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

COMPUTER AIDED DESIGN / COMPUTER AIDED MANUFACTURING (CAD/CAM)

ACADEMIC REGULATIONS, COURSE CATALOG 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 students, professionally competent and socially progressive, 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

The Department of Mechanical Engineering envisions value based education, research and development in the areas of Manufacturing and Computer Aided Engineering as an advanced center for Mechanical Engineering, producing graduates of world-class competence to face the challenges of global market with confidence, creating effective interface with various organizations.

MISSION

The mission of the Mechanical Engineering Department is to prepare effective and responsible engineers for global requirements by providing quality education and to improve pedagogical methods employed in delivering the academic programs to the needs of the industry and changing world by conducting basic and applied research and to generate intellectual property.

OR

M1: Prepare effective and responsible engineers for global requirements by providing quality education.

M2: Improve pedagogical methods employed in delivering academic program to the needs of the industry, prepare for higher education and building entrepreneurship.

M3: Conduct basic and applied research to generate intellectual property and adapt to professional standards.

M.TECH - PROGRAM OUTCOMES (POs)

Upon completion of M.Tech CAD / CAM, 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	:	Students 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 higher than the requirements in the appropriate bachelor program.
PO - 4	:	Identify, formulate and solve complex problems on modern-day issues of CAD/CAM systems using advanced technologies with a global perspective and envisage research in emerging thrust areas.
PO - 5	:	Model and apply appropriate techniques using 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.

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"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 course 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, course 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.

1. 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 course/course. These marks should also be uploaded along with the internal marks of other courses.

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 'COURSE' and 'COURSE' imply the same meaning here and refer to 'Theory Course', or 'Lab Course', or ‘Design/Drawing Course', 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	Dissertation Work Review – II	12	06
8	Dissertation Work Review – III	12	06
9	Dissertation Viva-Voce	28	14

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@3 credits + 05 @ 3 credits + 01@3 credits	30
Total Laboratory Courses (04)	04@ 2 credits	08
Mini Project with Seminar (01)	1@ 2 credits	02
Research Methodology and IPR	1@ 2 credits	02
Dissertation Work Review – II	1 @ 6 credits	06
Dissertation Work Review – III	1 @ 6 credits	06
Dissertation Viva -Voce	1 @14 credits	14
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 Course / 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 ith course and G_i is the grade point scored by the student in the ith 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 jth 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**

$$\text{Thus, } CGPA = 612 / 96 = 6.37$$

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 course 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 ith course and $G_i$is the grade point scored by the student in the ith 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 ith semester and C_i is the total number of credits in that semester and j represent the number of courses in which a student's is registered upto the semester. CGPA is rounded to two decimal places.

18. Is there any Software available for calculating Grade point averages and converting the same into Grades?

Yes, The institute has its own MIS software for calculation of SGPA, CGPA, etc.

19. Will the teacher be required to do the job of calculating SGPAs etc. and convert the same into Grades?

No. The teacher has to give marks obtained out of whatever maximum marks as it is. Rest is all done by the computer.

20. Will there be any Revaluation or Re-Examination System?

No. There will double valuation of answer scripts. There will be a make up Examination after a reasonable preparation time after the End Semester Examination for specific cases mentioned in the Rules and Regulations. In addition to this, there shall be a 'summer term' (compressed term) followed by the End Semester Exam, to save the precious time of students.

21. How fast syllabi can be and should be changed?

Autonomy allows us the freedom to change the syllabi as often as we need.

22. Will the Degree be awarded on the basis of only final year performance?

No. The CGPA will reflect the average performance of all the semester taken together.

23. What are Statutory Academic Bodies?

Governing Body, Academic Council, Examination Committee and Board of Studies are the different statutory bodies. The participation of external members in everybody is compulsory. The institute has nominated professors from IIT, NIT, University (the officers of the rank of Pro-vice Chancellor, Deans and Controller of Examinations) and also the reputed industrialist and industry experts on these bodies.

24. Who takes Decisions on Academic matters?

The Governing Body of institute is the top academic body and is responsible for all the academic decisions. Many decisions are also taken at the lower level like Boards of Studies. Decisions taken at the Board of Studies level are to be ratified at the Academic Council and Governing Body.

25. What is the role of Examination committee?

The Examinations Committee is responsible for the smooth conduct of internal, End Semester and make up Examinations. All matters involving the conduct of examinations, spot valuations, tabulations and preparation of Grade Cards etc., fall within the duties of the Examination Committee.

26. Is there any mechanism for Grievance Redressal?
The institute has grievance redressal committee, headed by Dean - Student affairs and Dean - IQAC.

27. How many attempts are permitted for obtaining a Degree?
All such matters are defined in Rules & Regulation

28. Who declares the result?
The result declaration process is also defined. After tabulation work wherein the SGPA, CGPA and final Grades are ready, the entire result is reviewed by the Moderation Committee. Any unusual deviations or gross level discrepancies are deliberated and removed. The entire result is discussed in the Examinations and Result Committee for its approval. The result is then declared on the institute notice boards as well put on the web site and Students Corner. It is eventually sent to the University.

29. Who will keep the Student Academic Records, University or IARE?
It is the responsibility of the Dean 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 course 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 course of the examination)	Expulsion from the examination hall and cancellation of the performance in that course 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 course 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 course of the examination (theory or practical) in which the candidate is appearing.	Expulsion from the examination hall and cancellation of the performance in that course and all other courses the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the courses 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 courses of the examination (including practicals and project work) already appeared and shall not be allowed to appear for examinations of the remaining courses 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 course 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 course and all the other courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the courses 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 course 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 course.
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 course and all other courses the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the courses 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 course and all the other courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the courses 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 course 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 course and all other courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the courses 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 course and all other courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the courses 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 course and all other courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the courses 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 course and all other courses the candidate has appeared including practical examinations and project work of that semester/year examinations.
12.	If any malpractice is detected which is not covered in the above clauses 1 to 11 shall be reported to the University for further action to award suitable punishment.	

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad - 500 043

CAD/CAM
COURSE CATALOG – MT23

I SEMESTER

Course Code	Course Name	Course Area	Category	Periods per week			Credits	Scheme of Examination Max. Marks		
				L	T	P		CIA	SEE	Total
THEORY										
BCCD01	Advanced CAD	PCC	Core	3	0	0	3	40	60	100
BCCD02	Optimization Techniques & Applications	PCC	Core	3	0	0	3	40	60	100
	Professional Core Elective – I	PCE	Elective	3	0	0	3	40	60	100
	Professional Core Elective – II	PCE	Elective	3	0	0	3	40	60	100
BHSD01	Research Methodology & IPR	--	--	2	0	0	2	40	60	100
	Audit Course	Audit - I	Audit	2	0	0	0	40	60	100
PRACTICAL										
BCCD11	Advanced Computer Aided Design Laboratory	PCC	Core	0	0	4	2	40	60	100
BCCD12	Computational Techniques 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	Course Area	Category	Periods per week			Credits	Scheme of Examination Max. Marks		
				L	T	P		CIA	SEE	Total
THEORY										
BCCD13	Advanced Finite Element Method	PCC	Core	3	0	0	3	40	60	100
BCCD14	Computer Integrated Manufacturing	PCC	Core	3	0	0	3	40	60	100
	Professional Core Elective – III	PCE	Elective	3	0	0	3	40	60	100
	Professional Core Elective – IV	PCE	Elective	3	0	0	3	40	60	100
	Audit Course	Audit - II	Audit	2	0	0	0	-	-	-
PRACTICAL										
BCCD23	Computer Aided Machining and Robotics Laboratory	PCC	Core	0	0	4	2	40	60	100
BCCD24	Simulation and Analysis Laboratory	PCC	Core	0	0	4	2	40	60	100
BCCD25	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	Course Area	Category	Periods per week			Credits	Scheme of Examination Max. Marks		
				L	T	P		CIA	SEE	Total
THEORY										
	Professional Core Elective – V	PEC	Elective	3	0	0	3	40	60	100
	Open Elective	OE	Elective	3	0	0	3	40	60	100
PROJECT										
BCCD34	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	Course Area	Category	Periods per week			Credits	Scheme of Examination Max. Marks		
				L	T	P		CIA	SEE	Total
BCCD35	Dissertation Work Review - III	Major Project	Core	0	0	12	6	40	60	100
BCCD36	Dissertation Viva-Voce	--	Core	0	0	28	14	40	60	100
TOTAL				**00**	**00**	**32**	**20**	**80**	**120**	**200**

PROFESSIONAL CORE ELECTIVE COURSES

S.No	Course Code	Course Name	Professional Electives
1	BCCD03	Additive Manufacturing Technologies	I
2	BCCD04	Design for Manufacturing and Assembly	I
3	BCCD05	Automation in Manufacturing	I
4	BCCD06	Special Manufacturing Process	I
5	BCCD07	IOT & Industry 4.0	II
6	BCCD08	Precision Engineering	II
7	BCCD09	Stress Analysis and Vibration	II
8	BCCD10	Mechanical Behavior of Materials	II
9	BCCD15	Computer Aided Process Planning	III
10	BCCD16	Mechatronics Applications in Manufacturing	III
11	BCCD17	Tribology	III
12	BCCD18	Machine Tool Design	III
13	BCCD19	Industrial Robotics	IV
14	BCCD20	Microprocessor in Automation	IV
15	BCCD21	Intelligent Manufacturing Systems	IV
16	BCCD22	Computer Graphics	IV
17	BCCD26	Performance Modeling and Analysis of Manufacturing Systems	V
18	BCCD27	Fuzzy Logic and Neural Networks	V
19	BCCD28	Design and Analysis of Experiments	V
20	BCCD29	Fracture Mechanics	V

OPEN ELECTIVE COURSES FOR OTHER DEPARTMENTS

S.No	Course Code	Course Name
1	BCCD30	Nano Technology
2	BCCD31	Energy from waste
3	BCCD32	Operations Research
4	BCCD33	Composite Materials

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

SYLLABUS
(I – III SEMESTERS)

COURSE CONTENT

ADVANCED CAD								
I SEMSTER: CAD/CAM								
Course Code	**Category**	**Hours /Week**			**Credits**	**Maximum Marks**		
BCCD01	**Core**	**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**		
Pre requisites: CAD/CAM								

I. COURSE OVERVIEW:

The aim of this course is to impart the overview of advanced computer applications or design and manufacturing. The course covers the basics of geometric modeling, surface modeling and solid modeling. This course also deals with creation of synthetic curves and surfaces. It imposes the knowledge of 2D and 3D transformation, data exchange formats and dimensioning and tolerances.

II. COURSE OBJETIVES:

The students will try to learn:

I. The basics, functional areas of CAD and efficient use of CAD software
II. The requirement and parametric representation of Geometric modelling and synthetic curves.
III. The classification of surface entities and surface representation methods.
IV. The 2D and 3D transformations, different types of projections and data exchange formats of files.

III. COURSE OUTCOMES:

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

CO1 Relate uses and Importance of CAD software in Industries for product design and development
CO2 Apply Geometric modelling representations for various curves to synthetic design method.
CO3 Develop the knowledge of surface modelling and parametric representation of analytic surfaces for creating part models
CO4 Develop the parametric representation of solids for different transformations.
CO5 Explain about the data exchange standards used to translate the data between CAD and other Computer aided technologies.

IV. COURSE CONTENT:

MODULE - I: Cad Tools, Basics of Geometric Modelling (09)

CAD Tools: Definition of CAD Tools, Graphics standards, Graphics software: requirements of graphics software, Functional areas of CAD, Efficient use of CAD software. Basics of Geometric Modelling: Requirement of geometric 3D Modeling, Geometric models, Geometric construction methods, Modelling facilities desired.

MODULE -II: Geometric Modelling (10)

Geometric Modeling: Classification of wireframe entities, Curve representation methods, Parametric representation of analytic curves: line, circle, arc, conics, Parametric representation of synthetic curves: Hermite cubic curve, Bezier curve, B-Spleen curve wire, NURBS, Curve manipulations.

MODULE -III: Surface Modelling (09)

Surface Modeling: Classification of surface entities, Surface representation methods, Parametric representation of analytic surfaces: plane surface, ruled surface, surface of revolution, tabulated cylinder.

Parametric representation of synthetic curves: Hermite cubic surface, Bezier surface, B-Spline surface, Blending surface, Surface manipulations.

MODULE -IV: Solid Modelling (10)

Parametric representation of synthetic surfaces: Hermite Bicubic surface, Bezier surface, Bezier Spline surface,

COONs surface, blending surface Sculptured surface, Surface manipulation; Displaying, Segmentation, Trimming, Intersection, Transformations (both 2Dand3D).

MODULE -V: Transformations (10)

2-D and 3-D transformations: translation, scaling, rotation, reflection, concatenation, homogeneous coordinates, Perspective projection, orthotropic projection, isometric projection, Hidden surface removal, shading, rendering. Evaluation Criteria: Evaluation criteria of CAD software, Data exchange formats: GKS, IGES, PHIGS, CGM, STEP Dimensioning and tolerances: Linear, angular, angular dimensions, maximum material condition (MMC), Least material condition (LMC), Regardless of feature size (RFS).

V. TEXT BOOKS:

1. Ibrahim Zeid, "Mastering CAD/CAM", Tata McGraw Hill, 2nd edition, 2013.
2. P. N. Rao, "CAD/CAM Principles and Applications", Tata McGraw Hill, 3rd edition, 2010.
3. M. P. Groover, E. Zimmers, "CAD/CAM Computer-Aided Design and Manufacturing", Pearson, 1st edition, 2003.
4. R. Alavala Chennakesava, "CAD/ CAM Concepts and Applications", PHI, 1st edition, 2013.

VI. REFERENCE BOOKS:

1. Farid Amirouche, "Principles of Computer-Aided Design and Manufacturing, Pearson, 2nd edition, 2004.
2. P. RadhaKrishnan, "CAD/CAM/CIM", New Age International, 4th edition, 2016.
3. Warren. S. Seames, "Computer Numerical Control Concepts and Programming", Delmar Cengage Learning, 4th edition, 2013.

VII. WEB REFERENCES:

1. http://nptel.ac.in/courses/112102101/
2. http://www.jour als.elsevier.com/computer-aided-design
3. https://www.elsevier.com/books/surface-modeling-for-cad-cam/choi/978-0-444-88482-41

VIII. E-TEXT BOOKS:

1. http://sbmpme.blogspot.in/2011/01/cad-cam-cim-p-radhakrishnan.html
2. https://www.scribd.com/doc/228624725/cad-cam-text-book-by-P-N-RAO

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. PowerPoint presentation

COURSE CONTENT

OPTIMIZATION TECHNIQUES AND APPLICATIONS								
I Semester: CAD/CAM								
Course Code	**Category**	**Hours /Week**			**Credits**	**Maximum Marks**		
BCCD02	**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**		
Pre requisites: Operations Research								

I. COURSE OVERVIEW:

Optimization Techniques is a scientific approach to decision making which seeks to determine how best to design and operate a system under conditions requiring allocation of scarce resources. Optimization Technique as a research tool, primarily has a set or collection of algorithms which act as tools for problems solving in chosen application areas. This course has extensive applications in engineering, business and public systems and is also used by manufacturing and service industries to solve their day-to-day problems.

II. COURSE OBJECTIVES:

The students will try to learn:

I. The importance of various methods single variable Non-Linear unconstrained optimization.
II. The effects of direct search and gradient methods in Multi variable Non-Linear unconstrained optimization.
III. The fundamental knowledge of Linear Programming and various algorithms of Integer Programming
IV. The working principle of various Nontraditional Optimization Algorithms.

III. COURSE OUTCOMES:

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

CO1	Recall classical optimization techniques and numerical methods of optimization.
CO2	Apply optimization methods and algorithms to develop and for solving various types of optimization problems.
CO3	Explain different approaches of optimizing (maximizing or minimizing) an engineering problem or a function
CO4	Apply the fundamental concepts of Programming of single variable non-linear unconstrained optimization
CO5	Apply the effects of Programming of multi variable non-linear unconstrained optimization
CO6	Explain the fundamental knowledge of Linear Programming and different types of simulation process.

IV. COURSE CONTENT:

MODULE -I: Single Variable Non-Linear Unconstrained Optimization (09)

Single Variable Non-Linear Unconstrained Optimization: Elimination methods: Uni-Model function-its importance, Fibonacci method, Golden section method. Interpolation methods: Quadratic & Cubic interpolation methods involutes.

MODULE -II: Multi Variable Non-Linear Unconstrained Optimization (10)
Multi variable non-linear unconstrained optimization: Direct search methods – Uni variant method, Pattern search methods – Powell‟s, Hook -Jeeves, Rosen brock search methods. Gradient methods: Gradient of function & its importance, Steepest descent method, Conjugate direction methods: Fletcher-Reeves & variable metric method.

MODULE -III: Linear Programming and Simulation (10)
Linear Programming – Formulation, Simplex method & Artificial variable optimization techniques: Big M &Two-phase methods. Sensitivity analysis: Changes in the objective coefficients, constants coefficients of the constraints. Addition and deletion of variables, constraints.
Simulation –Introduction–Types-steps –applications: inventory & queuing–Advantages and disadvantages.

MODULE -IV: Integer Programming and Stochastic Programming (09)
Integer Programming- Introduction – formulation – Gomory cutting plane algorithm – Zero orone algorithm, branch and bound method; Stochastic Programming: Basic concepts of probability theory, random variables distributions- mean, variance, correlation, covariance, joint probability distribution. Stochastic linear programming: Chance constrained algorithm.

MODULE -V: Geometric Programming (10)
Geometric Programming: Posynomials – Arithmetic - Geometric inequality – unconstrained G.P-constrained G.P(≤type only) Non-Traditional Optimization Algorithms: Genetics Algorithm-Working Principles, Similarities and Differences between Genetic Algorithm & Traditional Methods. Simulated Annealing-Working Principle-Simple Problems. Introduction to Particle Swarm Optimization (PSO) (very brief).

V. TEXT BOOK:
1. Kalyanmoy Deb, "Optimization for Engineering Design", PHI, 2nd edition, 2012.
2. S. S. Rao, "Optimization Theory & Applications", New Age International, 2nd edition, 2013.

VI. REFERENCE BOOK:
1. S. D. Sharma, "Operations Research", TMH, 1st edition, 2012.
2. H. A. Taha, "Operation Research", TMH, 9th edition, 2014.
3. R. L Rardin, "Optimization in Operations Research, Pearson education, 2nd edition, 2013.

VII. WEB REFERENCES:
1. http://nptel.ac.in/courses/110107092/

VIII. E-TEXT BOOK:
1. http://nptel.ac.in/downloads/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. PowerPoint presentation

COURSE CONTENT

ADDITIVE MANUFACTURING TECHNOLOGIES								
I SEMSTER: CAD/CAM								
Course Code	**Category**	**Hours /Week**			**Credits**	**Maximum Marks**		
BCCD03	**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**		
Pre requisites: Automation in Manufacturing								

I. COURSE OVERVIEW:

The primary objective of this course is to build bridges between the gap of an idea and production. The term Additive manufacturing covers a spectrum of processes where a component can be fabricated directly from the computer aided design. Rapid prototyping is a group of methods used to rapidly manufacture a scale model of a physical part or assembly using three-dimensional CAD, and Computed Tomography (CT).

II. COURSE OBJECTIVES:

The students will try to learn:

I. The fundamentals of AM and different types of AM process and their applications.
II. The principle, methods and advantages of Liquid, solid and Powder based RPT systems.
III. The data format and software used in additive manufacturing
IV. The applications of AM in various domains.

III. COURSE OUTCOMES:

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

CO1 Explain modern proto type product fabrication methods, types and need of additive manufacturing.
CO2 Outline operating principles of Liquid and Solid based additive manufacturing for various size and shape of parts.
CO3 Make use of rapid prototyping technologies with powered based depositing methods.
CO4 Apply software tools for slicing and parametric controls for developing complex shapes.
CO5 Identify engineering applications for multidisciplinary domains.

IV. COURSE CONTENT:

MODULE -I: Introduction to Additive Manufacturing Techniques (09)

Introduction: Prototyping fundamentals: Need for time compression in product development, Need for Additive Manufacturing, Historical development, Fundamentals of Additive Manufacturing, AM Process Chain, Advantages and Limitations of AM, commonly used Terms, Classification of AM process, Fundamental Automated Processes: Distinction between AM and CNC, other related technologies.

MODULE -II: Liquid and Solid Based Additive Manufacturing (10)

Liquid-based AM Systems: Stereo lithography Apparatus (SLA): Models and specifications, Process, working principle, photopolymers, photo polymerization, Layering technology, laser and laser scanning, Applications, Advantages and Disadvantages, Case studies. Solid ground curing (SGC): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Poly jet: Process, Principle, working principle, Applications, Advantages and Disadvantages, Case

studies. Micro fabrication. Solid-based AM Systems: Laminated Object Manufacturing (LOM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Fused Deposition Modeling (FDM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Multi-Jet Modelling (MJM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies.

MODULE -III: Powder Based Rapid Proto Typing Systems and Tooling (10)
Powder Based Rapid Prototyping Systems: Selective laser sintering (SLS): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Three-dimensional Printing(3DP): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies.

Rapid Tooling: Introduction to Rapid Tooling (RT), Conventional Tooling Vs. RT, Need for RT. Rapid Tooling Classification: Indirect Rapid Tooling Methods: Spray Metal Deposition, RTV Epoxy Tools, Ceramic tools, Investment Casting, Spin Casting, Diecasting, SandCasting,3D Kel tool process. Direct Rapid Tooling: Direct AIM, LOM Tools, DTM Rapid Tool Process, EOS Direct Tool Process and Direct Metal Tooling using 3DP.

MODULE -IV: Additive Manufacturing Data Format and Additive Manufacturing Software (10)
AM Data Formats: Reengineering for Digital Representation, STL Format, STL File Problems, Consequence of Building Valid and Invalid Tessellated Models, STL file Repairs: Generic Solution, Other Translators, Newly Proposed Formats. Mesh Refining by Sub division Techniques. AM Software's: Need for AM software, features of various AM software's like Magics, Mimics, Solid View, View Expert, 3 D View, Velocity 2, Rhino, STL View 3 Data Expert and 3 D doctor, Surgi Guide, 3-matic, Simplant, Mesh Lab.

MODULE -V: Additive Manufacturing Applications (09)
AM Applications: Application – Material Relationship, Application in Design, Application in Engineering, Analysis and Planning, Aerospace Industry, Automotive Industry, Jewelry Industry, Coin Industry, GIS application, Arts and Architecture. RP Medical and Bioengineering Applications: Planning and simulation of complex surgery, Customized Implants & Prosthesis, Design and Production of Medical Devices, Forensic Science and Anthropology, Visualization of Biomolecules. Web Based Rapid Prototyping Systems.

V. TEXT BOOKS:

1. Chua C.K., Leong K.F, LIMC.S, "Rapid Prototyping: Principles and Applications", World Scientific publications, 3rd edition, 2010.

VI. REFERENCE BOOKS

1. D.T Pham, S. S. Dimov, "Rapid Manufacturing", Springer, 1st edition, 2001.
2. Paul F Jacobs, "Rapid Prototyping& Manufacturing", Wohlers Associates, 2000 ASME Press, 1st edition, 1996.
3. Frank W. Liou, "Rapid Prototyping & Engineering Applications", CRC Press, Taylor & Francis Group, 2nd edition, 2011.

VII. WEB REFERENCES:

1. http://nptel.ac.in/courses/112107077/38
2. http://web.iitd.ac.in/~pmpandey/MEL120_html/RP_document.pdf

VIII. E-TEXT BOOKS:

1. https://books.google.co.in/books?id=4OYcyiDUpsQC&redir_esc=y
2. http://store.elsevier.com/Direct-Write-Technologies-for-Rapid-Prototyping-Applications/isbn-9780121742317/

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. PowerPoint presentation

COURSE CONTENT

DESIGN FOR MANUFACTURING AND ASSEMBLY								
I SEMSTER: CAD/CAM								
Course Code	**Category**	**Hours /Week**			**Credits**	**Maximum Marks**		
BCCD04	**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**		
Pre requisites: Design for Manufacturing								

I. COURSE OVERVIEW:

The aim of this course is to introduce about the basic design process which based on different aspects of manufacturing as well assembly. Design for manufacturing is an engineering methodology that focuses on reducing time-to-market and total production costs by prioritizing both the ease of manufacture for the product's parts and the simplified assembly of those parts into the final product.

II. COURSE OBJECTIVES:

The students will try to learn:

I. The design of a product and the manufacturing constraints that influence the design of parts and part systems.
II. The general design consideration for machining and casting processes
III. The design guidelines for welding, extrusion process and sheet metalwork.
IV. The development of the assemble process, classification of automatic assembly and design guidelines of manual assembly.

III. COURSE OUTCOMES:

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

CO1 Illustrate the design philosophy, material selection and principles for economical production.
CO2 Apply the design recommendations for various manufacturing processes
CO3 Evaluate the modifications in a design that can be facilitated during welding, forging, extrusion and sheet metal work
CO4 Apply feasible solutions for various product assembly lines
CO5 Classify for manual assembly requirements for various products workstations

IV. COURSE CONTENT:

MODULE -I: Introduction To Design (09)

Introduction: Design philosophy steps in design process, general design rules for manufacturability, basic principles of designing for economical production, creativity in design; Materials selection of materials for Design developments in material technology, criteria for material selection, material selection interrelationship with process selection process selection charts.

MODULE -II: Machining Process (10)

Machining process: Overview of various machining processes, general design rules for machining, dimensional tolerance and surface roughness, design for machining, ease of redesigning of components for machining ease with suitable examples. General design recommendations for machined parts; Metal casting: Appraisal of various casting processes, selection of casting process, general design considerations for casting, casting tolerances, use of solidification simulation in casting design, product design rules for sandcasting.

MODULE -III: Metal Joining (09)

Metal joining: Appraisal of various welding processes, factors in design of weldments, general design constitution guidelines, pre and post treatment of welds, effects of thermal stresses in weld joints, design of brazed joints; Forging, design factors for forging, closed dies forging design, parting lines of die drop forging die design general design recommendations.

Extrusion and sheet metal work: Design guidelines for extruded sections, design principles for punching, blanking, bending, deep drawing, Keeler Goodman forming line diagram, component design for blanking.

MODULE -IV: Assembly Advantages (10)

Assembly advantages: Development of the assemble process, choice of assemble method assemble advantages social effects of automation, automatic assembly transfer systems: Continuous transfer, intermittent transfer, indexing mechanisms, and operator, paced free, transfer machine

MODULE -V: Design Of Manual Assembly (10)

Design of manual assembly: Design for assembly fits in the design process, general design guidelines for manual assembly, development of the systematic DFA methodology, assembly efficiency, classification system for manual handling, classification system for manual insertion and fastening, effect of part symmetry on handling time, effect of part thickness and size on handling time, effect of weight on handling time, parts requiring two hands for manipulation, effects of combinations of factors, effect of symmetry effect of chamfer design on insertion operations, estimation of insertion time.

V. TEXT BOOKS:

1. Geoffrey Boothroyd, "Assembly Automation and Product Design", CRC Press, 2nd edition, 2013.
2. George E. Deiter, "Engineering Design-Material &Processing Approach", Tata McGraw Hill, 2nd edition, 2000.
3. Geoffrey Boothroyd, "Hand Book of Product Design", Marcel and Dekken, 1st edition, 1990.

VI. REFERENCE BOOKS:

1. A. Delbainbre, **"**Computer Aided Assembly", Springer, 2nd edition, 1992.
2. Geoffrey Boothroyd, Peter Dewhurst, Winston. A.Knight, "Product Design for Manufacturing an Assembly", CRC Press, 3rd edition, 2013.

VII. WEB REFERENCES:

1. http://nptel.ac.in/courses/107103012/
2. http://me.gatech.edu/files/capstone/L071ME4182DFA

VIII. E-TEXT BOOKS:

1. https://books.google.co.in/books/about/Assembly_Automation_and_Product_Design.html ?id=XFtgaNFzMHQC
2. https://books.google.co.in/books/about/Product_Design_for_Manufacture_and_Assem.html?id=qYGgjwEACAAJ.

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. PowerPoint presentation

COURSE CONTENT

AUTOMATION IN MANUFACTURING								
I SEMSTER: CAD/CAM								
Course Code	**Category**	**Hours /Week**			**Credits**	**Maximum Marks**		
BCCD05	**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**		
Pre requisites: Manufacturing Technology								

I. COURSE OVERVIEW:

One of the best ways to communicate one's idea is through some form of picture or drawing. Computer graphics is the accurate technique that develops the ability to visualize any object with all physical and dimensional configurations. The computer aided drawing assists in preparation of 2D and 3D drawings to carry out sophisticated design and analysis.

II. COURSE OBJECTIVES:

The students will try to learn

I. The role and basics of Automation in manufacturing applications.
II. The geometric entities, projections development of curves and surfaces of Geometrical Modeling.
III. The geometric modeling techniques used in CAD such as wireframe, solid modeling.
IV. The product data standards and structures in computer graphics.

III. COURSE OUTCOMES:

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

CO1 Relate the role of graphic communication in the engineering design process.
CO2 Explain the concepts and underlying theory of modeling and the usage of models in different engineering applications
CO3 Develop geometric models in various industrial applications
CO4 Outline basic concept of image visualization on computer screen.
CO5 Identify the 2D and 3D transformations and various projections in CAD for synthesis various products
CO6 Develop parametric and non – parametric equations for curves and surfaces

V. COURSE CONTENT:

MODULE -I: AUTOMATION IN PRODUCTION SYSTEMS (10)

Automated Manufacturing Systems, Computerized Manufacturing Support Systems, and Reasons for Automation, Automation Principles and Strategies. Manufacturing operations, Production Concepts and Mathematical Models and Costs of Manufacturing Operations Basic Elements of an Automated Systems, Advanced Automation Functions and Levels of automation.

MODULE -II: MATERIAL HANDLING (09)

Introduction to Material Handling: Overview of Material Handling Equipment, Considerations in Material Handling System Design, the 10 Principles of Material Handling. Material Transport Systems, Automated Guided Vehicle Systems, Monorails and other Rail Guided Vehicles, Conveyor Systems, Analysis of Material Transport Systems. Storage Systems, Storage System Performance, Storage, Location Strategies.

Conventional Storage Methods and Equipment, Automated Storage Systems, Engineering Analysis of Storage Systems. Automatic data capture-overview of Automatic identification methods, bar code technology, other ADC technologies.

MODULE -III: ASSEMBLY LINES (10)
Manual Assembly Lines - Fundamentals of Manual Assembly Lines, Alternative Assembly Systems, Design for Assembly, Analysis of Single Model Assembly Lines.

Line balancing problem, largest candidate rule, Kilbridge and Wester method, and Ranked Positional Weights Method, Mixed Model Assembly Lines, Considerations in assembly line design

MODULE -IV: TRANSFER LINES (10)
Transfer lines, Fundamentals of Automated Production Lines, Storage Buffers, and Applications of Automated Production Lines. Analysis of Transfer Lines with no Internal Storage, Analysis of Transfer lines with Storage Buffers.

MODULE -V: AUTOMATED ASSEMBLY SYSTEMS (09)
Automated Assembly Systems, Fundamentals of Automated Assembly Systems, Design for Automated Assembly, and Quantitative Analysis of Assembly Systems - Parts Delivery System at Work Stations, Multi- Station Assembly Machines, Single Station Assembly Machines, Partial Automation.

V. TEXT BOOKS:

1. Automation, Production systems and computer integrated manufacturing by Mikel P. Groover, Pearson Education.

VI. REFERENCE BOOKS:

1. CAD CAM: Principles, Practice and Manufacturing Management by Chris Mc Mohan, Jimmie Browne, Pearson Edu. (LPE)
2. Automation by Buckinghsm W, Haper & Row Publishers, New York, 1961
3. Automation for Productivity by Luke H.D, John Wiley & Sons, New York, 1972.

VII. WEB REFERENCES:

1. http://nptel.ac.in/courses/107103012/
2. http://me.gatech.edu/files/capstone/L071ME4182DFA

VIII. E-TEXT BOOKS:

1. https://books.google.co.in/books/about/Assembly_Automation_and_Product_Design.html?id=XFtgaNFzMHQC
2. https://books.google.co.in/books/about/Product_Design_for_Manufacture_and_Assem.html?id=qYGgjwEACAAJ.

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. PowerPoint presentation

COURSE CONTENT

SPECIAL MANUFACTURING PROCESS								
I SEMSTER: CAD/CAM								
Course Code	**Category**	**Hours /Week**			**Credits**	**Maximum Marks**		
BCCD06	**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**		
Pre requisites: Unconventional Machining Process (AMEC40)								

I. COURSE OVERVIEW:

This course is to introduce the concept of manufacturing process with the help of various processes widely employed in the industries. This course consists of surface treatment, processing of ceramics, development of geometrical modeling, e-manufacturing and rapid prototyping processes with the related details of equipment and applications. It introduces the different manufacturing processes.

II. COURSE OBJECTIVES:

The students will try to learn:

I. The manufacturing processes in surface treatment, types of surface coating and methods of coating.
II. The important effects of manufacturing processes in ceramics, powder preparation, processing of composites.
III. The concepts of fabrication of microelectronic devices, wafer preparation, bonding and packaging techniques and design in micro-electronic devices.
IV. The perceptions of Nano manufacturing techniques, working principles and techniques of RPT.

III. COURSE OUTCOMES:

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

CO1 Select suitable manufacturing processes to manufacture the products optimally.
CO2 Develop simplified manufacturing processes with the aim of reduction of cost and manpower.
CO3 Identify/control the appropriate process parameters, and possible defects of manufacturing processes in industries.
CO4 Evaluate the required surface treatment necessary for a particular application
CO5 Illustrate numerous stages involved in the processing of Ceramics
CO6 Apply the knowledge of various techniques for the fabrication of Micro Electronic components.

IV. COURSE CONTENT:

MODULE -I: Surface Treatment (10)

Surface Treatment: Scope, Cleaners, Methods of cleaning, Surface coating types, and ceramic and organic methods of coating, economics of coating. Electro forming, Chemical vapor deposition, thermal spraying, Ion implantation, diffusion coating, Diamond coating and cladding.

MODULE -II: Processing of Ceramics (10)

Processing of Ceramics: Applications, characteristics, classification Processing of particulate ceramics, Powder preparations, consolidation, Drying, sintering, Hot compaction, Area of application, finishing of ceramics. Processing of Composites: Composite Layers, Particulate and fiber reinforced composites, Elastomers, Reinforced plastics, MMC, CMC, Polymer matrix composites.

MODULE -III: Fabrication of Micro Electronic Devices (09)
Fabrication of Microelectronic Devices: Crystal growth and wafer preparation, Film Deposition oxidation, lithography, bonding and packaging, reliability and yield, Printed Circuit boards.

Computer aided design in microelectronics, surface mount technology, Integrated circuit economics.

MODULE -IV: E-Manufacturing (09)
E-Manufacturing: Nano manufacturing techniques and micromachining, High Speed Machining and hot Machining.

MODULE -V: Rapid Prototyping (10)
Rapid Prototyping: Working Principles, Methods, Stereo Lithography, Laser Sintering, Fused Deposition Method, Applications and Limitations, Rapid tooling, Techniques of rapid manufacturing.

V. TEXT BOOKS:

1. Kalpakijian, "Manufacturing Engineering and Technology", Pearson, 7th edition, 2015.
2. R. A. Lindburg, "Process and Materials of Manufacturing", PHI, 11th edition, 1990.
3. R. Rao, Thummala, Eugene, J. Rymaszewski, Van Nostrand Renihold, "Microelectronic packaging handbook", 2nd edition, 1995.

VI. REFERENCE BOOKS:

1. Tai - Run Hsu, "MEMS & Micro Systems Design and Manufacture", Tata McGraw Hill, 1st edition, 2017.
2. V. K. Jain, "Advanced Machining Processes" , Allied Publications, 1st edition, 2009.
3. John A Schey, "Introduction to Manufacturing Processes", Tata McGraw Hill, 3rd edition, 2012.

VII.WEB REFERENCES:

1. http://nptel.ac.in/courses/112/107/112107219

VIII. E-TEXT BOOK:

1. http://www.fcusd.org/cms/lib/CA01001934/Centricity/Domain/4529/Fundamentals% 20 of% 20 Modern%20Manufacturing%20Materials%20%20Processes%20and%20Systems%20%204th%20Edition.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. PowerPoint presentation

COURSE CONTENT

IOT AND INDUSTRY 4.0								
II SEMSTER: CAD/CAM								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BCCD07	**Elective**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	40	60	100
Contact Classes: 48	**Tutorials Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Pre requisites: Artificial Intelligence								

I. COURSE OVERVIEW:

Industry 4.0 concerns the transformation of industrial processes through the integration of modern technologies such as sensors, communication, and computational processing. Technologies such as Cyber-Physical Systems (CPS), Internet of Things (IoT), Cloud Computing, Machine Learning, and Data Analytics are considered to be the different drivers necessary for the transformation. Industrial Internet of Things (IIoT) is an application of IoT in industries to modify the various existing industrial systems. IIoT links the automation system with enterprise, planning and product lifecycle.

II. COURSE OBJECTIVES:

The students will try to learn:

I. The basics of Industry 4.0 and Business model and impact of IIoT.
II. the concepts of virtual reality, lean manufacturing.
III. To gain knowledge of various sensors and actuators.
IV. To analyze the various data transmission technologies.

III. COURSE OUTCOMES:

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

CO1 Explain Smart Business Perspective, Cyber security, Impacts of Industry 4.0.
CO2 Understand the basics of the Industrial Internet of Things.
CO3 Analyze various key technologies.
CO4 Implement various sensors and actuators.
CO5 Understand different industrial transmission technologies and IIOT applications in real life

IV. COURSE CONTENT:

MODULE -I: Industry 4.0 Basics (10)

Industry 4.0 Basics: Industrial revolution: Phases, Evolution of Industry4.0, Environmental impacts of industrial revolution, Applications, Design requirements, Drivers of Industry4.0, Sustainability Assessment of industries, Smart Business Perspective, Cyber security, Impacts of Industry 4.0.

MODULE -II: Industrial Internet of Things (09)

Industrial Internet of Things- Basics: IIoT and Industry 4.0, IIC, Industrial Internet Systems, Design of industrial internet systems, Impact of industrial internet, Benefits of industrial internet, Industrial sensing, Industrial Processes, Features of IIoT for industrial processes, Industrial plant–The future architecture, Digital Enterprise

Business Models and Reference Architecture of IIoT: Definition of a business model, Business models of IIoT, Industrial Internet Reference Architecture

MODULE -III: Key Technology (10)
Key Technologies: Off-site Technologies, Cloud Computing, Fog Computing Key Technologies: On-site Technologies.

Augmented Reality, Virtual Reality, Smart factories, Lean manufacturing system, Big Data and Advanced Analytics.

MODULE -IV: Sensors and Actuators (09)
Sensors: Various sensor types and their underlying working principles, Characteristics of Sensors – Resolution, calibration, accuracy and others, Sensor Categories – Thermal, Mechanical, Electrical, Optical and Acoustic sensors.
Actuators: Thermal, Hydraulic, Pneumatic, Electro mechanical Actuator

MODULE -V: Industrial Data Transmission and IOT Applications (10)
Industrial Data Transmission and Acquisition: Architecture of various data transmission technologies like Foundation Fieldbus, Profibus, Highway Addressable Remote Transducer (HART), Interbus, Bitbus, Digital STROM, Controller Area Network, and other recent and upcoming Technologies. Distributed Control System, SCADA and PLC System.
IOT Applications: IoT Applications on Industrial automation, Factories and Assembly line, Plant Security and Safety, Transportation, Agriculture, Healthcare, Home Automation, Oil, Chemical and Pharmaceutical Industry and others.

V. TEXT BOOKS:
1. Introduction to Industrial Internet of Things and Industry 4.0 by Sudip Misra, Chandana Roy, Anandarup Mukherjee, CRC Press.
2. Vijay Madisetti, Arshdeep Bahga, Ïnternet of Things, "A Hands on Approach", University Press.
3. Dr. SRN Reddy, RachitThukral and Manasi Mishra, "Introduction to Internet of Things: A practical Approach", ETI Labs.

VI. REFERENCE BOOKS:
1. Adrian McEwen, "Designing the Internet of Things", Wiley.
2. Raj Kamal, "Internet of Things: Architecture and Design", McGraw Hill.
3. Cuno Pfister, "Getting Started with the Internet of Things", O Reilly Media.

VII. WEB REFERENCES:
1. http:// nptel.ac.in/courses/112/106/112106130/

VIII. E-TEXT BOOK:
1. www.elsevier.com/books/advanced-applied-finite-element-methods/ross/978-1-898563-51-8.

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. PowerPoint presentation

COURSE CONTENT

PRECISION ENGINEERING								
I SEMSTER: CAD/CAM								
Course Code	**Category**	**Hours /Week**			**Credits**	**Maximum Marks**		
BCCD08	**Elective**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	40	60	100
Contact Classes:48	**Tutorials Classes: Nil**	**Practical Classes: Nil**				**Total Classes:48**		
Pre requisites: Quality and Precision Engineering								

I. COURSE OVERVIEW:

Precision engineering is involved with the design, manufacturing and measurement of highly specified parts for the medical, aerospace, automotive, oil and gas exploration and related industry. This course has been designed with industry to respond efficiently and effectively to the needs of the Precision Engineering industry.

II. COURSE OBJECTIVES:

The students will try to learn:

I. The importance of accuracy in machine tools, significance of selection of Tolerance & datum features
II. The field of tolerance analysis and geometric tolerances of mechanical products.
III. The importance of operation sequence for typical shaft type of components and preparation of process drawings.
IV. The conceptions of Measurements and working systems of CMM

III. COURSE OUTCOMES:

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

CO1 Recall the meaning of precision and the importance of employ in industries
CO2 Outline the principles of various precision engineering processes and apply them in actual field.
CO3 Illustrate the precision measurements, engineering design process for manufacturing the components
CO4 Explain the basic concepts of GD and tolerancing based on ASME and ISO standards
CO5 Summarize the concepts of datums and their classifications.
CO6 Apply the knowledge of Tolerance analysis of different machining process based on customer expectation

IV. COURSE CONTENT:

MODULE -I: Concept of Accuracy and Tolerance Zone Conversion (10)

Concepts of accuracy: Introduction, concept of accuracy of machine tools, spindle and displacement accuracies, accuracy of numerical control systems, errors due to numerical interpolation displacement measurement system and velocity lags; geometric dimensioning and tolerancing: Tolerance zone conversions, surfaces, features, features of size, datum features, datum Oddly configured and curved surfaces as datum features, equalizing datums datum feature of representation; form controls, orientation controls logical approach to tolerancing.

MODULE -II: Datums (09)

Datum systems: Design of freedom, grouped datum systems, different types, two and three mutually perpendicular grouped datum planes; Grouped datum system with spigot and recess, pin and hole; Grouped datum system with spigot and recess pair and tongue, slot pair, computation of translational and rotational accuracy, geometric analysis and application.

MODULE -III: Tolerance Analysis (10)

Tolerance analysis: Process capability, mean, variance, skewness, Kurtosis, process capability metrics, Cp, Cpk, Cost aspects, feature tolerances.

Geometric tolerances; surface finish, review of relationship between attainable tolerance grades and different machining process, cumulative effect of tolerances surfeit law, normal law and truncated normal law.

MODULE -IV: Tolerance Charting Techniques (10)

Tolerance charting techniques: Operation sequence for typical shaft type of components, preparation of process drawings for different operations, tolerance worksheets and centrally analysis, examples, design features to facilitate machining; datum features, functional and manufacturing components design, machining considerations, redesign for manufactured.

MODULE -V: Measuring System Processing (09)

In Processing or In-Situ measurement of position of processing, point-post process and on machine Measurement of dimensional features and surface-mechanical and optical measuring systems; working systems of CMM; Laser alignment and testing.

V. TEXT BOOKS:

1. R. L. Murthy, "Precision Engineering in Manufacturing", New Age International limited, 1st edition, 1996.
2. James D. Meadows, "Geometric Dimensioning and Tolerancing", Marcel Dekker, 1st edition, 1995.

VI. REFERENCE BOOKS:

1. Norio Taniguchi, "Nano Technology", Oxford University Press, 1st edition, 1996.
2. Matousek, "Engineering Design–A systematic Approach", Blackie & Son Ltd., London, 1st edition, 2013.

VII. WEB REFERENCES:

1.http:// nptel.ac.in/courses/112/104/112104250/

VIII. E-TEXT BOOK:

http://books.google.co.in/books/about/Precision_Engineering.html?id=7LehRTx2krQC&redir_esc=y

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. PowerPoint presentation

COURSE CONTENT

STRESS ANALYSIS AND VIBRATION								
I SEMSTER: CAD/CAM								
Course Code	**Category**	**Hours /Week**			**Credits**	**Maximum Marks**		
BCCD09	**Elective**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	40	60	100
Contact Classes:48	**Tutorials Classes: Nil**	**Practical Classes: Nil**				**Total Classes:48**		
Pre requisites: Mechanical Vibrations								

I. COURSE OVERVIEW:

The course covers the basic aspects of experimental stress analysis that includes exhaustive treatment of the most versatile techniques like photoelasticity and strain gauges. In addition, it also provides the fundamental aspects of different experimental techniques such as Moiré and Brittle Coatings and also a brief introduction to the nondestructive technique.

II. COURSE OBJECTIVES:

The students will try to learn:

I. The various measurement techniques involved for measuring parameters, types of Extensometers and their uses in various fields.
II. The effects of static and dynamic strain gauges and their classifications.
III. The concepts of Photo elastic effects and transmission of Photo elasticity.
IV. The failure theories in brittle coating and basics of Non-Destructive Testing and their types.

III. COURSE OUTCOMES:

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

CO 1 Illustrate the modern electronic measuring principle for different physical parameters
CO 2 Explain the measurement of strain under static and dynamic loads
CO 3 Apply knowledge on strain gauges and load cells for measuring mechanical quantities
CO 4 Analysis of measuring circuits and strains of different strain gauge rosettes
CO 5 Explain the concepts, types of photo elasticity and photo elastic materials

IV. COURSE CONTENT:

MODULE -I: Extensometers and Displacement Sensors (10)

Principles of Measurements, Accuracy, Sensitivity and Range of Measurements, Mechanical, Optical, Acoustical and Electrical Extensometers and their Uses, Advantages and Disadvantages, Capacitance Gauges, Laser Displacement Sensors.

MODULE -II: Electrical Resistance Strain Gauges (10)

Principle of operation and requirements, Types and their uses, Materials for Strain Gauges, Calibration and temperature compensation, Cross Sensitivity, Wheatstone Bridge and Potentiometer, Circuits for Static and Dynamic strain measurements, Strain indicators, Rosette Analysis, Stress Gauges, Load Cells, Data Acquisition, Six Component Balance.

MODULE -III: Photo Elasticity (10)

Two-Dimensional Photo elasticity, Photo elastic Materials, Concept of Light – Photo elastic Effects, Stress Optic Law, Transmission Photo elasticity, Jones Calculus, Plane and Circular Polariscopes.

Interpretation of Fringe Pattern, Calibration of Photo elastic Materials, Compensation and separation Techniques, Introduction to Three-Dimensional Photo Elasticity.

MODULE -IV: Brittle Coating and Moire Techniques (09)
Relation Between Stresses in Coating and Specimen, Use of Failure Theories in Brittle Coating, Moire Method of strain Analysis

MODULE -V: Non–Destructive Testing (09)
Fundamentals of NDT, Acoustic Emission Technique, Radiography, Thermography, Ultrasonics, Eddy Current Testing, Fluorescent Penetrant Testing

V. TEXT BOOKS:

1. J. W. Dally, W.F. Riley, "Experimental Stress Analysis", Tata McGraw Hill Inc., 1st edition, 2013.
2. L. S. Srinath, M.R. Raghava, K. Lingaiah, G. Garagesha, B. Pant, K. Ramachandra, "Experimental Stress Analysis", Tata McGraw Hill, New Delhi,1st edition,1984.

VI. REFERENCE BOOKS:

1. M. Hetenyi, "Hand Book of Experimental Stress Analysis", John Wiley and Sons Inc., New York, 1st edition, 1972.
2. A. A. Pollock, "Acoustic Emission in Acoustics and Vibration Progress", Ed. Stephens R.W.B. Chapman and Hall, 1st edition, 1993.

VII. WEB REFERENCES:

1. http:// nptel.ac.in/courses/112/103/112103111/

VIII. E-TEXT BOOK:

1. http:// 160592857366.free.fr/joe/e books/Mechanical Engineering Books Collection/VIBRATIONS/ mechVib theory and applications.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. PowerPoint presentation

COURSE CONTENT

MECHANICAL BEHAVIOUR OF MATERIALS								
I SEMSTER: CAD/CAM								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BCCD10	**Elective**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	40	60	100
Contact Classes: 48	**Tutorials Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Pre requisites: Elements of Mechanical Engineering								

I. COURSE OVERVIEW:

The basics of material structures and properties and strength of materials, shall be introduced to dislocation theories of plasticity behavior, various strengthening mechanisms. Emphasis on analytical and numerical methods for predicting material properties and behavior, as well as some discussion of the relationships between solid structure and material properties. Topics include: fracture, fatigue, plasticity, creep and deformation.

II. COURSE OBJECTIVES:

The students will try to learn:

I. The concept of fracture and its types, fracture curve and fracture mechanics.
II. The theory of elasticity and plasticity fracture mechanics and effects of deformation of various metals and polymers.
III. The effect of Mean stress, crack propagation and surface effects on Fatigue.
IV. The evolution of creep damage and Micro mechanisms of creep in materials.

III. COURSE OUTCOMES:

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

CO1 Recall the fundamentals of fracture and creep
CO2 Illustrate the importance of various materials and its application in an industry.
CO3 Summarize the importance of materials and their characteristics.
CO4 Explain the concept of fracture mechanics and Griffith theory of Brittle materials
CO5 Apply stress – strain relation in elasticity and plasticity behavior of metals and polymers
CO6 Develop S-N Curve and relate Stress Cycles on Fatigue.

IV.COURSE CONTENT:

MODULE -I: Fracture Introduction (09)

Introduction, Types of Fracture in Metals, Griffith Theory of Brittle Fracture, Fracture of Single Crystals, Ductile Fracture, Concept of the Fracture Curve. Fracture Mechanics: Strain Energy Release rate, Fracture Toughness and Design, Crack Opening Displacement, J-Integral, R Curve.

MODULE -II: Linear Elastic Fracture Mechanics (10)

Theory of Elasticity and Plasticity: Elasticity Theory: The State of Stress and strain, elastic stress-strain relation, anisotropy, elastic behavior of metals, ceramics and polymers. Plasticity: Hydrostatic and Deviatoric stress, Octahedral stress, yield criteria and yield surface, texture and distortion of yield surface, true stress and true strain, flow rules, strain hardening, Ramberg Osgood equation, stress -strain relation in plasticity, plastic deformation of metals and polymers.

MODULE -III: Fatigue-I (10)
Introduction, Stress Cycles, S-N Curve, Effect of Mean Stress on Fatigue, Cyclic Stress strain curve, Low Cycle Fatigue, Strain Life Equation.

Structural Features of Fatigue, Fatigue Crack Propagation, Effect of Metallurgical Variables on Fatigue.

MODULE -IV: Fatigue-II (09)
Effect of stress concentration on Fatigue, Size Effect, Surface effects on Fatigue, Fatigue under Combined stresses, Design for Fatigue, Machine Design Approach-Infinite life design, Local strain approach, Corrosion Fatigue, Effect of Temperature on fatigue.

MODULE -V: Creep Deformation (10)
The evolution of creep damage, primary, secondary and tertiary creep, Micro mechanisms of creep in materials and the role of diffusion, Ashby creep deformation maps. Stress dependence of creep – power law dependence. Comparison of creep performance under different conditions – extrapolation and the use of Larson-Miller parameters, Creep-fatigue interactions, Examples.

V. TEXT BOOKS:
1. G. E. Dieter, "Mechanical Metallurgy", McGraw Hill, 3rd edition, 2017.
2. L.B. Freund, S. Suresh Thin Film Materials, Cambridge University Press, 1st edition, 2013.

VI. REFERENCE BOOKS:
1. T.L. Anderson, "Fracture Mechanics Fundamentals and Applications", CRC press, 2nd edition, 2013.
2. B. Lawn, "Fracture of Brittle Solids", Cambridge Solid State Science Series, 2nd edition, 2013.
3. J.F. Knott, "Fundamentals of Fracture Mechanics", Butter worths & Co Publishers Ltd, 1st edition, 2013.
4. S. Suresh, "Fatigue of Materials", Cambridge University Press, 1st edition, 2013.

VII. WEB REFERENCES:
1. http://nptel.ac.in/courses/113/106/113106101/

VIII. E-TEXT BOOK:
1. http://3gaam.com/content/uploads/manual/mechanical-metallurgy-dieter.pdf

IX. 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. PowerPoint presentation

COURSE CONTENT

RESEARCH METHODOLOGY AND IPR								
I Semester: CSE, ES, CAD/CAM, AE, ST, EPS								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BHSD01	**Core**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		2	-	-	2	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Pre requisites: There are no prerequisites to take this course								

I. COURSE OVERVIEW:

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

II. COURSE OBJECTIVES:

The students will try to learn:

I. The Knowledge on formulate the research problem, characteristics of a good research and interpretation of collected data.
II. The importance of research ethics while preparing literature survey and writing thesis to achieve plagiarism free report.
III. The intellectual property rights such as patent, trademark, geographical indications and copyright for the protection of their invention done.

III. COURSE OUTCOMES:

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

CO1 Interpret the technique of determining a research problem for a crucial part of the research study.
CO2 Examine the way of methods for avoiding plagiarism in research.
CO3 Apply the feasibility and practicality of research methodology for a proposed project.
CO4 Make use of the legal procedure and document for claiming patent of invention.
CO5 Identify different types of intellectual properties, the right of ownership, scope of protection to create and extract value from IP.
CO6 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 (9)
Effective literature studies approaches, analysis Plagiarism, Research ethics.

MODULE – III: Research proposal (9)
Effective technical writing, how to write report, Paper Developing a Research Proposal.

Format of research proposal, presentation and assessment.

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

VI. REFERENCE BOOKS:

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

VII. WEB REFERENCES:

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

VIII. E-TEXT BOOKS:

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

IX. 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. PowerPoint presentation

COURSE CONTENT

ENGLISH FOR RESEARCH PAPER WRITING								
I Semester: CSE, ES, CAD/CAM, AE, ST, PEED								
Course Code	Category	Hours / Week			Credits	Maximum Marks		
BHSD02	Audit	L	T	P	C	CIA	SEE	Total
		-	-	-	-	-	-	-
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: Nil		
Pre requisites: There are no prerequisites to take this course								

I. COURSE OVERVIEW:

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

II. COURSE OBJECTIVES:

The students will try to learn:

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

III. COURSE OUTCOMES:

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

CO 1 Interpret the technique of determining a research problem for a crucial part of the research study.
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. COURSE CONTENT:

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:

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

VIII. E-TEXT BOOKS:

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

IX. 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. PowerPoint presentation

COURSE CONTENT

ADVANCED COMPUTER AIDED DESIGN LABORATORY								
I Semester: CAD / CAM								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BCCD11	**Core**	L	T	P	C	CIA	SEE	Total
		0	0	4	2	40	60	100
Contact Classes: Nil	**Tutorial Classes: Nil**	**Practical Classes: 45**				**Total Classes: 45**		

I. COURSE OVERVIEW:

Computer aided Design laboratory is a course primary important to mechanical engineering students. The aim is to impart the overview of computer applications or design and manufacturing the discrete engine components, assemblies and final product to meet the global competition. The course covers the basics of geometric modeling, surface modeling and solid modeling. This course also deals with creation of synthetic curves and surfaces. It imposes the knowledge of latest manufacturing techniques using different programming methods, Group Technologies. It makes the student to understand the modern inspection methods and concepts of CAD.

II. COURSE OBJECTIVES:

The students will try to learn:

I. The modern trends in design and manufacturing using CAD.
II. The significance of parametric technology and its application in 2D sketching.
III. The significance of parametric feature-based modeling and its application in 3D machine components modeling.
IV. The concepts of thermal analysis for transient heat transfer condition with different loads.

III. COURSE OUTCOMES:

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

CO1 Select the Parametric Modeling Fundamentals, Procedure, and "Shape before Size" Approaches for Product design.
CO2 Utilize graphics software for various CAD applications.
CO3 Choose importance of CAD in the light of allied technologies such as CAM, CAE and FEA.
CO4 Classify 3D assemblies that represent static and dynamic Mechanical Systems for assembly drawing.
CO5 Utilization of different inputs using Part model and Assembly of parts.
CO6 Develop the Generation of surfaces and Analysis of Models.

IV. COURSE CONTENT:

WEEK -1: INTRODUCTION TO CAD AND TOOLS: PART -1
Creation of working drawing, creating geometry, constraining the profile, extracting a part using tools, creating pattern of hole.

WEEK -2: INTRODUCTION TO CAD AND TOOLS: PART-2
Translating Rotating, Mirroring, Managing, The Specification Tree. Creating Sheets and Views, Creating Text and Dimensions.

WEEK -3: ASSEMBLY OF PART DRAWING: PART -1
Creating an assembly, moving components, assembling existing components, creating bill of materials.

WEEK -4: ASSEMBLY OF PART DRAWING: PART -2
Creating wire frame and surface geometry using generative shape design and sweep tools.

WEEK -5: GENERATION OF SURFACES: PART -1
Generation of Ferguson‟s cubic surface patches, Bezier surface patches

WEEK -6: GENERATION OF SURFACES: PART-2
Generation of Coon‟s patch, import and export of drawing from other software.

WEEK -7: ANALYSIS OF MODEL: PART -1
Linear static analysis: Automatic calculation of rigid body modes using specified Eigen value shift, lumped and consistent mass matrices.

WEEK -8: ANALYSIS OF MODEL: PART-2
Buckling Analysis: Jacobi inverse iteration techniques, steady state harmonic response, and mode superposition method, overall structural and damping.

WEEK -9: ANALYSIS OF MODEL: PART-3
Linear dynamic analysis: Nonlinear static analysis, Non-linear dynamic analysis.

WEEK -10: ANALYSIS OF MODEL: PART-4
Steady state heat transfer analysis problems.

WEEK -11: THERMAL ANALYSIS: PART -1
Transient Heat Transfer Analysis: Familiarity with element library, Defining Boundary conditions, multipoint constraint familiarity with different types of loads.

WEEK -12: THERMAL ANALYSIS: PART -2
Solution techniques, direct and iterative solver. Results and analysis. Design optimization.

WEEK -13: CAD AND TOOLS: PART-1
Translating Rotating, Mirroring, Managing, The Specification Tree. Creating Sheets and Views, Creating Text and Dimensions.

WEEK -14: ANALYSIS OF MODEL: PART -1
Linear static analysis: Automatic calculation of rigid body modes using specified Eigen value shift, lumped and consistent mass matrices.

V. TEXT BOOKS:

1. Farid Amirouche, "Principles of Computer-Aided Design and Manufacturing, Pearson", 2nd edition, 2004.
2. P. Radha Krishnan, "CAD/ CAM/ CIM", New Age International, 4th edition, 2016.
3. Warren. S. Seames, "Computer Numerical Control Concepts and Programming", Delmar Cengage Learning, 4th edition, 2013.

VI. E-TEXT BOOKS:

1. http://sbmpme.blogspot.in/2011/01/cad-cam-cim-p-radhakrishnan.html
2. https://www.scribd.com/doc/228624725/cad-cam-text-book-by-P-N-RAO

COURSE CONTENT

COMPUTATIONAL TECHNIQUES LABORATORY								
I Semester: CAD / CAM								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BCCD12	**Core**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		0	0	4	2	40	60	100
Contact Classes: Nil	**Tutorial Classes: Nil**	**Practical Classes: 45**				**Total Classes: 45**		

I. COURSE OVERVIEW:

This course is designed to give an overview of Computational Techniques of interest to engineers. Focus will be on numerical methods, their properties and analysis.

II. COURSE OBJECTIVES:

The students will try to learn

I. The MAT LAB programs for simple and complex engineering problems.
II. The output graphical plots of SF, BM for the given loads and thermal stress analysis of piston using MATLAB programs.
III. The MATLAB programs for graphic functions, multi body dynamics and solutions of difference equation using Euler method.
IV. The real time applications such as vibration and acceleration implemented using MATLAB programs.

III. COURSE OUTCOMES:

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

CO 1 Develop program and plot the Shear force, bending moment and geometric functions of single and double variables for complex engineering problems.
CO 2 Analysis of piston through MATLAB for thermal stresses.
CO 3 Develop formulation of ideal gas equation using MATLAB for thermodynamic relations.
CO 4 Develop Euler equation of motion using MATLAB programs to find path movement.
CO 5 Apply Simulation for multi body dynamic analysis software for balancing vibration.
CO 6 Determination of polynomial equation using method of Least Square Curve Fitting.

IV. LIST OF EXPERIMENTS:

Week-1: Introduction to MAT Lab Program

Applications to MATLAB in Mechanical Engineering.

Week-2: MAT Lab Program to Plot the Internal Forces, and Bending Moment

The radius of the semicircular member is 25 mm and supported with roller and hinged supports.
The load 300N acting vertically downward at the center and 200 N acting horizontally at the roller support toward left direction.
Write a MATLAB program to plot the internal forces, namely, the axial forces, shearing force and bending moment as functions of α for $0 < \alpha < 90^{o}$.

Week-3: Thermal Stress Analysis of Piston Using MAT Lab Program

Temperature distribution around the given piston dimensions.

Week-4: Formulation of Ideal and Real Gas Equations
Gas phase thermodynamic equations of state relate the three state variables of temperature, pressure, and volume for a gas. One of the three state variables can be calculated through the equation of state if values for the other two variables are known. For example, the ideal gas law states PV = RT ~ where P: pressure, Pa: V: specific or molar gas volume, m^3 mol R: ideal gas constant, (= 8.314 J/(mol K)) T : absolute temperature, K.

Week-5: Using MAT Lab Program Plot the Function of One Variable and Two Variable
Graphing-functions of one variable and two variables

Week-6: Multi Body Dynamic Analysis Through MAT Lab Program
Use of MATLAB to solve simple problems in vibration, Mechanism Simulation using multi body dynamic software

Week-7: MAT Lab Program for Euler's Equation of Motion
Solution of Difference Equations using Euler Method

Week-8: MAT Lab Program for Curve Fitting
Determination of polynomial using method of Least Square Curve Fitting.

Week-9: Dynamic Analysis Using MAT Lab Program
Dynamics and vibration analysis

Week-10: MAT Lab Program to Plot the Resultant Acceleration and the Variation of Acceleration
A jet plane is going in a parabolic path described by y=0.05x^2. At a point in the path, it has a velocity of 200 m/s, which is increasing at the rate of 0.8 m/s^2. Find the resultant acceleration and plot the variation of acceleration as a function of its horizontal position x.

Week-11: Formulation of Ideal and Real Gas Equations
Gas phase thermodynamic equations of state relate the three state variables of temperature, pressure, and volume for a gas. One of the three state variables can be calculated through the equation of state if values for the other two variables are known. For example, the ideal gas law states PV = RT ~ where P: pressure, Pa: V: specific or molar gas volume, m^3 mol R: ideal gas constant, (= 8.314 J/(mol K)) T : absolute temperature, K.

Week-12: MAT Lab Program for Euler's Equation of Motion
Solution of Difference Equations using Euler Method

Week-13: Using MAT Lab Program Plot the Function of One Variable and Two Variable
Graphing-functions of one variable and two variables.

Week-14: MAT Lab Program to Plot the Internal Forces, and Bending Moment
The radius of the semicircular member is 25 mm and supported with roller and hinged supports.
The load 300N acting vertically downward at the center and 200 N acting horizontally at the roller support toward left direction.

V. TEXT BOOKS:

1. Delores M.Etter, David C. Kuncicky, HollyMoore, "Introduction to MATLAB7", Pearson Education Inc, 1st edition, 2009.
2. Rao. V. Dukkipati , "MATLAB for ME Engineers" , New Age Science, 1st edition, 2008.
3. Agam Kumar Tyagi, "MATLAB and Simulink for Engineers", Oxford University Press 1st edition, 2012.

VI. WEB REFERENCES:

1. http://www.tutorialspoint.com/matlab/
2. http://in.mathworks.com/products/matlab/?requestedDomain=www.mathworks.com
3. http://www.iare.ac.in

COURSE CONTENT

ADVANCED FINITE ELEMENT METHOD								
II Semester: **CAD / CAM**								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BCCD13	**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**		
Pre requisites: Finite Element Methods								

I. COURSE OVERVIEW:

The finite element analysis (FEA) is a numerical method widely used for modeling and analyzing structures. This course introduces the mathematical modeling concepts of the Finite Element Method for solving structural, thermal and dynamics problems that are too complicated to be solved by analytical methods.

II. COURSE OBJECTIVES:

The students will try to learn:

I. The Properties of Stiffness Matrix derived for various types of loads applied on bars, trusses and beams.
II. The finite element formulations and solve 2-D CST, Iso parametric Elements and, Stress-Strain Analysis for 3D Elements.
III. The Eigenvalues and Eigenvectors for stepped bar and beam, explain nonlinear geometric and material non linearity.
IV. The 2D and 3D finite element plates behavior and Boundary Element Formulation of Electrostatic Problems through Numerical implementation.

III. COURSE OUTCOMES:

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

CO1 Explain the energy principles and weighted residual methods to develop the finite element method governing equation for solving bar and trusses.
CO2 Develop 2D problems using CST elements and 3D problems with tetrahedron elements for analyzing the Plates and shells.
CO3 Evaluate the natural frequencies and thermal stresses for 2-D problems
CO4 Apply theory of plate bending for non-linear and anisotropic materials using C^0 and C^1 continuity elements.
CO5 Apply finite element method for solving electrostatic problems using boundary value methods.
CO6 Apply the boundary elemental method for formulation of electrostatic problems in three dimensional analysis.

IV. COURSE CONTENT:

MODULE -I: Finite Element Methods-A Review (10)

One Dimensional Problems: Formulation of Stiffness Matrix for a Bar Element by the Principle of Minimum Potential Energy, Properties of Stiffness Matrix, Characteristics of Shape Functions, Quadratic shape functions. Analysis of Trusses: Derivation of Stiffness Matrix for Trusses, Stress and strain

Calculations, Calculation of reaction forces and displacements. Analysis of Beams: Derivation of Stiffness matrix for two noded, two degrees of freedom per node beam element, Load Vector, Deflection, Stresses, Shear force and Bending moment, Problems on uniform and stepped beams for different types of loads applied on beams.

MODULE -II: Bending of Plates and Shells (10)

Finite element – formulation of 2D Problems: Derivation of Element stiffness matrix for two-dimensional CST Element, Derivation of shape functions for CST Element, Elasticity Equations, constitutive matrix formulation, Formulation of Gradient matrix. Two dimensional Isoparametric Elements and Numerical integration. Finite element: formulation of 3D problems: Derivation of Element stiffness matrix for Tetrahedron Element, Properties of Shape functions for 3D Tetrahedral Element, Stress-Strain Analysis for 3D Element, Strain Displacement for Relationship Formulation.

MODULE -III: Steady State Heat Transfer Analysis (09)

Steady state heat transfer analysis: One Dimensional Finite Element analysis of fin and composite slabs. Two-dimensional steady state heat transfer problems: Derivation of Thermal Stiffness matrix for 2D heat transfer problems-CST, Derivation of thermal force vector for 2D heat transfer problems.

Dynamic Analysis: Formulation of mass matrices for uniform bar and beam Elements using lumped and consistent mass methods, Evaluation of Eigen values and Eigen vectors for a stepped bar and beam Problems.

MODULE -IV: Plate Bending (10)

Plate Bending: Introduction, Plate behavior, C1 (Kirchoff) Plate elements, C0 (Mindlin) Plate elements, Mindlin beam, More devices for C0 Plate elements, Boundary conditions, Analytical problems Nonlinear finite element of solids: Material Nonlinearities, objective rates, nonlinear elasticity, Plasticity, visco-plasticity, viscoelasticity.

MODULE -V: Boundary Element Method (09)

Boundary Element Method: Potential Problems: Introduction, boundary Element Approach Fundamental solution. Numerical Implementation, Determination of Ci, Final Relation, three-dimensional analysis, tackling kernel singularity. Boundary Element Formulation for Electrostatic Problems: Introduction, Basic Relation Boundary condition, other relations. Discretization and Matrix Formulation, Determination of term C(p)m.

V. TEXT BOOKS:

1. Robert D. Cook, David S. Malkus, Michael E. Plesha, Robert J. Witt, "Concepts and Applications of Finite Element Analysis", John Wiley & Sons, Incl., 4th edition, 2017.
2. O. C. Zienkiewicz, R. L. Taylor, J. Z. Zhu, "Finite Element Method: Its Basic and fundamentals", Butterworth Heinemann, 6th edition, 2018.

VI. REFERENCE BOOKS:

1. K. J. Bathe, "Finite Element Procedures", Prentice Hall, 3rd edition, 2018.
2. S. S. Rao, "Finite element method in Engineering", Butterworth Heinemann, 12th edition, 2018.
3. J. N. Reddy, "An introduction to nonlinear finite element analysis", Oxford University Press, 4th edition, 2018.

VII. ELECTRONICS RESOURCES:

1. http:// nptel.ac.in/courses/112/106/112106130/

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. PowerPoint presentation

COURSE CONTENT

COMPUTER INTEGRATED MANUFACTURING								
II Semester: **CAD / CAM**								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BCCD14	**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**		
Pre requisites: **CAD/CAM**								

I. COURSE OVERVIEW:

Computer Integrated Manufacturing is a course primary important to mechanical engineering students. The aim is to impart the overview of computer applications or manufacturing the engine components, assemblies and final product to meet the global competition. This course also deals with creation of synthetic curves and surfaces. It makes the student to understand the modern inspection methods and concepts of CIM.

II. COURSE OBJECTIVES:

The students will try to learn

I. The basic components and functions of CIM and NC systems in manufacturing
II. The requirement of data base management, Software & Hardware interface for CAD / CAM / CIM.
III. The different process layouts, material handling and advances in manufacturing system like: GT and CAPP their applications in industries
IV. The importance of computer aided in quality control and inspection methods.

III. COURSE OUTCOMES:

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

CO1	Demonstrate the importance of CIM and NC motion control systems.
CO2	Understanding the requirement of CIM Software & Hardware to integrate with required data base management systems
CO3	Explain the integration of activities into a complete flexible manufacturing system.
CO4	Apply the Parts coding and classification systems to implement the GT and JIT processes
CO5	Apply the advanced CAQC techniques for monitoring and control the processes
CO6	Apply the quality measuring techniques for inspection of manufactured products for industrial applications.

IV. COURSE CONTENT:

MODULE -I: Introduction to CIM (09)

Manufacturing - Types, Manufacturing Systems, CIM Definition, CIM wheel, CIM components, Evolution of CIM, needs of CIM, Benefits of CIM, basic components of NC system, NC motion control system, applications of NC, advantages and disadvantages of NC, computer Numerical control, advantages of CNC, functions of CNC, Direct Numerical Control, components of a DNC system, functions of DNC, advantages of DNC.

MODULE -II: Computer Aided Design (10)

Development of computers, CIM Hardware & Software, Data-Manufacturing data, types, sources,

Structure of data models, Data base and DBMS requirement, RDBMS, SQL, Computer Aided Design - benefits, Graphic Standards, Interfaces, CAD software, Integration of CAD/CAM/CIM.

MODULE -III: FLEXIBLE MANUFACTURING SYSTEMS (09)

FMS concept, Components of FMS, FMS Layouts, FMS planning and implementation, Tool Management systems-Tool monitoring.

Work holding devices, Modular fixturing, flexible fixturing, flexibility, quantitative analysis of flexibility, application and benefits of FMS, automated material handling system AGVs, Guidance methods, AS/RS.

MODULE -IV: Automated Process Planning (10)

Group Technology, Part families, Part classification and coding, Production flow analysis, Machine cell design, Applications and Benefits of Group Technology, Structure of a Process Planning, Process Planning function, CAPP - Methods of CAPP, CAD based Process Planning, Inventory management, Materials requirements planning - basics of JIT.

MODULE -V: Monitoring and Quality Control (10)

Types of production monitoring system, process control & strategies, direct digital control - Supervisory computer control, computer aided quality control, objectives of CAQC, QC and CIM, contact, non-contact inspection methods, CMM and Flexible Inspection systems. Integration of CAQC with CIM.

V. TEXT BOOKS:

1. S. Kant Vajpayee, "Principles of Computer Integrated Manufacturing", Prentice Hall of India, 1st edition, 2018.
2. P. Radhakrishnan, S. Subramanyan, "CAD/CAM/CIM", New Age International publishers, 4th edition, 2019.

VI. REFERENCE BOOKS:

1. A. W. Scheer, "CIM- Towards the Factory of the Future", Springer -Verlag, 1st edition, 2019.
2. V. Daniel Hunt, "Computer Integrated Manufacturing Hand Book", Chapman & Hall, 1st edition, 2019.

VII. ELECTRONICS RESOURCES:

1. http:// nptel.ac.in/courses/112/104/112104289/

VIII. MATERIALS ONLINE:

1. Course template
2. Tutorial question bank
3. Assignments
4. Model question paper – I
5. Model question paper – II

COURSE CONTENT

COMPUTER AIDED PROCESS PLANNING									
II Semester: **CAD / CAM**									
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**			
BCCD15	**Elective**	L	T	P	C	CIA	SEE	Total	
		3	-	-	3	40	60	100	
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Ni**				**Total Classes: 48**			
Pre requisites: Production Planning and Control									

I. COURSE OVERVIEW:

Computer-aided process planning (CAPP) is the use of computer technology to aid in the process planning of a part or product, in manufacturing. CAPP is the link between CAD and CAM in that it provides for the planning of the process to be used in producing a designed part.

II. COURSE OBJECTIVES:

The students will try to learn:

I. The fundamentals of computer aided process planning, group technology and applications.
II. The importance of design, tolerances and geometric transformation for modern manufacturing.
III. The implementation of process engineering and computer aided process planning.
IV. The integration of process planning activities into a complete system.

III. COURSE OUTCOMES:

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

CO1 Recall fundamentals of Computer Aided Process Planning, group technology and applications
CO2 Illustrate the importance of design and manufacturing geometric tolerances for selection of machining parameters
CO3 Summarize the variant and generative process planning approaches in decision making
CO4 Explain the different process planning techniques in multi-product manufacturing systems
CO5 Identify the requirements of integrated process planning systems, process planning and report generation
CO6 Apply the integrated manufacturing for expert process planning in automated industry.

IV. COURSE CONTENT:

MODULE -I: Introduction to Capp (09)

The Place of Process Planning in the Manufacturing Cycle-Process planning and production Planning-Process planning and Concurrent Engineering, CAPP, Group Technology.

MODULE -II: Part Design Representation (09)

Part Design Representation: Design Drafting-Dimensioning-Conventional Tolerance, Geometric Tolerance, CAD-input/output, devices-Topology, Geometric Transformation-Perspective Transformation-Data Structure, Geometric modelling for process planning, GT Coding, The OPITZ system, The MICLASS System.

MODULE -III: Process Engineering and Process Planning (10)
Process Engineering and Process Planning: Experience based planning-Decision table and Decision Trees-Process capability analysis.

Process Planning-Variant process planning-Generative Approach-Forward and backward planning, Input format, AI.

MODULE -IV: Computer Aided Process Planning Systems (10)
Computer Aided Process Planning Systems: Logical Design of process planning- Implementation Considerations - Manufacturing system components, Production Volume, No. of production families - CAM-I, CAPP, MIPLAN, APPAS, AUTOPLAN and PRO, CPPP.

MODULE -V: An Integrated Process Planning Systems (10)
Totally integrated processs planning systems-An Overview-Modulus Structure-Data Structure-Operation-Report Generation, Expert process planning.

V. TEXT BOOKS:

1. Gideon Halevi, Roland D. Weill, "Principle of process planning- A Logical Approach", Chapman & Hall, 1st edition, 2019.
2. T. C. Chang, Richard A. Wysk, "An Introduction to automated process planning systems", Prentice Hall, 1st edition, 2018.

VI. REFERENCE BOOKS:

1. T. C. Chang, "An Expert Process Planning System", Prentice Hall, 1st edition, 2018.
2. Nanua Singh, "Systems Approach to Computer Integrated Design and Manufacturing", John Wiley & Sons, 1st edition, 2016.
3. P. N. Rao, "Computer Aided Manufacturing", Tata McGraw Hill, 1st edition, 2017.

VII. ELECTRONICS RESOURCES:

1. http:// onlinecourses.nptel.ac.in/noc22_me10/preview

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. PowerPoint presentation

COURSE CONTENT

MECHATRONICS APPLICATIONS IN MANUFACTURING								
II Semester: **CAD / CAM**								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BCCC16	**Elective**	L	T	P	C	CIA	SEE	Total
		3	-	-	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Ni**				**Total Classes: 48**		
Pre requisites: Mechatronics								

I. COURSE OVERVIEW:

Concurrent engineering course is a systematic approach to the integrated, concurrent design of products and their related processes, including manufacture and support. This approach is intended to cause the developers from the outset, to consider all elements of the product life cycle from conception to disposal, including quality, cost, schedule, and user requirements.

II. COURSE OBJECTIVES:

The students will try to learn:

I. The mechatronics system design and characteristics of sensors and actuators and their selection for mechatronic systems.
II. The basic concepts of microprocessor, microcontroller and PLC used in mechatronics system.
III. The underlying concepts of MEMS and its applications in micro-manufacturing.

III. COURSE OUTCOMES:

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

CO1 Understand the interface sensor and actuator for a mechatronic system.
CO2 Indigenously design and develop a mechatronic system.
CO3 Design and develop MEMS for various industrial applications.
CO4 Analyze the role of control, modelling and stability of mechatronics system.
CO5 Explain the various case studies of mechatronics system like automated manufacturing systems pick and place robot, Automatic parking system.
CO6 Apply the design solutions for case studies of mechatronics systems.

IV. COURSE CONTENT:

MODULE -I: INTRODUCTION TO MECHATRONICS (10)

Introduction to Mechatronics - Systems - Mechatronics in Products - Measurement Systems - Control Systems - Traditional design and Mechatronics Design.

MODULE -II: SENSORS AND TRANSDUCERS (10)

Introduction - Performance Terminology - Displacement, Position and Proximity - Velocity and Motion -Fluid pressure - Temperature sensors - Light sensors - Selection of sensors – Signal processing - Servo
Systems

MODULE -III: MICROPROCESSORS IN MECHATRONICS (09)

Introduction - Architecture - Pin configuration - Instruction set - Programming of Microprocessors using 8085 instructions - Interfacing input and output devices - Interfacing D/A converters and A/D converters.

Applications, Temperature control - Stepper motor control - Traffic light controller.

MODULE -IV PROGRAMMABLE LOGIC CONTROLLERS (10)
Introduction - Basic structure - Input / Output processing - Programming -Mnemonics Timers, Internal relays and counters - Data handling - Analog input / output - Selection of PLC.

MODULE -V: DESIGN AND MECHATRONICS (09)
Designing - Possible design solutions - Case studies of Mechatronics systems.

V. TEXT BOOKS:

1. Michael B.Histand and David G. Alciatore, "Introduction to Mechatronics and Measurement Systems", McGraw-Hill International Editions, 1st edition, 2019.
2. Bradley, D.A., Dawson, D, Buru, N.C. and Loader, AJ, "Mechatronics ", Chapman and Hall, 1st edition, 2020.
3. Ramesh.S, Gaonkar, "Microprocessor Architecture, Programming and Applications" Wiley Eastern, 1st edition, 2020.

VI. REFERENCE BOOKS:

1. Lawrence J.Kamm, "Understanding Electro-Mechanical Engineering, An Introduction to Mechatronics ", Prentice-Hall, 1st edition, 2019.
2. Ghosh, P.K. and Sridhar, P.R., 0000 to 8085, "Introduction to Microprocessors for Engineers and Scientists ", Second Edition, Prentice Hall, 1st edition, 2020.

VII. ELECTRONICS RESOURCES:

1. https://www.cet.edu.in/noticefiles/259_Lecturer%20Note%20on%20Mechatronics-ilovepdf

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. PowerPoint presentation
8. E-Learning Readiness Videos (ELRV)

COURSE CONTENT

TRIBOLOGY								
II Semester: CAD / CAM								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BCCD17	**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**		
Pre requisites: Engineering Tribology								

I. COURSE OVERVIEW:

Design of surfaces in contact is a critical problem for mechanical engineering. This course addresses the design of tribological systems: the interfaces between two or more bodies in relative motion. Fundamental topics include: friction, wear, wear mechanism, wear model, hydrodynamic, hydrostatic and lubrication. It also covers the corrosion, prevention of corrosion and various types of engineering materials.

II. COURSE OBJECTIVES:

The students will try to learn:

I. The basic knowledge about different methods of friction, surface interaction and surface treatment
II. The principles of lubrication, lubrication regimes, theories of hydrodynamic and the advanced lubrication techniques.
III. The principles of Corrosion, factors affecting and prevention of corrosion.
IV. The in - depth knowledge of various engineering materials.

III. COURSE OUTCOMES:

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

CO1 Recall importance of Tribological phenomenon
CO2 Explain the application of Lubricants as per the requirements.
CO3 Identify different areas of Industrial Tribology.
CO4 Explain the friction, different laws of friction and topology of surfaces.
CO5 Illustrate wear processes, wear theory, behavior of metals and different instruments.
CO6 Outline the properties of lubricants, and their different types like solid, dry and gas lubrication

IV. COURSE CONTENT:

MODULE -I: Surface Interaction and Friction (09)

Topography of Surfaces, Surface features, properties and measurement, surface interaction, adhesive theory of sliding friction, rolling friction, friction properties of metallic and non-metallic materials, friction in extreme conditions, thermal considerations in sliding contact.

MODULE -II: Wear and Surface Treatment (09)

Process of wear, mechanism of various types of wear, laws of wear, theoretical wear models, wear of metals and non-metals, surface treatments, surface modifications, surface coatings methods, surface topography measurements, laser methods, instrumentation, international standards in friction and wear measurements.

MODULE -III: Lubricants and Lubrication Regimes (10)

Lubricants and their physical properties, viscosity and other properties of oils, additives and selection of lubricants, lubricants standards ISO, SAE, AGMA, BIS standards.

Lubrication regimes, solid lubrication, dry and marginally lubricated contacts, boundary lubrication hydrodynamic lubrication, elasto and plasto hydrodynamic, magneto hydrodynamic lubrication, hydro static lubrication, gas lubrication.

MODULE -IV: Corrosion (10)
Introduction, principle of corrosion, classification of corrosion, types of corrosion, factors influencing corrosion, testing of corrosion, in-service monitoring, simulated service, laboratory testing, evaluation of corrosion, prevention of corrosion, material selection, alteration of environment, design, cathodic and anodic protection, corrosion inhibitors.

MODULE -V: Engineering Materials (10)
Introduction, advanced alloys, super alloys, titanium alloys, magnesium alloys, aluminium alloys, and nickel-based alloys, ceramics, polymers, biomaterials, applications, bio-tribology and nano-tribology.

V. TEXT BOOKS:

1. G.W.Stachowiak, A.W.Batchelor, "Engineering Tribology", Butterworth-Heinemann, UK, 2nd edition, 2018.
2. E. Rabinowicz, "Friction and Wear of materials", John Willey &Sons, UK, 1st edition, 2018.

VI. REFERENCE BOOKS:

1. S. K. Basu, S. N.Sengupta, and B.B.Ahuja ,"Fundamentals of Tribology", Prentice –Hall of India, New Delhi, 1st edition, 2019.
2. J. A. Williams, "Engineering Tribology", Oxford Univ. Press, 1st edition, 2018.

VII. ELECTRONICS RESOURCES:

1. http:// /nptel.ac.in/courses/112/102/112102015/

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. PowerPoint presentation

COURSE CONTENT

MACHINE TOOL DESIGN								
II Semester: CAD / CAM								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BCCD18	**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**		
Pre requisites: Machine Tools and Metrology								

I. COURSE OVERVIEW:

An integrated study of machining/fabrication practices with machine tool design which comprises the analysis, planning, design, construction and application of tools, methods, and procedures necessary to increase manufacturing productivity.

II. OBJECTIVES:

The students will try to learn:

I. The tool design process when design the tooling for manufacturing of a product.
II. The basic principles in the design for strength of various machine parts.
III. The design of different types of bearings and effects of vibrations on machine tools.
IV. The programming of tool path generation and adaptive control for various machining process.

III. COURSE OUTCOMES:

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

CO1 Recall kinematic structures of different types of machines
CO2 Illustrate effect of vibrations on machine tool
CO3 Explain NC programming on CAD/CAM systems
CO4 Develop a solution-oriented approach by in depth knowledge of Machine Tool
CO5 Explain strength of various machine parts and observance of machine tools
CO6 Analyzes various types of bearings subjected to bending and torsion

IV. COURSE CONTENT:

MODULE -I: Kinematics of Machine Tools (09)

Shaping of geometrical and real surfaces, Developing and designing of kinematic schemes of machine tools, kinematics structures of lathe, drilling, milling, grinding, gear shaping and gear hobbing machines. Kinematic design of speed and feed boxes. Productivity loss. Stepped and stepless regulation, clutched drive

MODULE -II: Strengths And rigidity 0f Machine Tool Structures (10)

Basic principles of design for strength. Different types of structures. Overall compliance of machine tools. Design of beds, bases, columns, tables, cross rail for various machines. Various types of guide ways, their relative advantages. Materials for machine tool components including plastic guide way (PTFE).

MODULE -III: Analysis of Spindles, Bearings, And Power Screws (10)

Design of spindles subjected to combined bending and torsion. Layout of bearings. Pre-loading. Anti-

friction slide ways. Rolling contact hydrodynamic, hydrostatic. Hydrodynamic design of Journal bearings, Magneto bearings.

Machine Tool Vibrations**:** Effect of vibrations on machine tool. Free and Forced vibrations. Machine tool chatter

MODULE -IV: Computer- Aided Programming (10)
General information, APT programming, Examples APT programming problems (2D machining only). NC programming on CAD/CAM systems, the design and implementation of post processors introduction to CAD/CAM software, automatic Tool Path generation.

MODULE -V: Tooling for CNC Machines (09)
Interchangeable tooling system, present and qualifies tools, coolant fed tooling system, modular fixturing, quick change tooling system, automatic head changers. DNC Systems and Adaptive Control; Introduction, type of DNC systems, advantages arid disadvantages of DNC, adaptive control with optimization, Adaptive control with constrains, Adaptive control of machining processes like turning, grinding.

V. TEXT BOOKS:

1. N.K. Mehta, "Machine Tool Design and Numerical Control", Tata McGraw Hill, 3rd edition, 2013.
2. G.C. Sen, and Battacharya, "Principles of Machine Tools", Central book publishers, 2nd edition, 2013.

VI. REFERENCE BOOKS:

1. S. K. Basu, "Principles of Machine Tool Design", Oxford & IBH Publishing, 6th edition, 2013.
2. Yoramkoren, "Computer Control of Manufacturing Systems", Tata McGraw Hill, 1st edition, 2013.

VII. ELECTRONICS RESOURCES:

1. http:// /nptel.ac.in/courses/112/105/112105233/

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. PowerPoint presentation

COURSE CONTENT

INDUSTRIAL ROBOTICS								
II Semester: **CAD / CAM**								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BCCD19	**Elective**	L	T	P	C	CIA	SEE	Total
		3	-	-	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes:**				**Total Classes: 48**		
Pre requisites: Robotics								

I. COURSE OVERVIEW:

Robotics is to familiarize the students with the concepts and techniques in robotic engineering, manipulator kinematics, dynamics and control, chose, and incorporate robotic technology in engineering systems.

II. COURSE OBJECTIVES:

The students will try to learn:

I. The basics of robot anatomy position, representation and motions control of robot manipulators.
II. The functions of end effectors and various types of grippers used in Industrial Robotics for automation
III. The knowledge and skill on robot programming languages for different robotic tasks.
IV. The robot cell design, and future application of robotics in Industry.

III.COURSE OUTCOMES:

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

CO1 Recall various robot components and their workspace.
CO2 Identify various components of robot and select appropriate type of actuator for a joint.
CO3 Illustrate different sensors, functions of vision systems, and their applications
CO4 Illustrate the basic concepts associated with the components and sensors of Robots
CO5 Analyze the forward kinematics, inverse kinematics and Jacobian for serial and parallel robots.
CO6 Identify different types of end effectors and grippers required for specific applications.

IV. COURSE CONTENT:

MODULE -I: Introduction to Automation and Robotics (09)
Introduction: Automation and Robotics, Robot anatomy configuration, motions joint motion and rotation, work volume, robot drive system, control system and dynamic performance, precision of movement. Control System and Components: basic concept and modals controllers control system analysis, robot actuators and feedback components (sensors): Internal & External Sensors, Positions sensors, velocity sensors - Desirable features, tactile, proximity and range sensors, uses sensors in robotics, Power Transmission Systems.

MODULE -II: Motion Analysis and Control (10)
Motion Analysis and Control: Manipulator kinematics, position representation, Homogeneous transformation, D-H Notation, D-H Transformation Matrix, Forward & Inverse transformations, problems on planar & spatial manipulators, Differential Kinematics, Jacobian Formulation, problems, manipulator

path control: Slew, Joint Interpolated & Straight-line motions, trajectory planning: Joint space scheme, Cartesian space scheme, Cubic Polynomial fit without and with via point, blending.

MODULE -III: Robot Dynamics (10)

Lagrange – Euler & Newton - Euler formulations, problems on two link planar manipulators, configuration of robot controller. End Effectors: Grippers-types, operation, mechanism, force analysis, tools as end effectors consideration in gripper selection and design.

Machine Vision: Functions, Sensing and Digitizing-imaging, Devices, Lighting techniques, Analog to digital single conversion, Image storage, Image processing and Analysis-image data reduction, Segmentation feature extraction. Object recognition, training the vision system, Robotics application.

MODULE -IV: Robot Programming (10)

Lead through programming, Robot programming as a path in space, Motion interpolation, WAIT, SINGNAL AND DELAY commands, Branching capabilities and Limitations. Robot Languages: Textual robot languages, Generation, Robot language structures, Elements and functions.

MODULE -V: Robot Cell Design and Control (09)

Robot cell layouts-Robot centered cell, In-line robot cell, Considerations in work cell design, Work cell control, Inter locks, Error detection, Work cell controller. Robot Applications: Material transfer, Machine loading/unloading. Processing operations, Assembly and Inspection, Future Applications.

V. TEXT BOOKS:

1. M. P. Groover, "Industrial Robotics", Pearson, 2nd edition, 2018.
2. J.J Criag, "Introduction to Robotic Mechanics and Control", Pearson, 3rd edition, 2013.

VI. REFERENCE BOOKS:

1. K.S Fu, "Robotics", McGraw Hill, 1st edition, 2017.
2. Richard, D. Klafter,Thomas A Chmielewski, and Miachael Neigen, "Robotic Engineering An Integrated Approach", Prentice Hall, 1st edition, 2019.
3. Asada, Slotine, "Robot Analysis and intelligence", Wiley, 1st edition, 2018.
4. Mark W. Spong, M. Vidyasagar, I. John, "Robot Dynamics & Control", John Wiley & Sons, 1st edition, 2016.
5. R. K. Mittal, I. J. Nagrath, "Robotics and Control", Tata McGraw Hill, 1st edition, 2018.

VII. WEB REFERENCES:

1. http:// nptel.ac.in/courses/112/105/112105249/

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. PowerPoint presentation

COURSE CONTENT

MICROPROCESSOR IN AUTOMATION									
II Semester: **CAD / CAM**									
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**			
BCCD20	**Elective**	L	T	P	C	CIA	SEE	Total	
		3	-	-	3	40	60	100	
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes:**				**Total Classes: 48**			
Pre requisites:									

I. COURSE OVERVIEW:

Microprocessor in Automation is an interdisciplinary course that combines principles from mechanics, electronics, computer engineering, robotics and automatic control. The engineers design, develop and test a broad range of automated machines from industrial systems, artificial intelligence and medical equipment, to consumer products. Since their field involves such broad knowledge of engineering, these professionals are often general engineers, rather than having a particular specialization.

II. COURSE OBJECTIVES:

The students will try to learn:

I. The principles of gates, flip -flops, counters and registers and their uses in microprocessors.
II. The concepts and functional block diagram of 8085 microprocessor with Assembly language programs
III. The different types of interfacing peripherals used in various types of microprocessors.
IV. The implementation of signal conversion and digital algorithm.

III. COURSE OUTCOMES:

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

CO1	Remember the basics of Microprocessors
CO2	Explain the internal organization and operation of microprocessors.
CO3	Apply concepts of microprocessor for development of real-world problems
CO4	Outline basic concepts associated with the Number systems, and digital electronics in Microprocessors
CO5	Explain 8085 Microprocessors, architectures and its features.
CO6	Illustrate fundamentals of simple assembly language programming in 8085 microprocessors

IV. COURSE CONTENT:

MODULE -I: Introduction to Number Systems (09)

Introduction to Number Systems, codes, digital electronics: Logic Gates, combinational circuits design, Flip-flops, Sequential logic circuits design: Counters, Shift registers.

MODULE -II: Microprocessors (10)

Introduction to 8085 Functional Block Diagram, Registers, ALU, Bus systems, Timing and control

signals, Machine cycles, instruction cycle and timing states, instruction timing diagrams, Memory interfacing.

MODULE -III: Assembly Language Programming (09)
Addressing modes, Instruction set, simple programs in 8085; Concept of Interrupt, Need for

Interrupts, Interrupt structure. Multiple Interrupt requests and their handling, Programmable interrupt controller

MODULE -IV: Interfacing Peripherals (10)
Interfacing peripherals: Programmable peripheral interface (8255), Interfacing Analog to Digital Converter & Digital to Analog converter, Multiplexed seven segments LED display systems, Stepper Motor Control, Data Communication: Serial Data communication (8251), Programmable Timers (8253); 8086/8088 Microprocessor and its advanced features.

MODULE -V: Digital Control (10)
Introduction to Digital Control: Sampling theorem, Signal conversion and Processing, Z Transform, Digital Filters, Implementation of Digital Algorithm.

V. TEXT BOOKS:

1. Albert Pual Malvino, "Digital Computer Electronics: An Introduction to Microcomputers", Tata McGraw-Hill Publishing Company Ltd, 1st edition, 2018,
2. William H. Gothmann, "Digital Electronics: An Introduction to Theory and Practice", PHI Learning Private Limited, 1st edition, 2018.
3. Ramesh Gaonkar, "Microprocessor Architecture, Programming, and Applications with the 8085:Penram International Publishers. 6th edition, 2019
4. Benjamin C. Kuo, Digital Control Systems, Oxford University Press, 2nd edition, 2018.

VI. REFERENCE BOOKS:

1. S. J. Cahill, "Digital and Microprocessor Engineering", Wllis Horwood Limited, John Wiley & Sons, 1st edition, 2013.
2. Hall V. Douglas, "Microprocessors and Interfacing: Programming and Hardware", Tata McGraw Hill, 1st edition, 2016.
3. Lance A. Leventhal, "Microcomputer Experimentation with the Intel SDK-85", PHI 2nd edition, 2013.

VII. ELECTRONICS RESOURCES:

1. http://nptel.ac.in/courses/108/105/108105102/

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. PowerPoint presentation

COURSE CONTENT

INTELLIGENT MANUFACTURING SYSTEMS								
II Semester: CAD / CAM								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BCCD21	**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**		
Pre requisites: Automation in manufacturing								

I. COURSE OVERVIEW:

This course will provide students with artificial intelligence (AI) techniques and its application in manufacturing systems. Intelligent Manufacturing System provides a modern manufacturing system with integration of machines, processes, artificial intelligence which integrates the abilities of humans. Manufacturing system refers to the entire process of gathering inputs, arranging, and transforming them into the desired output. It seeks to achieve optimal utilization of manufacturing resources, minimize wastage, and add value to the business.

II. COURSE OBJECTIVES:

The students will try to learn:

I. The statistics and optimization methodologies in intelligent manufacturing systems.
II. The importance of Knowledge based system and Knowledge Acquisition
III. The importance of intelligence in manufacturing systems, so as to apply the artificial intelligence in the application of manufacturing
IV. The modern techniques such as APP and GT used in manufacturing systems

III. COURSE OUTCOMES:

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

CO1	Outline the systematic approach for design and implementation of manufacturing systems
CO2	Explain the Components of Knowledge Based Systems and Knowledge representation for Equipment Selection.
CO3	Apply Artificial intelligence (AI) and Machine Learning techniques to solve the real problems in shop-floor level or capacity planning problems.
CO4	Make use of various Automated Process Planning approach for problem solving
CO5	Develop various algorithms to cluster products based on group technology concepts

IV. COURSE CONTENT:

MODULE-I: Computer Integrated Manufacturing Systems (09)

Computer Integrated Manufacturing Systems Structure and functional areas of CIM system, - CAD, CAPP, CAM, CAQC, ASRS. Advantages of CIM. Manufacturing Communication Systems - MAP/TOP, OSI Model, Data Redundancy, Top- down and Bottom-up Approach, Volume of Information. Intelligent Manufacturing System Components, System Architecture and Data Flow, System Operation.

MODULE-II: Knowledge Based Systems in Manufacturing (10)
Basic Components of Knowledge Based Systems, Knowledge Representation, Comparison of Knowledge Representation Schemes, Interference Engine, Knowledge Acquisition.

MODULE-III: Machine Learning and AI (10)
Machine Learning - Concept of Artificial Intelligence, Conceptual Learning. Artificial Neural Networks - Biological Neuron.

Artificial Neuron, Types of Neural Networks, Applications in Manufacturing.

MODULE-IV: Automated Process Planning (09)
Automated Process Planning - Variant Approach, Generative Approach, Expert Systems for Process Planning, Feature Recognition, Phases of Process planning. Knowledge Based System for Equipment Selection (KBSES) - Manufacturing system design. Equipment Selection Problem, Modeling the Manufacturing Equipment Selection Problem, Problem Solving approach in KBSES, Structure of the KRSES.

MODULE-V: Group Technology (10)
Group Technology: Models and Algorithms Visual Method, Coding Method, Cluster Analysis Method, Matrix Formation - Similarity Coefficient Method, Sorting-based Algorithms, Bond Energy Algorithm, Cost Based method, Cluster Identification Method, Extended CI Method. Knowledge Based Group Technology - Group Technology in Automated Manufacturing System. Structure of Knowledge based system for group technology (KBSCIT) — Data Base, Knowledge Base, Clustering Algorithm.

V. TEXT BOOK:

1. Andrew Kusiak, "Intelligent Manufacturing Systems", Prentice Hall, 1st edition, 2013.
2. Yagna Narayana, "Artificial Neural Networks", PHI, 1st edition, 2004.
3. Groover M.P, "Automation, Production Systems and CIM", PHI, 4th edition, 2013.

VI. REFERENCE BOOK:

1. Li Min Fu, "Neural networks in Computer intelligence", TMH, 1st edition, 2013.
2. Jacek M. Zurada, "Introduction to Artificial Neural Systems", Jaico Publishing House, 1st edition, 2013.

VII. ELECTRONICS RESOURCES:

1. https://nptel.ac.in/courses/110/106/110106044/

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. PowerPoint presentation

COURSE CONTENT

COMPUTER GRAPHICS								
II Semester: CAD / CAM								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BCCD22	**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**		
Pre requisites: CAD/CAM								

I. COURSE OVERVIEW:

One of the best ways to communicate one's idea is through some form of picture or drawing. Computer graphics is the accurate technique that develops the ability to visualize any object with all physical and dimensional configurations. The computer aided drawing assists in preparation of 2D and 3D drawings to carry out sophisticated design and analysis.

II. COURSE OBJECTIVES:

The students will try to learn

I. The role and basics of Computer Graphics needed for CAD/CAM applications.
II. The geometric entities, projections development of curves and surfaces of Geometrical Modeling.
III. The geometric modeling techniques used in CAD such as wireframe, solid modeling.
IV. The product data standards and structures in computer graphics.

III. COURSE OUTCOMES:

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

CO1 Relate the role of graphic communication in the engineering design process.
CO2 Explain the concepts and underlying theory of modeling and the usage of models in different engineering applications
CO3 Develop geometric models in various industrial applications
CO4 Outline basic concept of image visualization on computer screen.
CO5 Identify the 2D and 3D transformations and various projections in CAD for synthesis various products
CO6 Develop parametric and non – parametric equations for curves and surfaces

IV. COURSE CONTENT:

MODULE -I: Introduction to Computer Graphics (09)

Introduction: Role of computer graphics in CAD/CAM, configuration of graphic workstations, menu design and graphical user interfaces, customization and parametric programming.

MODULE -II: Geometric Transformations, Fundamentals of 2D and 3D Transformations (10)

Geometric transformations and projections: Vector representation of geometric entities, homogeneous coordinate systems; Fundamentals of 2D and 3D transformations: reflection, translation, rotation, scaling, and shearing, Various types of projections.

MODULE -III: Development of Geometrical Modelling (09)

Curves: Modeling planar and space curves, analytical and synthetic approaches, non-parametric and parametric equations.

Surfaces: Modeling of bi-parametric freedom surfaces, Coons, Bezier, B-spline, and NURBS surfaces, surface manipulation techniques.

MODULE -IV: Geometrical Modeling (10)
Geometric Modeling: Geometric modeling techniques, wireframe modeling, solid modeling: B Rep CSG, hybrid modelers, feature based, parametric and variation modeling.

MODULE -V: Data Structures in Computer Graphics (10)
Data Structure in Computer Graphics: Introduction to product data standards and data structures, data-base integration for CIM.

V. TEXT BOOKS:

1. D. F. Rogers, J. A. Adams, "Mathematical Elements for Computer Graphics", Tata McGraw Hill, 2nd edition, 2017.
2. D. Faux, M. J. Pratt, "Computational Geometry for Design and Manufacture", Ellis Horwood, 1st edition, 2013.
3. Mortenson, M. E., "Geometric Modeling", Industrial Press, 3rd edition, 2006.
4. Ibrahim Zeid, "CAD/CAM: Theory and Practice", Tata McGraw Hill, 2nd edition, 2013.
5. B. K. Choi, "Surface Modeling for CAD/CAM", John Wiley & Sons, 1st edition, 1991.

VI. REFERENCE BOOKS:

4. C. Pozrikidis, "Introduction to Theoretical and Computational Fluid Dynamics", Oxford University Press, 2nd edition, 2013.
5. V. Patankar, Hemashava Suhas, "Numerical Heat Transfer and Fluid Flow", CRC Press, 1st edition, 2013.

VII. ELECTRONICS RESOURCES:

1. http://nptel.ac.in/courses/106/103/106103224

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. PowerPoint presentation

COURSE CONTENT

COMPUTER AIDED MACHINING AND ROBOTICS LABORATORY								
II Semester: CAD / CAM								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BCCD23	**Core**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		0	0	4	2	40	60	100
Contact Classes: Nil	**Tutorial Classes: Nil**	**Practical Classes: 45**				**Total Classes: 45**		
Prerequisite: Automation in Manufacturing								

I. COURSE OVERVIEW:

This laboratory will provide the Automation program integrates design and manufacturing to promote the present industrial requirement. This program allows a compressive study in the advances in Computer Aided Manufacturing technologies, Automation and Robotics.

II. COURSE OBJECTIVES:

The students will try to learn:

1. The part programming data generation through CAM software.
2. The APT based NC part programs for turning and Milling operations.
3. The tool path simulation for turning and Milling operation using CAM software.
4. The programming language and simulation of robots for pick and place

III.COURSE OUTCOMES:

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

CO 1	Develop part programming and sequences of operation of CNC turning machines
CO 2	Design APT based NC programming and tool path simulation for Milling and turning operations,
CO 3	Generate NC code for profile Milling operations using CAM software.
CO 4	Develop NC code and tool path simulation for profile Milling and Threading operations using CAM software.
CO 5	Develop program for robotic operations to pick and place the objects

IV. COURSE CONTENT:

Week-1: Introduction to Computer Aided Machining
Planning and selection of sequences of operation, tool setting on machine-practice.

Week-2: Part Program-1
Practice in part programming and operation of CNC turning machines, sub routines and use of cycles.

Week-3: Part Program-2
Practice in part program and operation of a machine center, joining and selection of sequence of operation, tool setting on machine.

Week-4: Numerical Control Programming-1
Generate APT based NC programming and tool simulation for drilling operation.

Week-5: Numerical Control Programming-2
Practice in APT based NC programming and tool simulation for facing operation.

Week-6: Numerical Control Programming-3
Generate of NC code for profile milling operation using CAM software

Week-7: Numerical Control Programming-4
Tool path simulation for profile milling operation using CAM software.

Week-8: Numerical Control Programming-2
Practice in APT based NC programming and tool simulation for turning operation.

Week-9: Numerical Control Programming-2
Practice in APT based NC programming and tool simulation for knurling operation.

Week-10: Numerical Control Programming-2
Practice in APT based NC programming and tool simulation for milling operation.

Week-11: Numerical Control Programming-5
Develop NC code and tool path simulation for thread operation using CAM software

Week-12: Robotics Simulation-1
Practice of robotic languages

Week-13: Robotics Simulation-2
3-D Robot Simulation for operation of pick-place robot.

Week-14: Robotics Simulation-3
Path following operation for the robot.

V. TEXT BOOKS:

1. Farid Amirouche, "Principles of Computer-Aided Design and Manufacturing, Pearson, 2nd edition, 2018.
2. P. Radha Krishnan, "CAD/ CAM/ CIM", New Age International, 4th edition, 2018.
3. Warren. S. Seames, "Computer Numerical Control Concepts and Programming", Delmar Cengage Learning, 4th edition, 2019.

VI. WEB REFERENCES:

1. http://sbmpme.blogspot.in/2011/01/cad-cam-cim-p-radhakrishnan.html.
2. https://www.scribd.com/doc/228624725/cad-cam-text-book-by-P-N-RAO.

COURSE CONTENT

SIMULATION AND ANALYSIS LABORATORY								
II Semester: CAD / CAM								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BCCD24	**Core**	L	T	P	C	CIA	SEE	Total
		0	0	4	2	40	60	100
Contact Classes: Nil	**Tutorial Classes: Nil**	**Practical Classes: 45**				**Total Classes: 45**		
Prerequisite: Advanced CAD								

I. COURSE OVERVIEW:

The simulation and analysis laboratory sessions are focusing on creation of geometry, meshing (Discretization) and the physics applied to thermal systems in order to visualize fluid flow and temperature distribution, solving, and reviewing results. This laboratory also covers the usage of finite element methods and necessary coding techniques in the interpretation of results. The Workbench environment is an intuitive up-front numerical methods analysis tool that is used in conjunction with CAD systems and/or Design Modeler. These simulations are used in performing structural, thermal, and electromagnetic systems in the emerging technologies of interdisciplinary applications such as mechanical, aerospace.

II. COURSE OBJECTIVES:

The students will try to learn

I. The importance of software tools needed to Analyze engineering problems.
II. The basics of MATLAB and solve vibration mechanism simulation using multi body dynamic software
III. The fundamentals of ANSYS and perform different stress analysis.
IV. The conductive and convective heat transfer analysis of 2D component using ANSYS.

III. COURSE OUTCOMES:

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

CO 1 Solve the vibration Mechanism problems using multi body dynamic software
CO 2 Analyze the Stress developed in plates using ANSYS
CO 3 Identify the Stresses in plate with a circular hole, rectangular L bracket and different types of beams using Ansys
CO 4 Analyze the Stress of an Axi– symmetric components
CO 5 Solve the thermal stress analysis of various 2D components using ANSYS

IV. COURSE CONTENT:

Week-1: MATLAB BASICS: Part -1
MAT LAB basics, dealing with matrices, Graphing-functions of one variable and two variables

Week-2: MATLAB BASICS: Part -2
Use of MATLAB to solve simple problems in vibration Mechanism Simulation using multi body dynamic software.

Week-3: ANSYS BASICS: Part -1
Introduction to Ansys Basics and usage of basic operation

Week-4: ANSYS BASICS: Part -2
Generation Stress analysis of a plate with a circular hole.

Week-5: STRESS ANALYSIS: Part -1
Stress analysis of rectangular L bracket

Week-6: STRESS ANALYSIS: Part -2
Stress analysis of beams (Cantilever, simply supported & Fixed ends)

Week-7: AXI- SYMMETRIC STRESS ANALYSIS: Part -1
Stress analysis of an Axi-symmetric component

Week-8: THERMAL ANALYSIS
Thermal stress analysis of a 2D component

Week-9: HEAT TRANFER ANALYSIS: Part -1
Conductive heat transfer analysis of a 2D component

Week-10: HEAT TRANFER ANALYSIS: Part -2
Convective heat transfer analysis of a 2D component

Week-11: HEAT TRANFER ANALYSIS: Part -3
Radiation heat transfer analysis of a 2D component

Week-12: HEAT TRANFER ANALYSIS: Part -4
Free Convection heat transfer analysis of a 2D component

Week-13: HEAT TRANFER ANALYSIS: Part -5
Forced Convection heat transfer analysis of a 2D component

Week-14: HEAT TRANFER ANALYSIS: Part -6
Radiation heat transfer analysis of a 2D component

V. TEXT BOOKS:

1. W T Thomson, "Theory of Vibrations with Applications", CBS Publishers, Delhi, 3rd edition, 2020.
2. S. S. Rao, "Mechanical Vibrations" Addison-Wesley Publishing Co., 5th edition, 2018.
3. Ashok Kumar Mallik, "Principles of Vibration Control", Affiliated East- West Press, 1st edition, 2019.

VI. WEB REFERENCES:

1. https://trove.nla.gov.au/work/6919983
2. https://2k9meduettaxila.files.wordpress.com/2012/09/rao-mechanical-vibrations-5th-edition-2k9meduettaxila-wordpress-com.pdf

COURSE CONTENT

PERFORMANCE MODELING AND ANALYSIS OF MANUFACTURING SYSTEMS								
III Semester: CAD / CAM								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BCCD26	**Elective**	L	T	P	C	CIA	SEE	Total
		3	-	-	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes:**				**Total Classes: 48**		
Prerequisites: Special Manufacturing Process								

I. COURSE OVERVIEW:

Manufacturing processes converts raw material to finished product for customer usage. Performance of a product depends on its quality in terms of accuracy of size, shape and constraints/relation between its features. Conversion cost and time can be optimized by judicious usage of energy, motions, resources, time etc without affecting the quality desired by the customer. Objective of learning this subject is to make the automated manufacturing practices/methods being implemented at leading industries across the globe, which ultimately leads to more customer satisfaction in terms of low cast and high quality.

II. COURSE OBJECTIVES:

The students will try to learn:

I. The importance of automation in manufacturing.
II. The influences of various stochastic models to industry
III. The illustrations of Queuing models and Queuing networks in manufacturing systems.
IV. The definition of Petri Nets and various types of Petri Nets used in manufacturing systems.

III. COURSE OUTCOMES:

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

CO1	Recall the basics of Automated manufacturing systems
CO2	Identify a type of system based on type of its dynamics, ways of analyzing system
CO3	Summarize the Work in process, Machine utilization, Flexibility and Performability for industry configurations
CO4	Illustrate Automated Manufacturing and their influence on industries
CO5	Develop simulation model for dynamic discrete-event stochastic system
CO6	Analyze M/M/m Steady state analysis for queuing in manufacturing systems

IV.COURSE CONTENT:

MODULE -I: Manufacturing Systems and Control (10)

Automated Manufacturing Systems, Modeling, Role of performance modeling, simulation models, Analytical models. Product cycle, Manufacturing automation, Economics of scale and scope, input/output model, plant configurations; Performance measures, Manufacturing lead time, Work in process, Machine utilization, Throughput, Capacity, Flexibility, Performability, Quality Control Systems, Control system architecture, Factory communications, Local area network interconnections, Manufacturing automation protocol, Database management system.

MODULE -II: Manufacturing Processes (09)
Examples of stochastics processes, Poisson process, Discrete time Markov chain models, Definition and notation, Sojourn times in states, Examples of DTMCs in manufacturing, Chapman-Kolmogorov equation, Steady-state analysis. Continuous Time Markov Chain Models, Definitions and notation, Sojourn times in states, examples of CTMCs in manufacturing – Equations for CTMC evolution – Markov model of a transfer line. Birth and Death Processes in Manufacturing – Steady state analysis of BD Processes – Typical BD processes in manufacturing.

MODULE -III: Queuing Model (09)
Notation for queues, Examples of queues in manufacturing systems, Performance measures, Little's result. Steady state analysis of M/M/m queue.

Queues with general distributions and queues with breakdowns – Analysis of a flexible machine center.

MODULE -IV: Queuing Networks (10)
Examples of QN models in manufacturing, Little's law in queuing networks, Tandem queue, An open queuing network with feedback, An open central server model for FMS, Closed transfer line, Closed server model, Garden Newell network

MODULE -V: Petri Nets (10)
Classical Petri Nets, Definition, Transition firing and reachability, Representational power, properties, Manufacturing models. Stochastic Petri Nets, Exponential timed Petri Nets, Generalized Stochastic Petri Nets, modeling of KANBAN systems, Manufacturing models.

V. TEXT BOOKS:

1. N. Viswanadham, Y. Narahari, "Performance Modelling of Automated Manufacturing Systems", Prentice Hall of India, New Delhi, 1st edition, 2013.
2. K. S. Trivedi, "Probability and Statistics with Reliability, Queuing and Computer Science Applications", Wiley Publications, 2nd edition, 2013.

VI. REFERENCE BOOKS:

1. S, C. Gupta, V. K. Kapoor, "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, 3rd edition, 2013.

VII. ELECTRONICS RESOURCES:

1. http:// nptel.ac.in/courses/112/103/112103293/

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. PowerPoint presentation

COURSE CONTENT

FUZZY LOGIC AND NEURAL NETWORKS								
III Semester: CAD / CAM								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BCCD27	**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**		
Prerequisites: Internet of Things								

I. COURSE OVERVIEW:

This course will provide the sufficient background in both fuzzy and neural network so that students in future can pursue advanced soft computing methodologies. This course combines knowledge, techniques, and methodologies from various sources, using techniques from neural networks and fuzzy set theory, as an extension, the course uses the Neuro Fuzzy models for the complex engineering problems.

II. COURSE OBJECTIVES:

The students will try to learn:

I. The importance of Fuzzy Logic and adaptive Fuzzy system techniques in building intelligent machines.
II. The Artificial Neural Network & Fuzzy Logic models to handle uncertainty and solve engineering problems.
III. The effects of Signal Processing and Image Processing in fuzzy logic and neural networks.
IV. The Artificial Neural Network & Fuzzy Logic models to handle uncertainty and solve engineering problems.

III. COURSE OUTCOMES:

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

CO1	Recall the fundamentals of Fuzzy logic and ANN
CO2	Explain the applications of both Neural Networks and Fuzzy Logic in different fields
CO3	Apply various learning laws of Neural Networks
CO4	Illustrate the concept of fuzziness involved in various systems and fuzzy set theory
CO5	Apply the fuzzy logic control and adaptive fuzzy logic and to design the fuzzy control using genetic algorithm
CO6	Apply Artificial Neural Network techniques in building intelligent machines

IV. COURSE CONTENT:

MODULE -I: Fuzzy Set Theory and Fuzzy Logic Control (09)

Basic concepts of fuzzy sets- Operations on fuzzy sets Fuzzy relation equations- Fuzzy logic control- Fuzzification –Defuzzification- Knowledge base Decision making logic- Membership functions – R.

MODULE -II: Adaptive Fuzzy Systems (09)

Performance index- Modification of rule base0- Modification of membership functions- Simultaneous modification of rule base and membership functions- Genetic Algorithms Adaptive fuzzy system- Neuro fuzzy systems.

MODULE -III: Artificial Neural Networks (09)

Counter propagation –Self organization Map- Congnitron and Neocognitron.

Hopfield Net. Kohonnen Nets- Grossberg Nets- Art-I, Art-II reinforcement learning.

MODULE -IV: Mapping and Recurrent Networks (09)

Application of fuzzy logic and neural networks to Measurement- Control- Adaptive Neural Controllers – Signal Processing and Image Processing.

MODULE -V: Case Studies (09)

Case Studies: Application of fuzzy logic and neural networks to Measurement- Control- Adaptive Neural Controllers – Signal Processing and Image Processing potential of composites.

V. TEXT BOOKS:

1. Vallum B. R And Hayagriva V.R C++, Neural networks and Fuzzy logic, BPB Publications, New Delhi, 1st edition, 2018.
2. D. Dirankov, H. Hellendoorn, M. Reinfrank, "Introduction to Fuzzy control", Narosa Publications House, New Delhi, 1st edition, 2019.
3. J. M. Zurada, "Introduction to Artificial Neural systems", Jaico Publishing House, New Delhi, 1st edition, 2019.

VI. REFERENCE BOOKS:

1. Chennakesava R. Alavala, "Fuzzy logic &Neural Networks", New Age International, 1st edition, 2018.
2. W. T. Millon, R. S. Sutton, and P. J. Werbos , "Neural Networks for control", MIT Press, 1st edition, 2019.
3. G. J. Klir, and B. B. Yuan, "Fuzzy sets Fuzzy logic", Prentice Hall of India Pvt. Ltd., 1st edition, 2020.
4. Kosko, "Neural Networks and Fuzzy systems", Prentice Hall of India Pvt. Ltd., New Delhi, 1st edition, 2020.

VII. WEB REFERENCES:

1. http:///nptel.ac.in/courses/127/105/127105006/

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. PowerPoint presentation

COURSE CONTENT

DESIGN AND ANALYSIS OF EXPERIMENTS								
III Semester: **CAD / CAM**								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BCCD28	**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**		
Pre requisites: Optimization Techniques								

I. COURSE OVERVIEW:

This is a basic course in designing experiments and analyzing the resulting data. This course is about planning and conducting experiments and about analyzing the resulting data in a way that valid and objective conclusions can be obtained. Opportunities to use the principles taught in the course arise in all aspects of today's industrial and business environment.

II.COURSE OBJECTIVES:

The students will try to learn:

I. The principle and role of experimentation in rapid scientific progress
II. The comparison of experiments with two variances, two means and more than two means data with confidence.
III. The process of designing an experiment including factorial and fractional factorial designs
IV. The logic of RSM, Taguchi methods, and compare with more traditional techniques.

III. COURSE OUTCOMES:

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

CO1 Explain the principles and methods for designing experiments and analyzing experimental data
CO2 Apply concepts of probability & statistics for two or more means, variances and ANOVA
CO3 Apply experimental design theory for any factorial design and its corresponding analytical methods.
CO4 Make use of concepts of linear model, steepest ascent, second orders model, and regression for Response surface methodology
CO5 Analyze Taguchis parameter design for robustness, noise factor, objective function and S/N rations for Data interpretation
CO6 Apply the Taguchi's parameter design for concept of robustness.

IV. COURSE CONTENT:

MODULE -I: Fundamentals of Experimentation (09)

Role of experimentation in rapid scientific progress, historical perspective of experimental approaches, Steps in experimentation, principles of experimentation.

MODULE -II: Simple Comparative Experiments (10)

Simple comparative experiments: Basic concepts of probability & statistics, comparison of two means and two variances, comparison of multiple (more than two) means and ANOVA.

MODULE -III: Experimental Designs (10)

Experimental designs: Factorial designs, fractional factorial designs, orthogonal arrays, standard Orthogonal arrays and interaction tables.

Modifying orthogonal arrays, selection of suitable orthogonal array design, analysis of experimental data.

MODULE -IV: Response Surface Methodology (09)

Concept, linear model, steepest ascent, second orders model, regression.

MODULE -V: Taguchi's Parameter Design (10)

Taguchi's Parameter Design: Concept of robustness, noise factor, objective function & S/N ratios, inner array& outer array design, data analysis.

V. TEXT BOOK:

1. D.C. Montgomery, "Design and Analysis of Experiments", John Wiley & Sons, NY", 10th edition, 2019.

VI. REFERENEC BOOK:

1. P. J. Ross, "Taguchi techniques for Quality Engineering", Tata McGraw-Hill Book Company, NY, 2nd edition, 2013.

VII. ELECTRONICS RESOURCES:

1.http:// nptel.ac.in/courses/110/105/110105087/

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. PowerPoint presentation

COURSE CONTENT

FRACTURE MECHANICS								
III Semester: CAD / CAM								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BCCD29	**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**		
Pre requisites: Stress Analysis Vibration								

I. COURSE OVERVIEW:

The focus of this course is to develop an understanding of the mechanics of fracture of engineering materials and structures under static and dynamic loading. Students will be taught the principles of linear elastic and elastic-plastic fracture mechanics and their application to engineering design. This course will also introduce key applications of fracture mechanics in industry including damage detection, failure analysis, and experimental techniques.

II. COURSE OBJECTIVES:

The students will try to learn:

I. The stress and strain fields around a crack tip for linear and nonlinear materials.
II. The crack affects a structure and stress Vs strain occurs in front of a crack in different materials,
III. The importance of design philosophies and fracture mechanics in Aerospace structure.
IV. The static and dynamic fatigue fracture techniques used to perform failure analysis.

III. COURSE OUTCOMES:

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

CO1 Recall the basic fracture and fatigue mechanisms
CO2 Explain various fracture and damage mechanisms in materials
CO3 Outline fundamental understanding of the effects of crack like defects on the performance of aerospace, civil, and mechanical Engineering structures
CO4 Illustrate various methods of fracture toughness measuring in materials
CO5 Apply different theories to calculate stress analysis in linear and nonlinear materials
CO6 Determine critical crack sizes and fatigue crack propagation rates in engineering structures

IV. COURSE CONTENT:

MODULE -I: Introduction to Fracture Mechanics (09)

The Crack Tip Plastic Zone, Methods for Measuring Fracture Toughness.

MODULE -II: Strength of Cracked Bodies (10)

Strength of cracked bodies, potential energy and surface energy, Griffith's theory, Irwin, Orwin extension of Griffith's theory to ductile materials, stress analysis of cracked bodies, effect of thickness on fracture toughness, stress intensity factors for typical geometries.

MODULE -III: Physical Aspects of Fatigue (09)

Phase in fatigue life, crack initiation, crack growth, Final fracture, dislocation, Fatigue fracture surfaces. Safe Life and Fail-safe design philosophies.

Importance of Fracture Mechanics in Aerospace structure, Applications to composite materials and structures.

MODULE -IV: Statical Aspects of Fatigue Behaviour (10)

Low cycle and high cycle fatigue, Coffin- Manson's Relation, transition Life, cyclic strain hardening and softening, analysis of load histories, cycle counting techniques, cumulative damage, Miner's theory, other theories

MODULE -V: Dynamic Fracture (10)

Dynamic Fracture, stress corrosion cracking, corrosion fatigue, fatigue, crack propagation under variable, amplitude load fluctuation, fatigue, crack Initiation, fatigue, crack propagation under constant, amplitude load fluctuation.

V. TEXT BOOKS:

1. K. Hellan, "Introduction to Fracture Mechanics", Tata McGraw Hill, 1st edition, 2013.
2. D. Broek, Kluwer, "The Practical Use of Fracture Mechanics" Academic Publisher, 1st edition, 2013.
3. D. Broek, M. Nijhoff, "Elementary Engineering Fracture Mechanics", Springer, 4th edition, 2013.

VI. REFERENCE BOOKS:

1. W. Barrpos, E. L. Ripley, "Fatigue of Aircraft Structures", Pergamon Press, Oxford, 1st edition, 2018.
2. C. G. Sih, "Mechanics of Fracture Vol. I, Sijthoff, Noordhoff International Publishing Co., Netherlands, 1st edition, 2019.
3. J. F. Knott, "Fundamentals of Fracture Mechanics", Butterworth & Co., (Publishers) Ltd., London. 1st edition, 2021.

VII. ELECTRONICS RESOURCES:

1. http:// nptel.ac.in/courses/112/106/112106065/

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. PowerPoint presentation

COURSE CONTENT

NANO TECHNOLOGY									
III Semester: OE									
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**			
BCCD30	**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**			
Pre requisites: NIL									

I. COURSE OVERVIEW:

Develop two modular undergraduate-level courses dealing with nanotechnology environment, health, and safety awareness, which will be offered entirely online to UT Tyler students, and as modules inserted separately into other courses to Texas State students. These courses will better prepare undergraduate students to advance to graduate nanotechnology programs and to work with nanomaterials in their future careers.

II. COURSE OBJECTIVES:

The students will try to learn:

I. The emerging needs in nanotechnology environment, health; and safety, and incorporate them into basic education that can be immediately employed in industry;
II. To Promote interdisciplinary interactions among engineering, engineering technology, science, and industrial management/technology majors;
III. To establish a Nanotechnology Advisory Council that will assist in providing current information related to research and tools in nanotechnology environment health and safety.

III. COURSE OUTCOMES:

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

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

IV. COURSE CONTENT:

MODULE-I: Introduction of Nano Technology (09)

Introduction, Size and shape dependence of material properties at the nanoscale, scaling relations, can nanorobots walk and nano planes fly, Nano scale elements in conventional technologies, Mechanics at nanoscale Enhancement of mechanical properties with decreasing size, Nanoelectromechanical systems, nano machines, Nano fluidics, filtration, sorting, Molecular motors, Application of Nano Technology.

MODULE-II: Nano Materials Synthesis Technology (10)
Nano material Synthesis Techniques: Top-down and bottom-up nanofabrication, Synthesis of nano composites, The Intel-IBM approach to nanotechnology: lithography, etching, ion implantation, thin film deposition, nano coatings and nano indentation, Electron beam lithography, Soft lithography: nanoimprinting and micro-contact printing, Solution/plasma-phase nanofabrication, sol-gel methods, template techniques.

MODULE-III: Characterization (09)
Imaging/characterization of nanostructures General considerations for imaging.

Scanning probe techniques: XRD, SEM, TEM, AFM and NSOM number, Maneuvers.

MODULE-IV: Metals and Semiconductors (10)
Metal and semiconductor nanoparticles Synthesis, stability, control of size, Optical and electronic properties, Ultra-sensitive imaging and detection with nano particles, bioengineering applications, Catalysis. Semiconductor and metal nanowires Vapor/liquid/solid growth and other synthesis techniques, Nanowire transistors and sensors.

MODULE-V: Carbon Nanotubes (10)
Structure and synthesis, Electronic, vibrational, and mechanical properties, how can C nanotubes enable faster computers, brighter TV screens, and stronger mechanical reinforcement.

V. TEXT BOOKS:
1. Kelsall, Hamley, Geoghegan, "Nanoscale Science and Technology", Wiley, 1st edition, 2018.
2. Di Ventra, Evoy, Heflin, "Introduction to Nanoscale Science and Technology" , Kluwer Academic Publishers, 2nd edition, 2019.

VI. REFERENCE BOOKS:
1. Poole, Owens, "Introduction to Nanotechnology", Wiley, 2nd edition, 2020
2. Ozin, Arsenault, "Nano Chemistry: A Chemical Approach to Nanomaterials", RSC Publishing, 2nd edition, 2018.

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

VIII. 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. PowerPoint presentation

COURSE CONTENT

ENERGY FROM WASTE								
III Semester: OE								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BCCD31	**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**		
Pre requisites: NIL								

I. COURSE OVERVIEW:

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

II. COURSE OBJECTIVES:

The students will try to learn:

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

III COURSE OUTCOMES:

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

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

IV. COURSE CONTENT

MODULE –I: Waste Sources & Characterization (10)

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 (10)
Biochemical Conversion – Energy production from organic waste through anaerobic digestion and fermentation. Thermo-chemical Conversion – Combustion, Incineration and heat recovery, Pyrolysis, Gasification; Plasma Arc Technology and other newer technologies.

MODULE –III: Waste to Energy & Environmental Implications (09)
Environmental standards for Waste to Energy Plant operations and gas clean-up. Savings on non-renewable fuel resources.

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

MODULE –IV: Thermo-Chemical Conversion (09)
Biogas production, land fill gas generation and utilization, thermo-chemical conversion: Sources of energy generation, gasification of waste using gasifies briquetting, utilization and advantages of briquetting, environmental benefits of bio-chemical and thermo- chemical conversion, comparison of various thermo-chemical conversion.

MODULE –V: E- Centralized and Decentralized Waste to Energy Plants (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. TEXT BOOKS:

1. Nicholas P Cheremisinoff, "Handbook of Solid Waste Management and Waste Minimization Technologies", An Imprint of Elsevier, New Delhi, 1st Edition, 2003.
2. Paul Breeze, "Energy from Waste", An Imprint of Elsevier, New Delhi, 1st Edition, 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, 2019.
2. C Y Were Ko-Brobby and E. B. Hagan, "Biomass Conversion and Technology", John Wiley & Sons, 1st edition, 2019.
3. C Parker and T Roberts (Ed), "Energy from Waste", An Evaluation of Conversion Technologies, elsevier Applied Science, London, 2018.

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 Thompson

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. PowerPoint presentation

COURSE CONTENT

OPERATIONS RESEARCH								
III Semester: OE								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BCCD32	**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**		
Pre requisites: NIL								

I. COURSE OVERVIEW:

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

II. COURSE OBJECTIVES:

The students will try to learn:

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

III. COURSE OUTCOMES:

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

CO1 Recall the basics of operation research
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 CONTENT:

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 (10)
Theory Of Games: Introduction, minimax (maximin) criterion and optimal strategy, solution of games with saddle points, rectangular games without saddle points, dominance principle, mx2 and 2xn games, graphical method; Inventory: Introduction, single item, deterministic models, purchase inventory models with one price break and multiple price breaks, shortages are not allowed, stochastic models, demand may be discrete variable or continuous variable, instantaneous production, instantaneous demand and continuous demand and no set up cost, single period model.

MODULE -V: Waiting Lines and Simulation (09)
Waiting Lines: Introduction, single channel, poisson arrivals, exponential service times, with infinite population and finite population models, multichannel, poisson arrivals, exponential service times with infinite population single channel Poisson arrivals; Simulation: Definition, types of simulation models, phases of simulation, applications of simulation, inventory and queuing problems, advantages and disadvantages, brief Introduction of simulation languages.

V. TEXT BOOKS:
1. J. K. Sharma, "Operations Research", Macmillan, 5th edition, 2012.
2. R. Pannerselvan, "Operations Research", PHI Publications, 2nd edition, 2006.

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

VII. 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. Tutorial question bank
3. Assignments
4. Model question paper – I
5. Model question paper – II
6. Lecture notes
7. PowerPoint presentation

COURSE CONTENT

COMPOSITE MATERIALS									
III Semester: OE									
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**			
BCCD33	**Elective**	L	T	P	C	CIA	SEE	Total	
		3	-	-	3	40	60	100	
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes:**				**Total Classes: 48**			
Prerequisites: NIL									

I. COURSE OVERVIEW:

Composite materials can be defined as a material structure consisting of two macroscopically identifiable materials working together to accomplish a superior result. This course covers the introduction, macro and micro mechanical analysis of a lamina and laminates in detail. This course will be useful in the field of mechanical, aeronautical and civil engineering both for doing research and develop a product.

II. COURSE OBJECTIVES:

The students will try to learn

I. The classification of composite materials and their applications in various engineering fields.
II. The manufacturing methods and different types of fibers reinforcement in composites.
III. The Macro mechanical stress and strain analysis of lamina and laminates
IV. The perceptions for design of laminated composite and failure Criterion for a Laminate.

III. COURSE OUTCOMES:

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

CO1 Recall the acquire knowledge about the composite materials
CO2 Demonstrate an ability to select raw materials for composites.
CO3 Identify the stresses and strains relation in composites materials.
CO4 Illustrate the various types of composites and their applications
CO5 Select the appropriate technique for manufacture of fibre reinforced composite
CO6 Analyse the elastic properties and simulate the mechanical performance of composite lamina

IV.COURSE CONTENT:

MODULE -I: Introduction to Composite Materials (09)

Introduction, Classification Polymer Matrix Composites, Metal Matrix Composites, Ceramic Matrix Composites, Carbon–Carbon Composites, Fiber-Reinforced Composites and nature-made composites, and applications.

MODULE -II: Reinforcements, Manufacturing Methods (09)

Reinforcements: Fibers- Glass, Silica, Kevlar, carbon, boron, silicon carbide, and born carbide fibers. Particulate composites, Polymer composites, Thermoplastics, Thermosets, Metal matrix and ceramic composites. Manufacturing methods: Autoclave, tape production, moulding methods, filament winding, man layup, pultrusion, RTM.

MODULE -III: Macro Mechanical Analysis of a Lamina (09)

Introduction, Definitions Stress, Strain, Elastic Moduli, Strain Energy. Hooke's Law for Different

Types of Materials, Hooke's Law for a Two-Dimensional Unidirectional Lamina, Plane Stress

Assumption.
Reduction of Hooke's Law in Three Dimensions to Two Dimensions, Relationship of Compliance and Stiffness Matrix to Engineering Elastic Constants of a Lamina.

MODULE -IV: Mechanical Analysis of a Laminates (09)
Introduction, Laminate Code, Stress–Strain Relations for a Laminate, In-Plane and Flexural Modulus of a Laminate, Hygrothermal Effects in a Laminate, Warpage of Laminates.

MODULE -V: Failure, Analysis, and Design of Laminates (09)
Introduction, Special Cases of Laminates, Failure Criterion for a Laminate, Design of a Laminated Composite, Other Mechanical Design Issues.

V. TEXT BOOKS:

1. Autar K. Kaw, "Mechanics of Composite Materials", CRC Press, 2nd edition, 2013.
2. Isaac, M Daniel, "Engineering Mechanics of Composite Materials", Oxford University Press, 1st edition, 2019.

VI. REFERENCE BOOK:

1. B. D. Agarwal, L. J. Broutman, "Analysis and performance of Fibre Composites", Wiley, New York, 1st edition, 2019.

VII. ELECTRONICS RESOURCES:

1. http://nptel.ac.in/courses/112/104/112104229/

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. PowerPoint presentation

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 courses 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**		
BHSD05	**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 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 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 teachers 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 impartance

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 yog. (Ashtanga)

MODULE – II: YAM AND NIYAM

Yam and Niyam. Do`s and Don't'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**		
BHSD09	**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 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 (dont's),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.pdf

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