from the list. Evaluation of audit course will be done at institute level. Method of conduction and method of assessment for audit courses is suggested.

For mandatory non-credit Audit courses, a student has to secure 40 marks out of 100 marks (i.e. 40% of the marks allotted) in the continuous internal evaluation for passing the subject/course. These marks should also be uploaded along with the internal marks of other subjects.

No marks or letter grades shall be allotted for mandatory non-credit Audit courses. Its result shall be declared with "Satisfactory" or "Not Satisfactory" performance.

6. SEMESTER STRUCTURE

The M.Tech. Programs in institute are of semester pattern, with four semesters consisting of Two academic years. Each academic year having Two Semesters: Odd and Even. Each Semester shall be of 22 weeks of duration (inclusive of Examinations), with a minimum of 90 instructional days per semester.

The two-year M.Tech. program consists of 68 credits and the student has to register for all 68 credits and earn all 68 credits for the award of M.Tech. degree. There is NO exemption of credits in any case.

UGC/AICTE specified definitions/descriptions are adopted appropriately for various terms and abbreviations used in these PG academic regulations, as listed below:

Each Semester shall have 'Continuous Internal Assessment (CIA)' and 'Semester End Examination (SEE)'. Choice Based Credit System (CBCS) and Credit Based Semester System (CBSS) are taken as 'references' for the present set of regulations. The terms 'SUBJECT' and 'COURSE' imply the same meaning here and refer to 'Theory Subject', or 'Lab Course', or 'Design/Drawing Subject', or 'Mini Project with Seminar', or 'Dissertation', as the case may be.

Before commencement of the class work, all the eligible students are required to register the courses through Samvidha (Student Management Portal) without fail.

7. 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 a minimum of 6.0/10.0 CGPA.

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. CURRICULUM AND COURSE STRUCTURE

The curriculum shall comprise Professional core courses, Professional elective courses, Audit courses, Open elective courses, Laboratory courses, Mini project with seminar, Phase-I Dissertation and Phase-II Dissertation.

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.
- **Dissertation Work / Project work**; 1 credit for 2 hours of project work per week.

Other student activities like study tour, guest lecture, conference/workshop participations, technical paper presentations and mandatory courses (Non-credit Audit Courses) will not carry any credits.

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 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	Phase – I Dissertation	20	10
8	Phase – II 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
Phase-I Dissertation	1 @10credit	10
Phase-II Dissertation	1 @16credits	16
TOTAL CREDITS		**68**

9. EVALUATION METHODOLOGY

9.1 Theory Course:

Each theory course will be evaluated for a total of 100 marks, out of which 40 marks for Continuous Internal Assessment (CIA) and 60 marks for Semester End Examination (SEE).

9.1.1 Semester End Examination (SEE):

The SEE shall be conducted for 60 marks of 3 hours duration. The syllabus for the theory courses shall be divided into FIVE modules and each module 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 12 marks. There could be a maximum of two / 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 40 marks, with 30 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 and 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: Outline of the Continuous Internal Assessments (CIA – 1 and CIA – 2) and SEE

Activities	CIA – 1	CIA – 2	SEE	Total Marks
Continuous Internal Examination (CIE)	10 marks	10 marks		20 marks
Assignment / Quiz	05 marks	05 marks		10 marks
Alternative Assessment Tool (AAT)	05 marks	05 marks		10 marks
Semester End Examination (SEE)			60 marks	60 marks
Total	--	--	100 marks	

Continuous Internal Examination (CIE):

Two CIE exams shall be conducted at the end of the 8th and 16th 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. Assignment has to submit either at the end of the CIE1 or CIE2 for the questions provided by 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.

Quiz: It is online proctor based online examination conducted either at the end of the CIE1 or CIE2.

The choice of conduction of Assignment / Quiz in CIE1 or CIE2 is purely choice of course handling faculty.

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 include,** Course related term paper, Technical seminar, Term paper, Case Study, Paper presentations conducted by reputed organizations relevant to the course etc.

The choice of selection of AAT is based on course handling faculty.

Note:

First mid-term examination shall be conducted on 50% of the syllabus, and the second mid-term examination shall be conducted on the remaining 50% of the syllabus.

The semester end examinations (SEE), for theory courses, will be conducted for 60 marks consisting of five questions (numbered from 1 to 5) carrying 12 marks each. Each of these questions is from each module and may contain sub-questions, for each question there will be an "either" "or" choice, which means, there will be two questions from each module, student should answer either of the two questions.

The duration of Semester End Examination is 3 hours.

9.2 Laboratory Course: For practical courses there shall be a Continuous Internal Assessment (CIA) during the semester for 40 marks and 60 marks for semester end examination. Out of the 40 marks for internal evaluation:

1. A write-up on day-to-day experiment in the laboratory (in terms of Preparation / Performance in the laboratory / Calculations and graphs / Results and error analysis / Viva-voce) which shall be evaluated for **10 marks**.
2. Viva-voce (or) tutorial (or) case study (or) application (or) poster presentation of the course concerned – **10 marks.**
3. Internal practical examination conducted by the laboratory teacher concerned shall be evaluated for **10 marks.**
4. The remaining 10 marks are for Laboratory Project, which consists of the Design (or) Software / Hardware Model Presentation (or) App Development (or) Prototype Presentation submission which shall be evaluated after completion of laboratory course and before semester end practical examination.
5. The Semester End Examination shall be conducted with an external examiner and the laboratory teacher. The external examiner shall be appointed from the cluster / other colleges which will be decided by the Principal. The Semester End Examination held for 3 hours and total 60 marks are divided and allocated asshown below:

    1. 10 marks for write-up
    2. 15 for experiment/program
    3. 15 for evaluation of results
    4. 10 marks for presentation on another experiment/program in the same laboratory course
    5. 10 marks for viva-voce on concerned laboratory course

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.

Registration of Dissertation Work: A candidate is permitted to register for the Dissertation Work after satisfying the attendance requirement in all the courses, both theory and laboratory. After satisfying the attendance requirement candidate must present in Dissertation Work Review – I, in consultation with his Supervisor, the title, objective and plan of action of his/her Dissertation work to the Project Review Committee (PRC) for approval within four weeks from the commencement of III semester. Only after obtaining the approval of the PRC can the student initiate the Dissertation work.

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 Dissertation 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, Supervisor / 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 Supervisor/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	Supervisor / Guide	40
2		Evaluation at the end of III Semester	Project Review Committee (PRC) comprising of senior faculty of the specialization, Supervisor / Guide and HOD.	60
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 Supervisor / Guide wherein the HOD convenes its meeting.	40
4		End Semester Examination (An open seminar followed by viva- voce)	The External Evaluation Committee (EEC) comprising of External Examiner, HOD and Supervisor / Guide wherein the HOD shall be the chairman of the committee.	60
Total (Phase-II)				**100**

9.3.4 As soon as a student submits 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. ATTENDANCE REQUIREMENTS AND DETENTION POLICY

The programs are offered based on a unit system with each course being considered a unit. Attendance is calculated separately for each course.

10.1 Attendance in all classes (Lectures/Laboratories) is compulsory. The minimum required attendance in each theory course (***also mandatory Audit Courses***) including the attendance of mid-term

examination / Laboratory etc. is 75%. Two periods of attendance for each theory course shall be considered, if the student appears for the mid-term examination of that course. A student shall not be permitted to appear for the Semester End Examinations (SEE), if s/he attendance is less than 75%.

10.2 **A** student's Seminar report and presentation on Mini Project shall be eligible for evaluation, only if he ensures a minimum of 75% of his attendance in seminar presentation classes on Mini Project during that semester.

10.3 **Condoning of shortage of attendance** (between 65% and 75%) up to a maximum of 10% (considering the days of attendance in sports, games, NCC, NSS activities and medical grounds) in each course (Theory /Laboratory / Mini Project with Seminar) of a semester shall be granted by the institute academic committee on genuine reasons.

10.4 A prescribed fee per course shall be payable for condoning shortage of attendance.

10.5 Shortage of Attendance below 65% in any course shall in **no case be condoned.**

10.6 A Student, whose shortage of attendance is not condoned in any course(s) (Theory/Lab/Mini Project with Seminar) in any semester, is considered as 'Detained in that course(s), and is not eligible to write Semester End Examination(s) of such course(s), (in case of Mini Project with Seminar, s/he Mini Project with Seminar Report or Presentation are not eligible for evaluation) in that Semester; and s/he has to seek re-registration for those course(s) in subsequent semesters, and attend the same as and when offered.

10.7 A student fulfills the attendance requirement in the present semester, shall not be eligible for readmission into the same class.

10.8 **a)** A student shall put in a minimum required attendance in at least **three theory courses (excluding *mandatory (non-credit audit)* course)** in first semester for promotion to second semester.

b) A student shall put in a minimum required attendance in at least **three theory courses (excluding *mandatory (non-credit audit)* course)** in second semester for promotion to third semester.

11. 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 COE shall invite external examiners to evaluate all the semester end examinations answer scripts on a prescribed date(s).

11.3 Laboratory examinations are conducted by involving external examiners.

11.4 Examinations Control Office headed by COE shall consolidate the marks awarded by internal and external examiners and award grades.

12. 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 (16 out of 40 marks) for each theory course in the CIA.
ii. Not less than 40% marks (24 out of 60 marks) for each theory course in the SEE.
iii. A minimum of 50% marks (50 out of 100 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 / Mini project with Seminar / Dissertation Project, if s/he secures.

i. Not less than 40% marks (16 out of 40 marks) in the CIA.

ii. Not less than 40% marks (24 out of 60 marks) in the SEE.

iii. A minimum of 50% marks (50 out of 100 marks) considering both CIA and SEE.

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 10 point grading system with the following letter grades as given below:

% of Marks Secured in a Subject / Course (Class Intervals)	Letter Grade (UGC Guidelines)	Grade Points
90% and above (≥ 90%, ≤ 100%)	O (Outstanding)	10
Below 90% but not less than 80% (≥ 80%, <90%)	A+ (Excellent)	9
Below 80% but not less than 70% (≥ 70%, <80%)	A (Very Good)	8
Below 70% but not less than 60% (≥ 60%, <70%)	B+ (Good)	7
Below 60% but not less than 50% (≥ 50%, <60%)	B (above Average)	6
Below 50% (<50%)	F (Fail)	0
Absent	**AB (Absent)**	**0**

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: "O", "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 "SA" denotes shortage of attendance (as per item 10) and hence prevention from writing Semester End Examination.

13.5 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 to compute 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.

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

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 of calculation of SGPA

Course	Credits	Letter Grade	Grade Points	Credit Points (Credit x Grade)
Course 1	4	A	8	4 x 8 = 32
Course 2	4	O	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 of calculation of CGPA

Semester	Credits	SGPA	Credits * SGPA
Semester I	24	7	24 * 7 = 168
Semester II	24	6	24 * 6 = 144
Semester III	24	6.5	24 * 6.5 = 156
Semester IV	24	6	24 * 6 = 144
	96		**612**

Thus, *CGPA = 612* / 96 = 6.37

16.0 PHOTOCOPY / REVALUATION

A student, who seeks the revaluation of the answer script, is directed to apply for the photocopy of his/her semester examination answer paper(s) in the theory course(s) within 2 working days from the declaration of results in the prescribed format to the Controller of Examinations through the Head of the Department. On receiving the photocopy, the student can consult with a competent member of faculty and seek the opinion for revaluation. Based on the recommendations, the student can register for the revaluation with prescribed fee. The Controller of Examinations shall arrange for the revaluation and declare the results. Revaluation is not permitted to the courses other than theory courses.

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 within four consecutive academic years from the year of his/her admission (with CGPA ≥ 6.0), shall forfeit his/her degree and his/her admission stands 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:

Classification of degree will be as follows:

Class Awarded	CGPA
First Class with Distinction	≥ 7.75
First Class	6.75≤ CGPA < 7.75
Second Class	6.00≤ CGPA < 6.75

Note: 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. 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. 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. 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. 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. TRANSITORY REGULATIONS

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.

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. 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

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 Program 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 introduced 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 program?
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 onlyfinal 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 of 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 Programs 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 AERONAUTICALENGINEERING

(AUTONOMOUS)

COURSE CATALOGUE

REGULATIONS: MT-23

ELECTRICAL POWER SYSTEMS

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										
BPSD01	Modern Power System Analysis	PCC	Core	3	0	0	3	40	60	100
BPSD02	Economic Operation of Power Systems	PCC	Core	3	0	0	3	40	60	100
	Professional Elective – I	PE	Elective	3	0	0	3	40	60	100
	Professional Elective – II	PE	Elective	3	0	0	3	40	60	100
BHSD01	Research Methodology & IPR	--	--	2	0	0	2	40	60	100
	Audit Course - I	Audit - I	Audit	2	0	0	0	--	--	--
PRACTICAL										
BPSD11	Power System Computational Laboratory	PCC	Core	0	0	4	2	40	60	100
BPSD12	Internet of Things Laboratory	PCC	Core	0	0	4	2	40	60	100
TOTAL				**16**	**00**	**08**	**18**	**280**	**420**	**700**

***Professional Elective- I and Professional Elective- I Lab must be of same course.**

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										
BPSD13	Digital Protection of Power Systems	PCC	Core	3	0	0	3	40	60	100
BPSD14	Power System Dynamics and Stability	PCC	Core	3	0	0	3	40	60	100
	Professional Elective - III	PE	Elective	3	0	0	3	40	60	100
	Professional Elective - IV	PE	Elective	3	0	0	3	40	60	100
	Audit Course - II	Audit - II	Audit	2	0	0	0	--	--	--
PRACTICAL										
BPSD23	Artificial Intelligence in Power Systems Laboratory	PCC	Core	0	0	4	2	40	60	100
BPSD24	Power Systems Laboratory	PCC	Core	0	0	4	2	40	60	100
BPSD25	Mini Project with Seminar	PCC	Core	0	0	4	2	40	60	100
TOTAL				**14**	**00**	**12**	**18**	**280**	**420**	**700**

***Professional Elective- III and Professional Elective- III Lab must be of same course.**

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										
	Professional Elective - V	PE	Elective	3	0	0	3	40	60	100
BPSD30	Open Elective	OEC	Elective	3	0	0	3	40	60	100
PROJECT										
BPSD34	Dissertation Work Review - II	Major Project	Core	0	0	12	6	40	60	100
TOTAL				**06**	**00**	**12**	**12**	**120**	**180**	**300**

IV. SEMESTER

Course Code	Course Name	Subject Area	Category	Periods per week			Credits	Scheme of Examination Max. Marks		
				L	T	P		CIA	SEE	Total
BPSD35	Dissertation Work Review - III	Major Project	Core	0	0	12	6	40	60	100
BPSD36	Dissertation Viva-Voce	--	Core	0	0	28	14	40	60	100
TOTAL				**00**	**00**	**40**	**20**	**80**	**120**	**200**

ELECTIVE COURSES

PROGRAM CORE ELECTIVES (PCE)

S.No	Course Code	Course Name	Professional Electives
1	BPSD03	HVDC Transmission and FACTS	I
2	BPSD04	Smart Grid Technologies	I
3	BPSD05	Internet of Things	I
4	BPSD06	Renewable Energy Systems	I
5	BPSD07	Reactive Power Compensation and Management	II
6	BPSD08	Hybrid Electric Vehicles	II
7	BPSD09	Advanced Digital Signal Processing	II
8	BPSD10	Electrical Power Distribution System	II
9	BPSD15	Swarm Intelligence Techniques in Power Systems	III
10	BPSD16	Industrial Load Modelling and Control	III
11	BPSD17	Cyber Security in Power System	III
12	BPSD18	Restructured Power Systems	III
13	BPSD19	AI Techniques in Power Systems	IV
14	BPSD20	Power Quality	IV
15	BPSD21	Data Science and Machine Learning for Modern Power Systems	IV
16	BPSD22	High Frequency Magnetic Components	IV
17	BPSD26	SCADA System and Applications	V
18	BPSD27	Power System Reliability	V
19	BPSD28	Grid Instrumentation and Communication Systems	V
20	BPSD29	Electrical Transients in Power Systems	V

OPEN ELECTIVE COURSES FOR OTHER DEPARTMENTS

S.No	Course Code	Course Name
1	BPSD30	Data Analytics
2	BPSD31	Operational Research
3	BPSD32	Real Time Operating Systems
4	BPSD33	Waste to Energy

AUDIT COURSES – I AND II

S.No	Course Code	Course Title
1	BHSD02	English for Research Paper Writing
2	BHSD03	Disaster Management
3	BHSD04	Sanskrit for Technical Knowledge
4	BHSD05	Value Education
5	BHSD06	Constitution of India
6	BHSD07	Pedagogy Studies
7	BHSD08	Stress Management by Yoga
8	BHSD09	Personality Development through Life Enlightenment Skills

COURSE CONTENT

MODERN POWER SYSTEM ANALYSIS								
I Semester: EPS								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BPSD01	**Core**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite: Power system operational control								

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. COURSES 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:

At the end of the course students should be able to:

CO1 Utilize the representation of basic components and single line diagram of power system for understanding the restructuring of system
CO2 Examine the optimal power flow solution using FACTS devices to solve power flow analysis problems using various methods.
CO3 Analyze the new bus voltages contingency by adding/removal of lines for illustrating the various techniques for contingency evaluation and analysis.
CO4 Evaluate the operating states and security monitoring of power systems to describe its contingency analysis.
CO5 Understand the importance of power flow analysis in planning and operation of power systems.
CO6 Apply the various algorithms for state estimation to estimate different components and states of power systems.

IV. COURSE CONTENT:

MODULE - I: PLANNINGAND 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 (10)

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 (10)

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. TEXTBOOKS:

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

VI. REFERENCE BOOKS:

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

VII. ELECTRONICS RESOURCES:

1. NPTEL Modern Power system analysis - NOC: Planning and Operational Studies of Power Systems.
2. NPTEL Modern Power system analysis - NOC: Introduction to symmetrical components.
3. NPTEL Modern Power system analysis - NOC: Power Flow Analysis.
4. https://nptel.ac.in/courses/104104085

VIII. MATERIALS ONLINE

1. Course template
2. Tutorial question bank
3. Definition and terminology
4. Assignments
5. Model question paper-I
6. Model question paper-II
7. Lecture notes
8. Early learning readiness videos (ELRV)
9. Power point presentations

COURSE CONTENT

ECONOMIC OPERATION OF POWER SYSTEMS								
I Semester: EPS								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BPSD02	**Core**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite: Power system analysis								

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. COURSES 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:

At the end of the course students should be able to:

CO1 Solve the unit Commitment problem with various constraints using conventional optimization techniques and general transmission line loss formula.
CO2 Identify an optimal operation setup of power system for minimizes operation costs and meet desired needs.
CO 3 Categorize single area load frequency control and two area load frequency control to minimize the transient deviations and steady state error to zero.
CO 4 Analyze the importance of Reactive power control and Power Factor in power systems for efficient and reliable operation of power systems.
CO 5 Develop the appropriate control scheme for compensating reactive power.
CO 6 Identify the different types of compensating equipment for reducing reactive power to improve system's efficiency.

IV. COURSE CONTENT:

MODULE - I: ECONOMIC LOAD SCHEDULING (10)

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 (10)

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. TEXTBOOKS:

1. J J Grainger, W D Stevenson, "Power system analysis", McGraw Hill, 1st edition, 2003.
2. Allen JWood, Bruce F Wollenberg, Gerald B Sheblé, "Power Generation, Operation and Control", Wiley Interscience, 2nd edition, 2013.

VI. REFERENCE BOOKS:

1. Olle, Elgerd, "Electric Energy Systems Theory an Introduction", TMH, 3rd edition 2006.

VII. ELECTRONICS RESOURCES:

1. NPTEL Economic Operation of Power Systems - NOC: Planning and Operational Studies of Power Systems.
2. NPTEL Economic Operation of Power Systems - NOC: Introduction to symmetrical components.
3. NPTEL Modern Power system analysis - NOC: Power Flow Analysis.

VIII. MATERIALS ONLINE

1. Course template
2. Tutorial question bank
3. Definition and terminology
4. Assignments
5. Model question paper-I
6. Model question paper-II
7. Lecture notes
8. Early learning readiness videos (ELRV)
9. Power point presentations

COURSE CONTENT

HVDC TRANSMISSION AND FACTS								
I Semester: EPS								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
BPSD03	**Elective**	3	-	-	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite: HVDC Transmission System								

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. COURSES 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:

At the end of the course students should be able to:

CO1	Explain the basic fundamental of FACTS controllers
CO2	Interpret the enhancement of stability using static shunt and series compensation
CO3	Model and design of coordinating multiple FACTS controllers UPFC and IPFC using control techniques
CO4	Develop the knowledge of HVDC transmission and HVDC converters and the applicability and advantage of HVDC transmission over conventional AC transmission.
CO5	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

IV. COURSE CONTENT:

MODULE - I: FACTS CONCEPTS (10)

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 (10)

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 (10)

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. TEXTBOOKS:

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. ELECTRONICS RESOURCES:

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

VIII. MATERIALS ONLINE

1. Course template
2. Tutorial question bank
3. Definition and terminology
4. Assignments
5. Model question paper-I
6. Model question paper-II
7. Lecture notes
8. Early learning readiness videos (ELRV)
9. Power point presentations

COURSE CONTENT

SMART GRID TECHNOLOGIES								
I Semester: EPS								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
BPSD04	**Elective**	3	-	-	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite: -								

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 Microgrid 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:

CO1 Explain the features smart grid to increase grid efficiency, selfhealing, accessibility and reliability.
CO2 Analyze the different energy storage solutions available for improving grid stability and security.
CO3 Analyze the dynamic behaviour of Microgrid and its grid integration issues to meet the load requirement effectively.
CO4 Outline the role of different renewable resources like PV, Wind, etc for improving the system dynamics performance.
CO5 Identify the efficient management of power quality for compatibility between all the equipments connected to the grid.
CO6 Make use of sensors, transducers, intelligent electronic devices and meter to improve the distribution system overall performance.

IV. COURSE SYLLABUS:

MODULE -I: –INTRODUCTION 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 -II: AUTOMATION IN GRID MANAGEMENT (09)

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) (10)

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 (10)

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 GRID (10)

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.

V. TEXTBOOKS:

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.

VI. REFERENCE BOOKS:

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

VII. ELECTRONICS RESOURCES:

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. MATERIALS ONLINE

1. Course template
2. Tutorial question bank
3. Assignments
4. Model question paper-I
5. Model question paper-II
6. Lecture notes
7. Early learning readiness videos (ELRV)
8. Power point presentations

COURSE CONTENT

INTERNET OF THINGS								
I Semester: EPS								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BPSD05	**Elective**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
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 OBJECTIVES:

The students will try to learn:

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

III COURSE OUTCOMES:

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

CO1 Explain internal building blocks of IOT for the evolution of Internet of Things
CO2 Understand the programming of microcontroller for the functional stack of IoT ecosystem.
CO3 Understand the concepts of data synchronization for agility and autonomy in protocols
CO4 Apply IEEE 802.11 protocol for topology and security in physical and MAC layers
CO5 Identify the applications of IoT including home automation, smart cities, and smart environment to implement the real time applications.
CO6 Make use of appropriate communication protocols to acquire the knowledge of programming with Raspberry PI.

IV. COURSE SYLLABUS:

MODULE -I: –INTRODUCTION (10)

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 (09)

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 (09)

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 autonomy.

Enabling autonomy and agility by the internet of things, technical requirements for satisfying the new demands in production, 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 (10)

The Meaning of DiY in the Network Society- Sensor-actuator Technologies and Middleware as a Basis for a DiY Service Creation Framework - Device Integration – Middleware Technologies 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 WebOntology - The Internet of Things in Context of EURIDICE - Business Impact.

MODULE -V: FROM THE INTERNET OF THINGS TO THE WEB OF THINGS (10)

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. TEXTBOOKS:

1. Charalampos Doukas , Building Internet of Things with the Arduino, Create space, April, 2002.
2. Dieter Uckelmann et.al, “Architecting the Internet of Things”, Springer, 201.1

VI. REFERENCE BOOKS:

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

VII. ELECTRONICS RESOURCES:

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

VIII. MATERIALS ONLINE

1. Course template
2. Tutorial question bank
3. Assignments
4. Model question paper-I
5. Model question paper-II
6. Lecture notes
7. Early learning readiness videos (ELRV)
8. Power point presentations

COURSE CONTENT

RENEWABLE ENERGY SYSTEMS								
I Semester: EPS								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
BPSD06	**Elective**	3	-	-	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite: -								

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:

CO1 Understand the need of energy conversion and the various methods of energy storage.
CO2 Analyze the major parameters of sun movement, solar radiation and tracking systems for calculation of solar insolation.
CO3 Identify different concentrating collectors for conversion of solar energy into thermal energy.
CO4 Explain the concepts involved in wind energy conversion system using vertical and horizontal wind mills.
CO5 Illustrate the operational methods of ocean energy for electrical energy conversion.
CO6 Utilize the distribution technologies for renewable energy distribution and storage.

IV. COURSE SYLLABUS:

MODULE -I: GLOBAL AND NATIONAL ENERGY SCENARIO (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 (10)

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 -III: BIO GAS, TIDAL AND OCEAN ENERGY CONVERSION SYSTEMS (10)

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 – IV: GEO-THERMAL ENERGY AND FUEL CELLS (10)

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 -V: ENERGY SYSTEMS AND GRIDS (09)

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. TEXTBOOKS:

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.

VII. ELECTRONICS RESOURCES:

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

VIII. MATERIALS ONLINE

1. Course template
2. Tech-talk topics
3. Assignments
4. Model question paper-I
5. Model question paper-II
6. Lecture notes
7. Early learning readiness videos (ELRV)
8. Power point presentations

COURSE CONTENT

REACTIVE POWER COMPENSATION AND MANAGEMENT								
II Semester: EPS								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
BPSD07	**Core**	3	-	-	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite: Power system analysis								

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. COURSES 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:

CO1 Discuss the objectives and specifications of reactive compensation for designing the compensating equipment.
CO2 Describe the characteristics of an uncompensated line and a compensated line which are used for evaluating the performance of lines.
CO3 Examine the mathematical modeling, operation planning and transmission benefits in reactive power coordination.
CO4 Describe the load patterns, power tariffs, flicker and harmonic voltage levels used in billing the power consumers.
CO5 Explain the use of different types of capacitors, their characteristics which are used in user side reactive power management.
CO 6 Discuss the impact of electric traction systems and furnaces on the reactive power and suggest the user side reactive power management techniques.

IV. COURSE CONTENT:

MODULE - I: LOAD COMPENSATION (10)

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 (10)

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 interference

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 (10)

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. TEXTBOOKS:

1. TJE Miller, "Reactive power control in Electric power systems", Wiley Publication, 1st Edition, 1982.
2. D MTagare, "Reactive power Management", by Tata McGraw Hill, 1st edition, 2004.

VI. REFERENCE BOOKS:

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

VII. ELECTRONICS RESOURCES:

1. NPTEL Reactive Power Compensation and Management- NOC: Planning and Operational Studies Of Reactive Power Compensation And Management.
2. NPTEL Reactive Power Compensation and Management - NOC: Explain the basic fundamental of Reactive Power Compensation and Management.
3. NPTEL Reactive Power Compensation and Management - NOC: applicability and advantage of Reactive Power Compensation and Management.

VIII. MATERIALS ONLINE

1. Course template
2. Tutorial question bank
3. Definition and terminology
4. Assignments
5. Model question paper-I
6. Model question paper-II
7. Lecture notes
8. Early learning readiness videos (ELRV)
9. Power point presentations

COURSE CONTENT

POWER SYSTEM COMPUTATIONAL LABORATORY								
I Semester: EPS								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BPSD11	**Core**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		-	-	4	2	40	60	100
Contact Classes: Nil	**Tutorial Classes: Nil**	**Practical Classes: 45**				**Total Classes: 45**		
Prerequisite: Power System Computational								

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. COURSES 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 OUTCOMES:

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

CO1	Understand the concept of Admittance matrix for the formulation of various inspection and transformation methods.
CO2	Develop the programming for load flow algorithms.
CO3	Analyze the characteristics of fast decoupled loaf flow methods for developing algorithm.
CO4	Analyze the features of various algorithms applicable for protection of Transformers and transmission lines.
CO5	Categorize the transient and short circuit analysis for analyzing the performance of the system.
CO6	Analyze the various iterative methods applicable for state estimation of the power system.

IV. LIST OF EXPERIMENTS:

Week1: FORMATION OF BUS ADMITTANCE MATRIX
Develop program for Ybus formation by direct inspection method.

Week2: SINGULAR TRANSFORMATION
Develop program for Ybus formation by singular transformation method.

Week 3: GAUSS - SEIDAL LOAD FLOW METHOD
Develop program for G-S load flow algorithm

Week 4: NEWTON - RAPHSON LOAD FLOW METHOD
Develop program for N-R load flow algorithm in polar coordinates.

Week 5: FAST DECOUPLED LOAD FLOW METHOD
Develop program for FDLF algorithm.

Week 6: DC LOAD FLOW
Develop program for DC load flow algorithm.

Week 7: BUILDING ALGORITHM
Develop Program for ZBUS building algorithm

Week 8: SHORT CIRCUIT ANALYSIS
Develop program for short circuit analysis using ZBUS algorithm.

Week 9: TRANSIENT STABILITY
Develop program for transient stability analysis for single machine connected to infinite bus.

Week 10: LOAD DISPATCH PROBLEM
Develop program for economic load dispatch problem using lambda iterative method.

Week 11: DYNAMIC PROGRAMMING METHOD
Develop program for unit commitment problem using forward dynamic programming method.

Week 12: STATE ESTIMATION
Develop program for state estimation of power system.

Week 13: ECONOMIC DISPATCH IN POWER SYSTEMS.
Develop program to meet the system demand for economic operation of power systems.

Week14: LOAD – FREQUENCY DYNAMICS OF SINGLE- AREA AND TWO-AREA POWER SYSTEMS.
Develop program for load frequency controller (LFC) under different control modes and to obtain the best system response.

V. TEXTBOOKS:

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

COURSE CONTENT

INTERNET OF THINGS LABORATORY								
I Semester: EPS								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
BPSD12	**Core**	-	-	4	2	40	60	100
Contact Classes: Nil	**Tutorial Classes: Nil**	**Practical Classes: 45**				**Total Classes: 45**		
Prerequisite: Power System Computational								

I. COURSE OVERVIEW:

The main objective of the course is to provide knowledge on internet of things and how important it is in present scenario. IoT is a connecting bridge between physical world and cyber world and Machine to Machine communication i.e. with automation as one subset. IoT refers to uniquely identifiable objects and their virtual representations in an Internet like structure. Measurement of various electrical quantities and functioning of induction motor in the case of over voltage, current is using arduino. Design a relay to protect the home appliances from over currents, under voltages and over voltages.

II. COURSES OBJECTIVES:

The students will try to learn:

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

IV. COURSE OUTCOMES:

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

CO1	List the different IOT applications and importance of IOT in present scenario.
CO2	List the application of Arduino for Node MCU
CO3	Know the different sensors available to measure the current and voltage
CO4	Design the digital voltmeter and ammeter for both AC and DC circuits
CO5	Design a digital frequency meter to measure the frequency in an AC circuit.
CO6	Measure the power and energy consumption in a home using Arduino

V. LIST OF EXPERIMENTS:

Week1: ARDUINO BASED DIGITAL VOLTMETER, AMMETER
Design of digital voltmeter and ammeter using Arduino

Week2: ARDUINO BASED WATTMETER, ENERGY METER
Design of digital wattmeter and energy meter using Arduino

Week 3: CONROLLING RGB LED
Programming for Controlling RGB LED using Arduino and Wi-Fi module

Week 4: IOT TO CONTROL REMOTE LED
Programming for Internet of things with Android and Arduino. Build an Arduino based IoT to control a remote LED.

Week 5: INTERFACING BLUETOOTH MODULE
Programming for how to interface HC-05 Bluetooth module with Arduino UNO for control of small dc motor.

Week 6: **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.

Week 7: **INTERFCAING IR SENSOR**
Programming to Interface IR sensors and Bluetooth for detecting obstacle using Arduino with android Application

Week 8: **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
.

Week 9: **SEND DATA FROM ARDUINO TO WEB PAGE**
Programming for how to send data from Arduino to Webpage using Wi-Fi module

Week 10: **DIGITAL PROTECTION OF THREE PHASE INDUCTION MOTOR**
Studying the ON / OFF control strategies of small dc motor using IoT.
Develop program for economic load dispatch problem using lambda iterative method.

Week 11: **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.

Week 12: **OVER CURRENT RELAY**
Design of over current relay in distribution system and displaying the tripping status of the relay through IoT.

Week 13: **OVER VOLTAGE RELAY**
Design of over voltage relay in distribution system and displaying the tripping status of the relay through IoT.

Week 14: **OVER SPEED RELAY**
Design of over speed relay in distribution system and displaying the tripping status of the relay through IoT.

VI. TEXTBOOKS:

1. Samuel Greengard, K B Kanchandhani, “The Internet of Things”, Tata Mc Graw Hill Publishing Company, 2nd edition, 1998
2. Cuno Pfister, “Getting started with Internet of Things”, Khanna Publishers, 5th edition, 2012.

COURSE CONTENT

DIGITAL PROTECTION OF POWER SYSTEMS								
II Semester: EPS								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BPSD13	**Core**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite: Power systems								

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.

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II. COURSES OBJECTIVES:

The students will try to learn

I. The working of numerical relays.
II. Mathematical approach towards protection.
III. Algorithms for numerical protection Power flow analysis using various methods.

III. COURSE OUTCOMES:

At the end of the course students should be able to:

CO1	Illustrate the significance of protection systems and elements involved in protection of the power system.
CO2	Develop the structures, mathematical models and formulae of digital relays for mathematical analysis of the system.
CO3	Identify the basic components of digital relay and signal conditioning subsystems for implementation of digital protection.
CO4	Develop the mathematical models for analysis of the relying algorithms to address the various types of faults in the power system.
CO5	Categorize the digital relying algorithms to minimize the transient deviations and steady state error to zero.
CO6	Analyze the various algorithms applicable for protection of Transformers and transmission lines.

IV. COURSE CONTENT:

MODULE - I: MATHEMATICAL BACKGROUND TO DIGITAL PROTECTION (10)

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 (10)

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 (09)

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 (10)

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: DIGITAL PROTECTION OF TRANSFORMERS AND TRANSMISSION LINES (10)

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. TEXTBOOKS:

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 is Corporate Publishing, 1st edition, 2006.
2. SRB hide "Digital Power System Protection" PHI Learning Pvt.Ltd. 3rd edition, 2014.

VII. ELECTRONICS RESOURCES:

1. NPTEL Digital Power system protection - NOC: Digital protection of Power Systems.
2. NPTELDigital Power system protection- NOC: Introduction to protection of Power Systems.
3. NPTEL Digital Power system protection- NOC: Power systems protection.
4. https://nptel.ac.in/courses/134104085

VIII. MATERIALS ONLINE

1. Course template
2. Tutorial question bank
3. Definition and terminology
4. Assignments
5. Model question paper-I
6. Model question paper-II
7. Lecture notes
8. Early learning readiness videos (ELRV)
9. Power point presentations

COURSE CONTENT

POWER SYSTEM DYNAMICS AND STABILITY								
II Semester: EPS								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
BPSD14	**Core**	3	-	-	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite: Power system operation and control								

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. COURSES 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:

At the end of the course students should be able to:

CO1	Illustrate the significance of power system stability and approach for analysis of multi machine system.
CO2	Develop the state space equations, unit conversions, equivalent circuits for mathematical analysis of the synchronous machines.
CO 3	Develop the basic components of digital relay and signal conditioning subsystems for implementation of digital protection.
CO 4	Identify the types of excitation and voltage control configurations to address the effects of voltage changes and reactive power.
CO 5	Explain the methods to enhance the small signal stability of the power system.

IV COURSE CONTENT:

MODULE - I: POWER SYSTEM STABILITY: A CLASSICAL APPROACH (10)

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 (10)

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 (10)

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 (10)

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. 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.

MODULE –V: EXCITATION AND PRIME MOVER CONTROL (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. TEXTBOOKS:

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. ELECTRONICS RESOURCES:

1. NPTEL Power Systemsstability - NOC: components of digital relay and signal conditioning.
2. NPTELPower System Stability and Control- NOC: Types of excitation and voltage control configurations.
3. NPTEL significance of power system stability- NOC: Small signal stability of the power system.

VIII. MATERIALS ONLINE

1. Course template
2. Tutorial question bank
3. Definition and terminology
4. Assignments
5. Model question paper-I
6. Model question paper-II
7. Lecture notes
8. Early learning readiness videos (ELRV)
9. Power point presentations

COURSE CONTENT

SWARM INTELLIGENCE TECHNIQUES IN POWER SYSTEMS								
II Semester: EPS								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
BPSD15	**Core**	3	-	-	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite: Electrical power systems								

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. COURSES 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:

CO1: Illustrate the capabilities of bio-inspired system and conventional methods in solving optimization problems
CO2: Analyze the importance of exploration and exploitation of swarm intelligent system to attain near global optimal solution.
CO3: Distinguish the functioning of various swarm intelligent systems for solving power system problems.
CO4: Develop various bio-inspired algorithms for the power system engineering applications
CO5: Categorize the optimization problems using evolutionary techniques using genetic algorithms and particle swarm optimization.
CO6: Analyze the various search methods to for solving constrained and unconstrained optimization problems.

IV COURSE CONTENT:

MODULE –I: FUNDAMENTALS OF SOFT COMPUTING TECHNIQUES (10)

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 (10)

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 onvelocity and positions PSO topologies control parameters GA and PSO algorithms for solving ELDproblems.

MODULE –III: ANT COLONY OPTIMIZATION AND ARTIFICIAL BEE COLONY ALGORITHMS (10)

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 ELDproblems.

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 (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. ELECTRONICS RESOURCES:

1. https://www.researchgate.net/publication/277571471
2. https://www.researchgate.net/publication/220834557
3. file.scirp.org/pdf/IJCCE_2013072414532965.pdf
4. rtpis.org/documents/mypaper/RTPIS_publication_1284584660.pdf

COURSE CONTENT

INDUSTRIAL LOAD MODELLING AND CONTROL								
II Semester: EPS								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BPSC16	**Core**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite: Electrical Distribution systems								

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. COURSES 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:

At the end of the course students should be able to:

CO1 Apply knowledge of engineering science including electrical circuits, control systems and electrical machines in industrial load modelling and control.
CO2 Determine the industrial load management in a power system to supply specific amount of demand.
CO3 Outline the interruptible load control, Direct load control, controls power quality impacts for minimizing transmission line losses and energy saving in industries.
CO4 Analyse the cooling and heating loads, cool storage, control strategies in an industrial power system.
CO5 Design a capitative power unit in industrial load for imparting knowledge of various controllers with its evolution, principle of operation and applications
CO 6
CO6 Determine the optimal operating strategies of power capacitors for integrated load management and industries with economic justification.

IV. COURSE CONTENT:

MODULE - I: ELECTRIC ENERGY SCENARIO (10)

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 (10)

Cooling and heating loads, load profiling, modeling, cool storage, types.

Control strategies, optimal operation, problem formulation, case studies.

MODULE –IV: CAPTIVE POWER UNITS (09)

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

MODULE –V: OPTIMAL OPERATING STRATEGIES (10)

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

V. TEXTBOOKS:

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.

VI. 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 Electricity Utility 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.

VII. ELECTRONICS RESOURCES:

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

VIII. MATERIALS ONLINE

1. Course template
2. Tutorial question bank
3. Definition and terminology
4. Assignments
5. Model question paper-I
6. Model question paper-II
7. Lecture notes
8. Early learning readiness videos (ELRV)
9. Power point presentations

COURSE CONTENT

CYBER SECURITY IN POWER SYSTEMS								
II Semester: EPS								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
BPSC17	**Elective**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	0	0	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite: Cyber Security								

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.COURSES 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:

CO1: Relate the need for cyber security and exploring of IT securitybackground for power system
CO2: Demonstrate the solutions for strengthening of the cyber security system in power generation, transmission, and distribution sectors againstattackers, threats
CO3: Illustrate the vulnerabilities in power system like attack on the computermonitoring and controlling devices, and attack on the SCADA network
CO4 : Identify the solutions, standards and guidelines, where to look further
CO5 : Develop a frame work for a cyber-security program to facilitate thedevelopment of Cyber Security Standards

IV. COURSE CONTENT:

MODULE –IINTRODUCTION TO CYBER SECURITY (10)

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 –II INTRODUCTION TO SMART GRID (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 –III SMART GRID SYSTEM PERFORMANCE EVALUATION (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 – IV SMART GRID CYBERSECURITY (10)

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 – V CYBER SECURITY IN THE ENERGY SECTOR (10)

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: ImplementingSecurity 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

VII. ELECTRONICS RESOURCES:

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. MATERIALS ONLINE

1. Course template
2. Tutorial question bank
3. Definition and terminology
4. Assignments
5. Model question paper-I
6. Model question paper-II
7. Lecture notes
8. Early learning readiness videos (ELRV)
9. Power point presentations

COURSECONTENT

RESTRUCTURED POWER SYSTEMS								
II Semester: EPS								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
BPSD18	**Elective**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	0	0	3	40	60	100
Contact Classes:48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite: Power System Stability								

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 andeconomic issues in power industry.
CO2: Analyze the consumer and supplier behavior with the principle of demand and supply elasticity
CO3: Interpret the restructured power systems across the world based on market architecture
CO4: Analyze the different pricing mechanisms to encourage efficienteconomic behavior
CO5: Examine transmission network usage pricing and loss allocationmethods to ensure reliable and secure operation of power system.
CO6: Interpret congestion in transmission network with respect to ATC,TTC, TRM and CBM.

IV. COURSE CONTENT:

MODULE –I OVERVIEW OF RESTRUCTURED POWER SYSTEM (10)

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 (10)

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 (10)

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.

VI. TEXTBOOKS:

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.

VII. 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. ELECTRONICS RESOURCES:

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

VIII. MATERIALS ONLINE

1. Course template
2. Tutorial question bank
3. Definition and terminology
4. Assignments
5. Model question paper-I
6. Model question paper-II
7. Lecture notes
8. Early learning readiness videos (ELRV)
9. Power point presentations

COURSECONTENT

AI TECHNIQUES IN POWER SYSTEMS								
II Semester: EPS								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BPSC19	**Elective**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	0	0	3	30	70	100
Contact Classes:48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite: Power System								

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. COURSES 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:

CO1 Understand the concepts of biological foundations of artificial neural networks for learning techniques
CO2 Analyze the associative models in neural networks for correlations between data cases in the space of models.
CO3 Identify the neural networks control schemes for closed-loop performance in terms of small tracking errors and bounded controls.
CO4 Evaluate fuzzy logic and its controllers for fuzzy rule base, data base and inference engine
CO5 Analyze the knowledge of genetic algorithm for solving both constrained and unconstrained optimization problems
CO6 Develop applications of AI Techniques in electrical engineering for power generation, control, and transmission devices used by electric Utilities.

IV. COURSE CONTENT:

MODULE –I: OVERVIEW OF RESTRUCTURED POWER SYSTEM (10)

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 (10)

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 HTand 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 (09)

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. ELECTRONICS RESOURCES:

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

VIII. MATERIALS ONLINE

1. Course template
2. Tutorial question bank
3. Definition and terminology
4. Assignments
5. Model question paper-I
6. Model question paper-II
7. Lecture notes
8. Early learning readiness videos (ELRV)
9. Power point presentations

COURSECONTENT

POWER QUALITY								
II Semester: EPS								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
BPSC20	**Elective**	3	0	0	3	40	60	100
Contact Classes:48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite: Electrical Distribution system								

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. COURSES 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 should be able to:

CO1	Identify the Power Quality problem by applying the techniques to mitigate them.
CO2	Analyze the methodology to improve the power quality for sensitive loads by various custom power devices.
CO3	Analyze the difference between failure, outage and Interruptions for reliability evaluation to power quality
CO4	Analyze the voltage sag and swell based power quality problem in Single phase and three phase system for reenergization of large load.
CO5	Identify the Power Quality problems in Industry power systems for harmonic distortions in the nonlinear loads.
CO6	Evaluate power quality monitoring and classification mitigating techniques for the quality of voltage and current produced by a power plant.

IV. COURSE CONTENT:

MODULE - I: INTRODUCTION (10)

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 (10)

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 (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 (10)

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. TEXTBOOKS:

1. Math H J Bollen, “Understanding Power Quality Problems”, IEEE Press, 1st edition, 2007.
2. Sastry Vedam Mulukutla 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. R Sastry Vedam Mulukutla S Sarma, “Power Quality VAR Compensation in Power Systems”, CRC Press,1st edition, 2000.
3. A Ghosh, G Ledwich, “Power Quality Enhancement Using Custom Power Devices”, Kluwer Academic,1st edition, 2002.

VII. ELECTRONICS RESOURCES:

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. MATERIALS ONLINE

1. Course template
2. Tutorial question bank
3. Definition and terminology
4. Assignments
5. Model question paper-I
6. Model question paper-II
7. Lecture notes
8. Early learning readiness videos (ELRV)
9. Power point presentations

COURSE CONTENT

DATA SCIENCE AND MACHINE LEARNING FOR MODERN POWER SYSTEMS								
II Semester: EPS								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BPSC21	**Elective**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	0	0	3	40	60	100
Contact Classes:48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite: Power System								

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 should be able to:

CO1	Summarize the basics of power system and smart grid technology forunderstanding the performance of data driven system
CO2	Make use of Singular Value Decomposition (SVD), and Monte Carlo simulation for state estimation and detection of anomalies in power system
CO3	Examine data regression, data fitting and chi-square test by using thestatistical studies for complex power analysis
CO4	Analyze the statistical proficiency and model identification forinterference of data-based models of power system.
CO5	Evaluate the performance of smart grid/renewable energy/powersystem to study different data models.
CO6	Adapt the operation, control and maintenance work for addressing thereal time problems in the field of Power system/smart grid.

IV. COURSE CONTENT:

MODULE –I: INTRODUCTION (10)

Phasor Analysis of basic circuits, Conservation of Power, Complex Power calculation, Introductionof 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 (10)

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. ELECTRONICS RESOURCES:

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

VIII. MATERIALS ONLINE

1. Course template
2. Tutorial question bank
3. Definition and terminology
4. Assignments
5. Model question paper-I
6. Model question paper-II
7. Lecture notes
8. Early learning readiness videos (ELRV)
9. Power point presentations

COURSECONTENT

HIGH FREQUENCY MAGNETIC COMPONENTS								
II Semester: EPS								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
BPSD22	**Elective**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	0	0	3	40	60	100
ContactClasses:48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite: Electro Magnetic Fields								

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:

CO1 Demonstrate the different materials and their properties used for magnetic cores.
CO2 Explain the concept of skin effect and proximity effect for different types of conductors.
CO3 Calculate the winding resistance for different types of conductors.
CO4 Estimate the winding power loss for current with harmonics.
CO5 Analyze the self-capacitance components of different conductors.
CO6 Estimate the self-capacitance of Parallel-Plate Capacitor, Two Parallel Round Conductors etc.

IV. COURSE CONTENT:

MODULE –I: FUNDAMENTALS OF MAGNETIC DEVICES AND MAGNETIC CORE (10)

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 SkinEffects 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 (09)

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 (10)

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. ELECTRONICS RESOURCES:

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

COURSE CONTENT

ARTIFICIAL INTELLIGENCE IN POWER SYSTEMS LABORATORY								
II Semester: EPS								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
BPSD23	**Core**	-	-	4	2	30	70	100
Contact Classes: Nil	**Tutorial Classes: Nil**	**Practical Classes:36**				**Total Classes: 36**		
Prerequisite: -								

I. COURSE OVERVIEW:

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. COURSES 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 should be able to:

CO1	Develop a neural network-based model for Load flow analysis.
CO2	Analyze the state estimations using neural network.
CO3	Analyze contingency technique to predict the effect of outages like failures of equipment, transmission line using ANN
CO4	Apply the power system security u s i n g neural network.
CO5	Determine automatic Generation Control for single are a system and two area systems using Fuzzy Logic Method.
CO6	Analyze the transient and small signal stability analysis of Single- Machine-Infinite Bus (SMIB) system using Fuzzy Logic

IV. LIST OF EXPERIMENTS

WEEK –1: LOAD FLOW ANALYSIS

Load flow analysis using neural network.

WEEK –2: STATE ESTIMATIONS

State estimations using neural network.

WEEK –3: CONTINGENCY ANALYSIS

Contingency analysis using neural network.

WEEK –4: POWER SYSTEM SECURITY

Power system security using neural network.

WEEK –5: AGC - SINGLE AREA SYSTEM / TWO AREA SYSTEM

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

WEEK –6: SMALL SIGNAL STABILITY ANALYSIS

Fuzzy logic based small signal stability analysis.

WEEK –7: ECONOMIC DISPATCH THERMAL UNITS
Economic dispatch of thermal units using conventional and ANN algorithms.

WEEK –8: VIII: ECONOMIC DISPATCH THERMAL UNITS
Economic dispatch of thermal units using conventional and GA algorithms.

WEEK –9: ECONOMIC DISPATCH THERMAL UNITS
Economic dispatch of thermal units using conventional and Fuzzy logic.

WEEK –10: ECONOMIC DISPATCH OF THERMAL PLANTS
Economic dispatch of thermal plants using conventional and ANN algorithms.

WEEK –11: ECONOMIC DISPATCH OF THERMAL PLANTS
Economic dispatch of thermal plants using conventional and GA algorithms.

WEEK –12: ECONOMIC DISPATCH OF THERMAL PLANTS
Economic dispatch of thermal plants using conventional and Fuzzy logic.

WEEK –13: ECONOMIC DISPATCH OF HYDRO POWER PLANTS
Economic dispatch of thermal plants using conventional and Fuzzy logic

WEEK –14: ECONOMIC DISPATCH OF NUCLEAR PLANTS
Economic dispatch of nuclear plants using conventional and Fuzzy logic

V. TEXT BOOKS:

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.

COURSE CONTENT

POWER SYSTEMS LABORATORY								
II Semester: EPS								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
BPSD24	**Core**	-	-	4	2	30	70	100
Contact Classes: Nil	**Tutorial Classes: Nil**	**Practical Classes:36**				**Total Classes: 36**		
Prerequisite: - Electrical Power Systems								

I. COURSE OVERVIEW:

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 should be able to:

CO 1 Determine earth resistance by using crank type earth tester.

CO 2 Explain the concept of electrical integrity of connections and contacts in acircuit breaker using milli-volt drop test.

CO 3 Apply the concept of soil resistivity as function of salinity and time.

CO 4 Analyze internal fault protection of single-phase transformer using merzprice protection.

CO 5 Examine the alternator during over voltage, under voltage, over and underfrequency by using respective relays.

IV. LIST OF EXPERIMENTS

WEEK –1: EARTH TESTER

Determination of earth resistance by using crank type earth tester.

WEEK –2: MILLI VOLT DROP TEST

Measurement of contact resistances of different combinations of test objects.

WEEK –3: SOIL RESISTIVITY

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

WEEK –4: MICROPROCESSOR BASED OVER CURRENT RELAY

Determination of performance characteristics of microprocessor based over current relay.

WEEK –5: ELECTROMECHANICAL OVER CURRENT RELAY

Determination of performance characteristics of electromechanical over current relay.

WEEK –6: BREAKDOWN STRENGTH OF AIR BY HORN GAP

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

WEEK 7: POWER ANGLE CHARACTERISTICS OF SYNCHRONOUS MACHINE

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

WEEK –8: MERZ PRICE PROTECTION IN SINGLE PHASE TRANSFORMER

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

WEEK –9: DIFFRENTIAL PROTECTION SCHEME IN SYNCHRONOUS GENERATOR

Study of differential protection in three phase ac generator.

WEEK –10: NEGATIVE SEQUENCE PROTECTION IN ALTERNATOR

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

WEEK –11: OVER FREQUENCY AND UNDER FREQUENCY PROTECTION

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

WEEK –12: PERFORMANCE OF ALTERNATOR AGAINST INTERNAL FAULTS

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

WEEK –13: CHARACTERISTICS OF IDMT OVER CURRENT RELAY.

To study the Operation of a Non- Directional (I D M T relay) and plot the inverse time current characteristics

WEEK –14: TESTING OF STRING INSULATOR

Determine string efficiency of suspension insulator with and without guard ring.

V. TEXT 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.

COURSE CONTENT

RESEARCH METHODOLOGY AND IPR								
I Semester: ST								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
BHSD01	**Core**	2	0	0	2	40	60	100
Contact Classes: 48	**Total Tutorials: Nil**	**Total Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite: NIL								

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 student 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:

CO 1 Interpret the technique of determining a research problem for a crucial part of the research study.
CO 2 Examine the way of methods for avoiding plagiarism in research.
CO 3 Apply the feasibility and practicality of research methodology for a proposed project.
CO 4 Make use of the legal procedure and document for claiming patent of invention.
CO 5 Identify different types of intellectual properties, the right of ownership and scope of protection to create and extract value from IP.
CO 6 Defend the intellectual property rights throughout the world with the involvement of world intellectual property organization

IV. COURSE CONTENT:

MODULE-I: INTRODUCTION (10)

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 (09)

Effective literature studies approaches, analysis Plagiarism and Research ethics.

MODULE-III: RESEARCHPROPOSAL (97)
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 (10)
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 (10)
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. Panneerselvam, Ramasamy. Research methodology. PHI Learning Pvt. Ltd., 2014.
2. Goddard, Wayne, and Stuart Melville. Research methodology: An introduction. Juta and Company Ltd, 2004.
3. Ranjit Kumar, "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. Correa, Carlos M. Intellectual property rights, the WTO and developing countries: the TRIPS agreement and policy options. Zed books, 2000.
3. Niebel, "Product Design", McGraw Hill, 1974.
4. Asimov, "Introduction to Design", Prentice Hall, 1962

VII. ELECTRONICS RESOURCES:

1. https://wac.colostate.edu/docs/books/try/chapter1.pdf
2. https://www.scribbr.com/dissertation/methodology/
3. http://nptel.ac.in/courses/107108011/

VIII. MATERIALS ONLINE:

1. Course Template
2. Tutorial Question Bank
3. Assignments
4. Model Question Paper – I
5. Model Question Paper - II
6. Lecture Notes
7. Early Lecture Readiness Videos
8. Power point presentation

COURSE CONTENT

ENGLISH FOR RESEARCH PAPER WRITING								
III Semester: AE, CSE, ES, EPS, CAD/CAM & STE								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BHSD02	**Audit**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		-	-	-	-	-	-	-
Contact Classes: Nil	**Total Tutorials: Nil**	**Total Practical Classes: Nil**				**Total Classes: Nil**		
Prerequisite: NIL								

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 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

CO 2 Examine the way of methods for avoiding plagiarism in research

CO 3 Apply the feasibility and practicality of research methodology for a proposed project.

CO 4 Make use of the legal procedure and document for claiming patent of invention.

CO 5 Identify different types of intellectual properties, the right of ownership, scope of protection to create and extract value from IP

IV. SYLLABUS:

MODULE – I: PLANNING AND PREPARATION

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

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

MODULE – III: DISCUSSION AND CONCLUSIONS

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

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

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:

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.

COURSE CONTENT

DISASTER MANAGEMENT								
III Semester: AE, CSE, ES, EPS, CAD/CAM & STE								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BHSD03	**Audit**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		-	-	-	-	-	-	-
Contact Classes: Nil	**Total Tutorials: Nil**	**Total Practical Classes: Nil**				**Total Classes: Nil**		
Prerequisite: NIL								

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

IV. SYLLABUS

MODULE – I: INTRODUCTION

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

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

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

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

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

COURSE CONTENT

SANSKRIT FOR TECHNICAL KNOWLEDGE								
III Semester: AE, CSE, ES, EPS, CAD/CAM & STE								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BHSD04	**Audit**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		-	-	-	-	-	-	-
Contact Classes: Nil	**Total Tutorials: Nil**	**Total Practical Classes: Nil**				**Total Classes: Nil**		
Prerequisite: NIL								

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

CO 2 Formulate simple sentences

CO 3 Apply order and roots

CO 4 Understand Ancient Sanskrit literature about science & technology

CO 5 Develop logical thinking being a logical language in technical concepts

IV. SYLLUBUS:

MODULE – I: INTRODUCTION

Alphabets in Sanskrit, Past/Present/Future Tense.

MODULE – II: SENTENCES

Simple Sentences

MODULE – III: ROOTS

Order, Introduction of roots

MODULE – IV: SANSKRIT LITERATURE

Technical information about Sanskrit Literature

MODULE – V: TECHNICAL CONCEPTS

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.

COURSE CONTENT

VALUE EDUCATION								
III Semester: AE, CSE, ES, EPS, CAD/CAM & STE								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
BHSD05	**Audit**	-	-	-	-	-	-	-
Contact Classes: Nil	**Total Tutorials: Nil**	**Total Practical Classes: Nil**				**Total Classes: Nil**		
Prerequisite: NIL								

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
CO 2 Adopt value-based living and holistic technologies to save nature
CO 3 Inculcate positive thinking, dignity of labor and religious tolerance
CO 4 Develop the overall Character and Competence through self-management
CO 5 Practice Self-control. Honesty through Studying effectively all religious messages

IV. SYLLABUS:

MODULE – I: VALUES AND SELF-DEVELOPMENT

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

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

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

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

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”.

COURSE CONTENT

CONSTITUTION OF INDIA								
III Semester: AE, CSE, ES, EPS, CAD/CAM & STE								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BHSD06	**Audit**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		-	-	-	-	-	-	-
Contact Classes: Nil	**Total Tutorials: Nil**	**Total Practical Classes: Nil**				**Total Classes: Nil**		
Prerequisite: NIL								

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.
CO 2 Understand the Constitutional Rights and duties
CO 3 Explain the functioning of three wings of the government i.e., executive, legislative and judiciary
CO 4 Analyse the decentralization of power between central, state and local self-government.
CO 5 Apply the knowledge in strengthening of the constitutional institutions like CAG, Election Commission and UPSC for sustaining democracy

IV. SYLLABUS:

MODULE – I: HISTORY OF MAKING OF THE INDIAN CONSTITUTION & PHILOSOPHY OF THE INDIAN CONSTITUTION

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

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

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

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 Zilla 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

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

COURSE CONTENT

PEDAGOGY STUDIES								
III Semester: AE, CSE, ES, EPS, CAD/CAM & STE								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BHSD07	**Audit**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		-	-	-	-	-	-	-
Contact Classes: Nil	**Total Tutorials: Nil**	**Total Practical Classes: Nil**				**Total Classes: Nil**		
Prerequisite: NIL								

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 teacher's education
CO 2 Understand pedagogical practices are being used by teachers in formal and informal classrooms in developing countries
CO 3 Interpret the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners
CO 4 Classify the importance of class room practice, curriculum and learning in Professional Development.
CO 5 Summarize teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy

IV. SYLLABUS:

MODULE – I: INTRODUCTION

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

Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education.

MODULE – III: PEDAGOGICAL PRACTICES

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

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

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.

COURSE CONTENT

STRESS MANAGEMENT BY YOGA								
III Semester: AE, CSE, ES, EPS, CAD/CAM & STE								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BHSD08	**Audit**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		-	-	-	-	-	-	-
Contact Classes: Nil	**Total Tutorials: Nil**	**Total Practical Classes: Nil**				**Total Classes: Nil**		
Prerequisite: NIL								

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:

CO 1 Understand Ashtanga yog and its importance

CO 2 Identify the Dos and Do nots of Life by practicing the Yam and Niyam

CO 3 Interpret the Shaucha and its components

CO 4 Make use of breathing techniques and Asan and Pranayam

CO 5 Develop healthy mind in a healthy body thus improving social health also

IV. SYLLABUS:

MODULE – I: INTRODUCTION

Definitions of Eight parts of yoga. (Ashtanga)

MODULE – II: YAM AND NIYAM

Yam and Niyam. Do`s and Dunst's in life. Ahinsa, satya, astheya, bramhacharya and aparigraha.

MODULE – III: SHAUCHA

Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

MODULE – IV: ASAN AND PRANAYAM

Asan and Pranayam. Various yog poses and their benefits for mind & body

MODULE – V: BREATHING TECHNIQUES

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”.

COURSE CONTENT

PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS								
III Semester: AE, CSE, ES, EPS, CAD/CAM & STE								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
BHSD09	**Audit**	-	-	-	-	-	-	-
Contact Classes: Nil	**Total Tutorials: Nil**	**Total Practical Classes: Nil**				**Total Classes: Nil**		
Prerequisite: NIL								

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.
CO 2 Identify day to day work and duties for developing peace and prosperity as depicted in Geeta.
CO 3 Formulate the daily life style by depicting the verses from Bhagavatgeetha.
CO 4 Outline the verses of Shrimad Bhagavad Geetha for holistic development.
CO 5 Demonstrates personality development by verses of Bhagavatgeetha.

IV. SYLLUBUS:

MODULE – I: HOLISTIC DEVELOPMENT

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 (don'ts),Verses- 71,73,75,78 (do's)

MODULE – II: BHAGWAD GEETA

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

Shrimad BhagwadGeeta: Chapter 6-Verses 5, 13, 17, 23, 35, Chapter 18-Verses 45, 46, 48.

MODULE – IV: BASIC KNOWLEDGE

Statements of basic knowledge. Shrimad BhagwadGeeta: Chapter2-Verses 56, 62, 68. Chapter 12 -Verses 13, 14, 15, 16,17, 18

MODULE – V: ROLE MODEL

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.pd

COURSE CONTENT

SCADA SYSTEM AND APPLICATIONS								
III Semester: EPS								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BPSD26	**Elective**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite: Power systems								

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. COURSES 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:

At the end of the course students should be able to:

CO1 Demonstrate the basic functionality, merits and demerits of PLC and SCADA systems for supervisory control of an industrial system.
CO2 Develop the ladder diagram and functional block diagrams for interfacing PLC with SCADA system.
CO3 Identify the typical components of SCADA systems used for interfacing with real time systems
CO4 Analyze the different types of architectures and communication technologies of a typical SCADA system
CO5 Make use of SCADA systems for controlling, security and energy management of a power system networks
CO6 Appraise the superiority of SCADA systems in operation, controlling, and monitoring of oil, gas, water and power industries.

IV. COURSE CONTENT:

MODULE - I: INTRODUCTION TO SCADA AND PLC (10)

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

MODULE–II: SCADA SYSTEM COMPONENTS (10)

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

MODULE –III: INTRODUCTION TO SCADA AND PLC (10)

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 (10)

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.

V. TEXTBOOKS:

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 is Corporate Publishing, 1st edition, 2006.
2. SRB hide "Digital Power System Protection" PHI Learning Pvt.Ltd. 3rd edition, 2014.

VII. ELECTRONICS RESOURCES:

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. MATERIALS ONLINE

1. Course template
2. Tutorial question bank
3. Definition and terminology
4. Tech-talk topics
5. Assignments
6. Model question paper-I
7. Model question paper-II
8. Lecture notes
9. Early learning readiness videos (ELRV)
10. Power point presentations

COURSE CONTENT

POWER SYSTEM RELIABILITY								
III Semester: EPS								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BPSD27	**Elective**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite: Power systems								

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 distributionsystems 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. Illustrate the basic concepts and techniques of modern reliability engineering tool

III.COURSE OUTCOMES:

CO1 Apply concepts of the probability theory for power systems reliability evaluation
CO2 Apply probability methods to formulate and probabilistically simulate simple electric energy systems for computing reliability indices and production costs
CO3 Evaluate generation capacities by pooling all sources of generation with all loads
CO4 Analyze distribution system networks with indices to improve powersystem performance
CO5 Illustrate optimal solutions for improvising power transfer capability,enhancing power quality and reliability
CO6 Justify the basic tasks of Supervisory Control Systems (SCADA)aswell as their typical applications in industries

IV. COURSE CONTENT:

MODULE –I: BASIC PROBABILITY THEORY (10)

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 (10)

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 (10)

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. ELECTRONICS RESOURCES:

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. MATERIALS ONLINE

1. Course template
2. Tutorial question bank
3. Assignments
4. Model question paper-I
5. Model question paper-II
6. Lecture notes
7. Early learning readiness videos (ELRV)
8. Power point presentations

COURSE CONTENT

GRID INSTRUMENTATION AND COMMUNICATION SYSTEMS								
III Semester: EPS								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BPSD28	**Elective**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite: Power systems								

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:

CO1 Know the digital voltage, frequency, time measurements and digital displays with A/D & D/A circuits operation along with theirdrawbacks.
CO2 Explore data acquisition systems along with emergency andpreventive control to know their importance.
CO3 Analyze signal and system analyzers to know their application to dataanalysis.
CO4 Illustrate about PMU to know their application in computer control.
CO5 Interpret the PLC programming languages to know their applicationin smart grid.
CO6 Understand SCADA components and its interfaces, security in smart grid.

IV. COURSE CONTENT:

MODULE –I: DIGITAL INSTRUMENTATION (10)

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 (10)

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 (10)

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 bandand broad communication over power lines", Willy Publications.

VII. ELECTRONICS RESOURCES:

1. https://intra.ece.ucr.edu/~hamed/Smart_Grid_Topic_3_Communications.pdf
2. https://www.slideshare.net/syedmustafablr/grid-computing-notes
3. https://onlinelibrary.wiley.com/doi/book/10.1002/9781118820216
4. https://books.google.co.uk/books/about/Grid_Enabled_Remote_Instrumentation.html?id=X3Jn Va 56ibAC&utm_source=gb-gplus-shareGrid

VIII. MATERIALS ONLINE

1. Course template
2. Tutorial question bank
3. Assignments
4. Model question paper-I
5. Model question paper-II
6. Lecture notes
7. Early learning readiness videos (ELRV)
8. Power point presentations

COURSE CONTENT

ELECTRICAL TRANSIENTS IN POWER SYSTEMS								
III Semester: EPS								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BPSD29	**Elective**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	30	70	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite: Power systems								

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 focuses 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:

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

IV. COURSE CONTENT:

MODULE –I: REVIEW OF TRAVELLING WAVE PHENOMENA (10)

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 (10)

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 (10)

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/1853/14488https://www.weibull.com/basics/reliability.htm
3. https://www.download.springer.com/static/pd
4. https://www.web.mit.edu/energylab/www/pubs/el99-005wp.pdf

VIII. MATERIALS ONLINE

1. Course template
2. Tutorial question bank
3. Assignments
4. Model question paper-I
5. Model question paper-II
6. Lecture notes
7. Early learning readiness videos (ELRV)
8. Power point presentations

COURSE CONTENT

DATA ANALYTICS								
III Semester: OE								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
BPSD30	**Elective**	3	-	-	3	40	6	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite: -								

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

IV. COURSE SYLLABUS:

MODULE – I: BUSINESS ANALYTICS (10)

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 (10)

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 (10)

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. TEXTBOOKS:

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. ELECTRONICS RESOURCES:

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

VIII. MATERIALS ONLINE

1. Course template
2. Tutorial question bank
3. Assignments
4. Model question paper-I
5. Model question paper-II
6. Lecture notes
7. Early learning readiness videos (ELRV)
8. Power point presentations

COURSE CONTENT

OPERATIONS RESEARCH								
III Semester: OE								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BPSD31	**Elective**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite: -								

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 will be able to:

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

IV. COURSE SYLLABUS:

MODULE -I: INTRODUCTION AND ALLOCATION (10)

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 (10)

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 (10)

Waiting Lines: Introduction, single channel, poison arrivals, exponential service times, with infinite population and finite population models, multichannel, poison 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. TEXTBOOKS:

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. ELECTRONICS RESOURCES:

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. MATERIALS ONLINE

1. Course template
2. Assignments
3. Model question paper-I
4. Model question paper-II
5. Lecture notes
6. Early learning readiness videos (ELRV)
7. Power point presentations

COURSE CONTENT

REAL TIME OPERATING SYSTEMS								
III Semester: OE								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
BPSD32	**Elective**	3	-	-	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite: -								

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 time operating 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 management and synchronization for communication systems.
CO2 Compare soft real-time operating system and hard real-time operating systems for the priority-based task scheduling.
CO3 Outline the components of real time operating systems for the design of reliable embedded system.
CO4 Analyze finite state machine for the task scheduling and execution in kernel models.
CO5 Develop a semaphore token for the execution of one or more threads in mutual exclusion.
CO6 Interpret message queue in asynchronous communications protocol for send and receive messages simultaneously.

IV. COURSE CONTENT:

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 (09)

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 (09)

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. TEXTBOOKS:

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. ELECTRONICS RESOURCES:

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. MATERIALS ONLINE

1. Course template
2. Tutorial question bank
3. Assignments
4. Model question paper-I
5. Model question paper-II
6. Lecture notes
7. Early learning readiness videos (ELRV)
8. Power point presentations

COURSE CONTENT

WASTE TO ENERGY								
III Semester: OE								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
BPSD33	**Elective**	3	-	-	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite: -								

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. COURSES OBJECTIVES:

The students will try to learn

I. The principles of solid waste management in reducing and eliminating dangerous wastematerials.
II. The design and operations of a municipal solid waste.
III. The insight of the design and operations of a municipal solid waste.

III. COURSE OUTCOMES:

At the end of the course students should be able to:

CO1 Identify the different sources and types of solid waste by the properties of municipal solid waste for segregation and collection of waste.
CO2 Illustrate the classification, preliminary design considerations of landfill and methods of landfill disposal of solid to control greenhouse gases
CO3 Understand the Composition, characteristics of leachate to control the emission of gases by monitoring the movement of landfill leachate.
CO4 Outline the Biochemical conversion of biomass for energy generation by anaerobic digestion of solid waste.
CO5 Apply the knowledge in planning and operations of waste to Energy plants by followinglegal legislation related to solid waste management.
CO6 Illustrate the thermo-chemical conversion of Biogas by using Gasification process for energy generation.

IV. COURSE CONTENT:

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 (10)

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

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

MODULE –IV: THERMO-CHEMICAL CONVERSION (10)

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 (10)

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 TEXTBOOKS:

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

VI. REFERENCE BOOKS:

1. Challal, D S, "Food, Feed and Fuel from Biomass", IBH Publishing Co. Pvt. Ltd., 1st edition,1991.
2. C Y Were Ko-Brobby and E. B. Hagan, "Biomass Conversion and Technology", John Wiley& Sons, 1st Edition, 1996.
3. C Parker and T Roberts (Ed), "Energy from Waste", An Evaluation of ConversionTechnologies, Elsevier Applied Science, London, 1985.
4. KL Shah, "Basics of Solid and Hazardous Waste Management Technology", Prentice Hall,Reprint Edition, 2000. 5. M Datta, "Waste Disposal in Engineered Landfills", Narosa Publishing House, 19972002.

VII. ELECTRONICS RESOURCES:

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 Thompso
3. https://www. E-waste poses a Health Hazard: SairudeenPattazhy

VIII.MATERIALS ONLINE

1. Course template
2. Tutorial question bank
3. Assignments
4. Model question paper-I
5. Model question paper-II
6. Lecture notes
7. Early learning readiness videos (ELRV)
8. Power point presentations

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 2023-2024 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 of 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 75% in every course as stipulated by Institute. I am fully aware that an attendance of less than 75% 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 MT23 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