Sri Krishnadevaraya University College of Engineering & Technology
Ananthapuramu – 515 003 (A.P) India
Mechanical Engineering

Draft Academic Regulations of M.Tech. (Full Time/Regular) Programme
(Effective for the students admitted into M.Tech. I year from the Academic Year 2025-26 onwards)

Sri Krishnadevaraya University College of Engineering & Technology offers **Two** Years (**Four** Semesters) full-time Master of Technology (M.Tech.) Degree programme, under Choice Based Credit System (CBCS) in different branches of Engineering and Technology with different specializations.
Sri Krishnadevaraya University College of Engineering & Technology, Ananthapuramu shall confer M. Tech. degree on candidates who are admitted to the programme and fulfil all the requirements for the award of the degree.

1. **Award of the M.Tech. Degree**
   A student will be declared eligible for the award of the M.Tech. degree if he/she fulfils the following:
   1.1 Pursues a course of study for not less than two academic years and not more than four academic years.
   1.2 Registers for 70 credits and secures all 70 credits.

2. Students, who fail to fulfil all the academic requirements for the award of the degree within four academic years from the year of their admission, shall forfeit their seat in M.Tech. course and their admission stands cancelled.

3. **Programme of Study:**

   The following M.Tech Specializations are offered at present in different branches of Engineering and Technology:

S.No.	Branch	Name of the Specialization
01	Computer Science and Engineering	Computer Science and Engineering
02	Electronics and Communication Engineering	Embedded Systems & VLSI Design
03	Electrical and Electronics Engineering	Electrical Power Systems
04	Mechanical Engineering	Thermal Engineering
05	Civil Engineering	Structural Engineering

4. **Eligibility for Admissions**:
   4.1 Admission to the M. Tech Program shall be made subject to the eligibility, qualification and specialization prescribed by the A.P. State Government/University from time to time.
   4.2 Admissions shall be made either on the basis of the merit rank or Percentile obtained by the qualified student in the relevant qualifying GATE Examination/ the merit rank obtained by the qualified student in an entrance test conducted by A.P. State Government (APPGECET) for M.Tech. programmes/an entrance test conducted by University/on the basis of any other exams approved by the University, subject to reservations as laid down by the Govt. from time to time.

Sri Krishnadevaraya University College of Engineering & Technology
Ananthapuramu – 515 003 (A.P) India
Mechanical Engineering

5. Programme related terms:

5.1 ***Credit:*** A unit by which the course work is measured. It determines thenumber of hours of instructions required per week. One credit is equivalent to one hour of teaching (Lecture/Tutorial) or two hours of practical work/field work per week. Credit definition:

1Hr.Lecture(L) per week	1 credit
1Hr.Tutorial(T) per week	1 credit
1Hr.Practical(P)per week	0.5credit

5.2 ***Academic Year:*** Two consecutive (one odd + one even) semesters constitute one academic year.

5.3 ***Choice Based Credit System (CBCS):*** The CBCS provides choice for students to select from the prescribed courses.

6. Programme Pattern:

6.1 Total duration of the M.Tech. programme is two academic years

6.2 Each academic year of study is divided into two semesters.

6.3 Each Semester shall be of 22 weeks duration (inclusive of Examinations), with a minimum of 90 instructional days per semester.

6.4 The student shall not take more than four academic years to fulfil all the academic requirements for the award of M.Tech. degree from the date of commencement of first year first semester, failing which the student shall forfeit the seat in M.Tech. programme.

6.5 The medium of instruction of the programme (including examinations and project reports) will be in English only.

6.6 All subjects/courses offered for the M.Tech. degree programme are broadly classified as follows:

S.No.	Broad Course Classification	Course Category	Description
1.	Core Courses	Foundational &Professional Core Courses (PC)	Includes subjects related to the parent discipline/ department/ branch of Engineering
2.	Elective Courses	Professional Elective Courses(PE)	Includes elective subjects related to the parent discipline/ department/ branch of Engineering
		Open Elective Courses (OE)	Elective subjects which include inter-disciplinary subjects or subjects in an area outside the parent discipline which are of importance in the context of special skill development
3.	Research	Research Methodology &IPR	To understand importance and process of creation of patents through research
		Technical Seminar	Ensures preparedness of students to undertake major projects/ Dissertation, based on core contents related to specialization
		Co curricular Activities	Attending conferences, scientific Presentations and other scholarly activities
		Dissertation	M.Tech. Projector Major Project

Sri Krishnadevaraya University College of Engineering & Technology
Ananthapuramu – 515 003 (A.P) India
Mechanical Engineering

4.	Audit Courses	Mandatory non credit courses	Covering subjects of developing desired attitude among the learners is on the line of initiatives such as Unnat Bharat Abhiyan, Yoga, Value education etc.

6.7 The college shall take measures to implement Virtual Labs (https://www.vlab.co.in) which provide remote access to labs in various disciplines of Engineering and will help student in learning basic and advanced concept through remote experimentation. Student shall be made to work on virtual lab experiments during the regular labs.

6.8 A faculty advisor/mentor shall be assigned to each specialization to advise students on the programme, its Course Structure and Curriculum, Choice of Courses, based on his competence, progress, pre-requisites and interest.

6.9 Preferably 25% course work for the theory courses in every semester shall be conducted in the blended mode of learning.

7. Attendance Requirements:

7.1 A student shall be eligible to appear for the University external examinations if he/she acquires 75% of attendance in aggregate of all the courses.

7.2 Condonation of shortage of attendance in aggregate up to 10% (65% and above and below 75%) in each semester may be granted by the College Academic Committee.

7.3 Condonation of shortage of attendance shall be granted only on genuine and valid reasons on representation by the candidate with supporting evidence

7.4 Students whose shortage of attendance is not condoned in any semester are not eligible to take their end examination of that class.

7.5 A stipulated fee shall be payable towards condonation of shortage of attendance.

7.6 A student will not be promoted to the next semester unless he satisfies the attendance requirements of the present semester. They may seek re-admission into that semester when offered next.

7.7 If any candidate fulfils the attendance requirement in the present semester, he shall not be eligible for readmission into the same class.

7.8 If the learning is carried out in blended mode (both offline & online), then the total attendance of the student shall be calculated considering the offline and online attendance of the student.

8. Evaluation – Distribution and Weightage of Marks:

The performance of a student in each semester shall be evaluated subject - wise (irrespective of credits assigned), for a maximum of 100 marks for theory and 100 marks for practical, based on Internal Evaluation and End Semester Examination.

8.1 There shall be five units in each of the theory subjects. For the theory subjects 60 marks will be for the End Examination and 40 marks will be for Internal Evaluation.

8.2 Two Internal Examinations shall be conducted for 30 marks each, one in the middle of the Semester and the other immediately after the completion of instruction. First mid examination shall be conducted for I & II units of the syllabus and second mid examination for III, IV &V units. Each mid exam shall be conducted for a total duration of 120 minutes with 3 questions (without choice) eachquestionfor10marks. Final Internal marks for a total of 30 marks shall be arrived at by considering the marks secured by the student in both the internal

examinations with 80% weightage to the better internal exam and 20% to the other. There shall be two online examinations conducted duringtherespectivemidexaminationsbythecollegefortheremaining10 marks with 20 objective questions.

8.3 The following pattern shall be followed in the End Examination:

i. Five questions shall be set from each of the five units with either/or type for 12 marks each.
ii. All the questions have to be answered compulsorily.
iii. Each question may consist of one, two or more bits.

8.4 For practical subjects, 60 marks shall be for the End Semester Examinations and 40 marks will be for internal evaluation based on the day-to-day performance.
The internal evaluation based on the day-to-day work-10 marks, record- 10 marks and the remaining 20 marks to be awarded by conducting an internal laboratory test. The end examination shall be conducted by the examiners, with a breakup mark of Procedure-10, Experimentation-25, Results-10, Viva- voce-15

8.5 There shall be a **Technical Seminar** during I year II semester for internal evaluation of100 marks. A student under the supervision of a faculty member shall collect the literature on a topic and critically review the literature and submit it to the department in a report form and shall make an oral presentation before the Project Review Committee consisting of Head of the Department, supervisor/mentor and two other faculty members of the department. The student must secure a minimum of 50% of marks, to be declared successful. If he fails to obtain the minimum marks, he must reappear for the same as and when supplementary examinations are conducted. The Technical seminar shall be conducted anytime during the semester as per the convenience of the Project Review Committee and students. There shall be no external examination for Technical Seminar.

8.6 There shall be Mandatory **Audit courses** in I & II semesters for zero credits. There is no external examination for audit courses. However, attendance shall be considered while calculating aggregate attendance and student shall be declared to have passed the mandatory course only when he/she secures 50% or more in the internal examinations. In case, the student fails, a re- examination shall be conducted for failed candidates for 40 marks every six months/semester satisfying the conditions mentioned in item 1 & 2 of the regulations.

8.7 A candidate shall be deemed to have secured the minimum academic requirement in a subject if he secures a minimum of 40% of marks in the End Examination and a minimum aggregate of 50% of the total marks in the End Semester Examination and Internal Evaluation taken together.

8.8 In case the candidate does not secure the minimum academic requirement in any of the subjects he/she has to reappear for the Semester Examination either supplementary or regular in that subject or repeat the course when next offered or do any other specified subject as may be required.

8.9 The laboratory records and mid semester test papers shall be preserved for a minimum of 3 years in the respective institutions as per the University norms.

9. Credit Transfer Policy

As per University Grants Commission (Credit Framework for Online Learning Courses through SWAYAM) Regulation, 2016, the University shall allow up to a maximum of 40% of the total courses being offered in a particular Programme in a semester through the Online Learning courses through SWAYAM.

9.1 The University shall offer credit mobility for MOOCs and give the equivalent credit weightage to the students for the credits earned through online learning courses through SWAYAM platform.

9.2 The online learning courses available on the SWAYAM platform will be considered for credit transfer. SWAYAM course credits are as specified in the platform

9.3 Student registration for the MOOCs shall be only through the institution, it is mandatory for the student to share necessary information with the institution

9.4 The institution shall select the courses to be permitted for credit transfer through SWAYAM. However, while selecting courses in the online platform institution would essentially avoid the courses offered through the curriculum in the offline mode.

9.5 The institution shall notify at the beginning of semester the list of the online learning courses eligible for credit transfer in the forthcoming Semester.

9.6 The institution shall also ensure that the student has to complete the course and produce the course completion certificate as per the academic schedule given for the regular courses in that semester

9.7 The institution shall designate a faculty member as a Mentor for each course to guide the students from registration till completion of the credit course.

9.8 The university shall ensure no overlap of SWAYAM MOOC exams with that of the university examination schedule. In case of delay in SWAYAM results, the university will re-issue the marks sheet for such students.

9.9 Student pursuing courses under MOOCs shall acquire the required credits only after successful completion of the course and submitting a certificate issued by the competent authority along with the percentage of marks and grades.

9.10 The institution shall submit the following to the examination section of the university:

a) List of students who have passed MOOC courses in the current semester along with the certificates of completion.

b) Undertaking form filled by the students for credit transfer.

9.11 The university shall resolve any issues that may arise in the implementation of this policy from time to time and shall review its credit transfer policy in the light of periodic changes brought by UGC, SWAYAM, NPTEL and state government.

Note: Students shall also be permitted to register for MOOCs offered through online platforms other than SWAYAM NPTEL. In such cases, credit transfer shall be permitted only after seeking approval.

10. Re-registration for Improvement of Internal Evaluation Marks:

A candidate shall be given one chance to re-register for each subject provided the internal marks secured by a candidate are less than 50% and has failed in the end examination

10.1 The candidate should have completed the course work and obtained examinations results for I, II and III semesters.

10.2 The candidate should have passed all the subjects for which the Internal Evaluation marks secured are more than 50%.

10.3 Out of the subjects the candidate has failed in the examination due to Internal Evaluation marks secured being less than 50%, the candidate shall be given one chance for each Theory subject and for a maximum of <u>three</u> Theory subjects for Improvement of Internal evaluation marks.

10.4 The candidate has to re-register for the chosen subjects and fulfil the academic

requirements.

10.5 For re registration the candidates have to apply to the University through the college by paying the requisite fees and get approval from the University before the start of the semester in which re-registration is required

10.6 In the event of availing the Improvement of Internal evaluation marks, the internal evaluation marks as well as the End Examinations marks secured in the previous attempt(s) for the reregistered subjects stand cancelled.

11. Evaluation of Project/Dissertation Work:

The Project work shall be initiated at the beginning of the III Semester and the duration of the Project is of two semesters. Evaluation of Project work is for 300 marks with 200 marks for internal evaluation and 100 marks for external evaluation. Internal evaluation of the Project Work – I & Project work – II in III & IV semesters respectively shall be for 100 marks each. External evaluation of final Project work viva voce in IV semester shall be for 100 marks.

A Project Review Committee (PRC) shall be constituted with the Head of the Department as Chairperson, Project Supervisor and one faculty member of the department offering the M.Tech. programme.

11.1 A candidate is permitted to register for the Project Work in III Semester after satisfying the attendance requirement in all the subjects, both theory and laboratory (in I & II semesters).

11.2 AcandidateispermittedtosubmitProjectdissertationwiththeapprovalof PRC. The candidate has to pass all the theory, practical and other courses before submission of the Thesis.

11.4 Project work shall be carried out under the supervision of teacher in the parent department concerned.

11.5 A candidate shall be permitted to work on the project in an industry/research organization on the recommendation of the Head of the Department. In such cases, one of the teachers from the department concerned would be the internal guide and an expert from the industry/ research organization concerned shall act as co-supervisor/ external guide. It is mandatory for the candidate to make full disclosure of all data/results on which they wish to base their dissertation. They cannot claim confidentiality simply because it would come into conflict with the Industry's or R&D laboratory's own interests. A certificate from the external supervisor is to be included in the dissertation.

11.6 Continuous assessment of Project Work - I and Project Work – II in III & IV semesters respectively will be monitored by the PRC.

11.7 The candidate shall submit status report by giving seminars in three different phases (two in III semester and one in IV semester) during the project work period. These seminar reports must be approved by the PRC before submission of the Project Thesis.

11.8 After registration, a candidate must present in Project Work Review - I, in consultation with his Project Supervisor, the title, objective and plan of action of his Project work to the 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 project work.

11.9 The Project Work Review - II in III semester carries internal marks of 100. Evaluation should be done by the PRC for 50 marks and the Supervisor will

evaluate the work for the other 50 marks. The Supervisor and PRC will examine the Problem Definition, Objectives, Scope of Work, Literature Survey in the same domain and progress of the Project Work.

11.10 A candidate has to secure a minimum of 50% of marks to be declared successful in Project Work Review - II. Only after successful completion of Project Work Review – II, candidate shall be permitted for Project Work Review – III in IV Semester. The unsuccessful students in Project Work Review - II shall reappear for it as and when supplementary examinations are conducted.

11.11 The Project Work Review - III in IV semester carries 100 internal marks. Evaluation should be done by the PRC for 50 marks and the Supervisor will evaluate it for the other 50 marks. The PRC will examine the overall progress of the Project Work and decide whether or not eligible for final submission. A candidate has to secure a minimum of 50% of marks to be declared successful in Project Work Review - III. If he fails to obtain the required minimum marks, he has to reappear for Project Work Review - III after a month.

11.12 For the approval of PRC the candidate shall submit the draft copy of dissertation to the Head of the Department and make an oral presentation before the PRC.

11.13 After approval from the PRC, the students are required to submit a report showing that the plagiarism is within 30%. The dissertation report will be accepted only when the plagiarism is within 30%, which shall be submitted along with the dissertation report.

11.14 Research paper related to the Project Work shall be published in conference proceedings/UGC recognized journal. A copy of the published research paper shall be attached to the dissertation.

11.15 After successful plagiarism check and publication of research paper, three copies of the dissertation certified by the supervisor and HOD shall be submitted to the College.

11.16 The dissertation shall be adjudicated by an external examiner selected by the University. For this, the Principal of the College shall submit a panel of three examiners as submitted by the supervisor concerned and department head for each student. However, the dissertation will be adjudicated by one examiner nominated by the University.

11.17 If the report of the examiner is not satisfactory, the candidate shall revise and resubmit the dissertation, in the time frame as decided by the PRC. If report of the examiner is unfavorable again, the thesis shall be summarily rejected. The candidatehastoreregisterfortheprojectandcompletetheprojectwithinthe stipulated time after taking the approval from the University

11.18 If the report of the examiner is satisfactory, the Head of the Department shall coordinate and make arrangements for the conduct of Project Viva voce exam.

11.19 The Project Viva voce examinations shall be conducted by a board consisting of the Supervisor, Head of the Department and the external examiner who has adjudicated the dissertation. For Dissertation Evaluation (Viva voce) in IV Sem. there are external marks of 100 and it is evaluated by external examiner. The candidate must secure a minimum of 50% marks in Viva voce exam.

11.20 If he fails to fulfil the requirements as specified, he will reappear for the Project Viva voce examination only after three months. In the reappeared examination also, if he fails to fulfil the requirements, he will not be eligible for the award of the degree.

Sri Krishnadevaraya University College of Engineering & Technology
Ananthapuramu – 515 003 (A.P) India
Mechanical Engineering

12. Credits for Co-curricular Activities

The credits assigned for co-curricular activities shall be given by the principals of the colleges and the same shall be submitted to the University.

A Student shall earn 02 credits under the head of co-curricular activities, viz., attending Conference, Scientific Presentations and Other Scholarly Activities.

Following are the guidelines for awarding Credits for Co-curricular Activities

Name of the Activity	Maximum Credits/ Activity
Participation in National Level Seminar/ Conference/ Workshop /Training programs (related to the specialization of the student)	1
Participation in International Level Seminar / Conference / workshop/Training programs held outside India (related to the Specialization of the student)	2
Academic Award/ Research Award from State Level/National Agencies	1
Academic Award/Research Award from International Agencies	2
Research/Review Publication in National Journals (Indexed in Scopus / Web of Science)	1
Research/Review Publication in International Journals with Editorial board outside India (Indexed in Scopus / Web of Science)	2

Note:

i) Credit shall be awarded only for the first author. Certificate of attendance and participation in a Conference/Seminar is to be submitted for awarding credit.

ii) Certificate of attendance and participation in workshops and training programs (Internal or External) is to be submitted for awarding credit. The total duration should be at least one week.

iii) Participation in any activity shall be permitted only once for acquiring required credits under co curricular activities

13. Grading:

As a measure of the student's performance, a 10-point Absolute Grading System using the following Letter Grades and corresponding percentage of marks shall be followed:

After each course is evaluated for 100 marks, the marks obtained in each course will be converted to a corresponding letter grade as given below, depending on the range in which the marks obtained by the student fall.

Structure of Grading of Academic Performance

Range in which the marks In the subject fall	Grade	Grade points Assigned
≥90	S (Superior)	10
≥80 &<90	A(Excellent)	9
≥70&<80	B(Very Good)	8
≥60 &<70	C(Good)	7
≥50&<60	D(Pass)	6
<50	F (Fail)	0
Absent	Ab (Absent)	0

Sri Krishnadevaraya University College of Engineering & Technology
Ananthapuramu – 515 003 (A.P) India
Mechanical Engineering

A student obtaining Grade 'F' or Grade 'Ab' in a subject shall be considered failed and will be required to reappear for that subject when it is offered in the next supplementary examination.

i) For non credit audit courses, "Satisfactory" or "Unsatisfactory" shall be indicated instead of the letter grade and this will not be counted for the computation of SGPA/CGPA/Percentage.

Computation of Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA):

The Semester Grade Point Average (SGPA) is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student, i.e.,

$$SGPA=\Sigma (C_i \times G_i)/\Sigma C_i$$

where, C_i isthe number of credits of the i^{th} subject and G_i is the grade point scored by the student in the i^{th} course.

i) The Cumulative Grade Point Average (CGPA) will be computed in the same manner considering all the courses undergone by a student over all the semesters of a program, i.e.,

$$CGPA=\Sigma(C_i \times S_i)/ \Sigma C_i$$

where "S_i"is the SGPA of the i^{th} semester and C_i is the total number of credits of i^{th} semester.

ii) Both SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

iii) While computing the SGPA the subjects in which the student is awarded Zero grade points will also be included.

Grade Point: It is a numerical weight allotted to each letter grade on a 10-point scale. Letter Grade : It is an index of the performance of students in a said course. Grades are denoted by letters S, A, B, C, D and F.

14. Award of Class:

After a student has satisfied 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:

Class Awarded	Percentage of Marks to be secured
First Class with Distinction	≥70%
First Class	<70%≥ 60%
Pass Class	<60%≥ 50%

15. Exit Policy: The student shall be permitted to exit with a PG Diploma based on his/her request to the university through the institution at the end of first year subject to passing all the courses in first year.

The University shall resolve any issues that may arise in the implementation of this policy from time to time and shall review the policy in the light of periodic changes brought by UGC, AICTE and State government.

Sri Krishnadevaraya University College of Engineering & Technology
Ananthapuramu – 515 003 (A.P) India
Mechanical Engineering

16. Withholding of Results:

If the candidate has any case of in-discipline pending against him, the result of the candidate shall be withheld, and he will not be allowed/promoted into the next higher semester. The issue of degree is liable to be withheld in such cases.

17. Transitory Regulations

Discontinued, detained, or failed candidates are eligible for readmission as and when the semester is offered after fulfilment of academic regulations. Candidates who have been detained for want of attendance or not fulfilled academic requirements or who have failed after having undergone the course in earlier regulations or have discontinued and wish to continue the course are eligible for admission into the unfinished semester from the date of commencement of class work with the same or equivalent subjects as and when subjects are offered, subject to Section2 and they will follow the academic regulations into which they are readmitted.

18. General:

18.1 The academic regulations should be read for purpose of any interpretation.

18.2 Disciplinary action for Malpractice/improper conduct in examinations is appended.

18.3 Where the words “he”, “him”, “his”, occur in the regulations, they include “she”, “her”, “hers”.

18.4 In the case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Vice-Chancellor is final.

18.5 The University may change or amend the academic regulations or syllabi at any time and the changes or amendments shall be made applicable to all the students on rolls with effect from the dates notified by the University.

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Sri Krishnadevaraya University College of Engineering & Technology
Ananthapuramu – 515 003 (A.P) India
Mechanical Engineering

RULES FOR DISCIPLINARY ACTION FOR MALPRACTICES / IMPROPER CONDUCT IN EXAMINATIONS

	Nature of Malpractices /Improper conduct	Punishment
	If the candidate:	
1.(a)	Possesses or keeps accessible in examination hall, any paper, notebook, programmable calculators, cell phones pager, palm computers or any other form of material concerned with or related to the subject of the examination (theory or practical) in which he is appearing but has not made use of (material shall include any marks on the body of the candidate which can be used as an aid in the subject of the examination)	Expulsion from the examination hall and cancellation of the performance in that subject only.
(b)	Gives assistance or guidance or receives it from any other candidate orally or by any other body language methods or communicates through cell phones with any candidate or persons in or outside the exam hall in respect of any matter.	Expulsion from the examination hall and cancellation of the performance in that subject only of all the candidates' involved. In case of an outsider, he will be handed over to the police and a case is registered against him.
2.	Has copied in the examination hall from any paper, book, programmable calculators, palm computers or any other form of material relevant to the subject of the examination (theory or practical) in which the candidate is appearing.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the subjects of that semester/year. The Hall Ticket of the candidate is to be cancelled and sent to the University.
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 For four consecutive semesters from class work and all University examinations. The continuation of the Course by the candidate is subject to the Academic Regulations in connection with forfeiture of seat. The Performance of the original candidate who has been impersonated, shall be cancelled in all the subjects of the examination (including practical's and project work) already appeared and shall not be allowed to appear for examinations

		of the remaining subjects of that semester/year. The candidate is also debarred for four consecutive semesters from class work and all University examinations if his involvement is established. Otherwise, the candidate is debarred for two consecutive semesters from class work and all University examinations. The continuation of the Course by the candidate is subject to the academic Regulations in connection with forfeiture of seat. If the Imposter is an outsider, he will be handed over to the Police and a case is registered against him.
4.	Smuggles in the Answer book or additional sheet or takes out or arranges to send out the question paper during the examination or answer book or additional sheet, during or after the examination.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection With forfeiture of seat.
5.	Uses objectionable, abusive or offensive language in the answer paper or in letters to the examiners or writes to the examiner requesting him to award pass marks.	Cancellation of the performance in that subject only.
6.	Refuses to obey the orders of the Chief Superintendent /Assistant- Superintendent /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 officer-incharge 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 officer-in-charge, 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	In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that subject and all other subjects the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the subjects of that semester/year. If the candidate physically assaults the invigilator/officer-in-charge of the Examinations, then the candidate is also debarred and forfeits his/her seat. In case of outsiders, they will be handed over to the police and a police case is registered against them.

	of property in the examination hall or any part of the College campus 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.	
7.	Leaves the exam hall taking away answer script or intentionally tears of the script or any part there of inside or outside the examination hall.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
8.	Possess any lethal weapon or firearm in the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat.
9.	If student of the college, who is not a candidate for the particular examination or any person not connected with the college indulges in any malpractice or Improper conduct mentioned in clause 6 to 8.	Student of the colleges expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat. Person(s) who do not belong to the College will be handed over to police and a police case will be registered against them.
10.	Comes in a drunken condition to the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall

Sri Krishnadevaraya University College of Engineering & Technology
Ananthapuramu – 515 003 (A.P) India
Mechanical Engineering

		not be permitted for the remaining examinations of the subjects of that semester/year.
11.	Copying detected on the basis of internal evidence, such as, during valuation or during special scrutiny.	Cancellation of the performance in that subject only or in that subject and all other subjects the candidate has appeared including practical examinations and project work of that semester/year examinations, depending on the recommendation of the committee.
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.	

1. Malpractices identified by squad or special invigilators
2. Punishments to the candidates as per the above guidelines.
3. Punishment for institutions: (if the squad reports that the college is also involved in encouraging malpractices)
4. A show cause notice shall be issued to the college.
5. Impose a suitable fine on the college.
6. Shifting the examination center from the college to another college for a specific period of not less than one year.

Note:
Whenever the performance of a student is cancelled in any subject/subjects due to Malpractice, he has to register for End Examinations in that subject/subjects consequently and has to fulfil all the norms required for the award of Degree.

Sri Krishnadevaraya University College of Engineering & Technology
Ananthapuramu – 515 003 (A.P) India
Mechanical Engineering

SKUCET Curriculum
M.Tech Course Structure – R24
MECHANICAL ENGINEERING

Semester-I					
THERMAL ENGINEERING (TE)					
S.No.	**Course Code**	**Course Name**	**Category**	**L- T - P**	**Credits**
1.		Advanced Fluid Mechanics	PC	3-0-0	3
2.		Advanced Thermodynamics	PC	3-0-0	3
3.		1. Advanced Gas Turbines 2. Design of Thermal Systems 3. Alternative Fuel Technologies	PE	3-0-0	3
4.		1. Advanced Refrigeration & Air Conditioning 2. Finite Element Analysis in Thermal Engineering 3. Fuel & Combustion Technology	PE	3-0-0	3
5.		Advanced Fluid Mechanics Lab	PC	0-0-4	2
6.		Thermal Engineering Lab-I	PC	0-0-4	2
7.		Research Methodology And IPR	MC	2-0-0	2
8.		English for Research Paper Writing	AC	2-0-0	0
				Total	**18**

Sri Krishnadevaraya University College of Engineering & Technology
Ananthapuramu – 515 003 (A.P) India
Mechanical Engineering

Sri Krishnadevaraya University College of Engineering & Technology					
THERMAL ENGINEERING (TE)					
Semester-II					
S.No.	**Course Code**	**Course Name**	**Category**	**L- T - P**	**Credits**
1.		Advanced IC Engines	PC	3-0-0	3
2.		Advanced Heat & Mass Transfer	PC	3-0-0	3
3.		1. Solar Energy Technologies 2. Advanced Power Plant Engineering 3. Design of heat exchanger	. PE	. 3-0-0	3
4.		1. Pollution Control Technologies 2. Optimization Techniques & its Applications 3. Renewable Energy Technologies	PE	3-0-0	3
5.		Advanced Heat & Mass Transfer Lab	PC	0-0-4	2
6.		Thermal Engineering Lab-II	PC	0-0-4	2
7.		Technical Seminar	PR	0-0-4	2
8.		Stress Management for Yoga Personality	AC	2-0-0	0
				Total	**18**

Sri Krishnadevaraya University College of Engineering & Technology
Ananthapuramu – 515 003 (A.P) India
Mechanical Engineering

Sri Krishnadevaraya University College of Engineering & Technology					
THERMAL ENGINEERING (TE)					
Semester-III					
S.No.	**Course Code**	**Course Name**	**Category**	**L- T - P**	**Credits**
1.		1. Waste to Energy 2. Computational Fluid Dynamics 3. Cryogenic Engineering	PE	3-0-0	3
2.		Students are advised to opt for an open elective course of their choice being offered by other Departments of the Institute	OE	3-0-0	3
3.		Dissertation phase –I	PR	0-0-20	10
4		Co Curricular Activities	PR		02
				Total	**18**

Sri Krishnadevaraya University College of Engineering & Technology					
THERMAL ENGINEERING (TE)					
Semester-IV					
S.No.	**Course Code**	**Course Name**	**Category**	**L- T - P**	**Credits**
1.		Dissertation Phase – II	PR	0-0-32	16
				Total	**16**

Sri Krishnadevaraya University College of Engineering & Technology
Ananthapuramu – 515 003 (A.P) India
Mechanical Engineering

Course Code	ADVANCED FLUID MECHANICS	L	T	P	C
		3	0	0	3
Semester		I			

Course Objectives:

1.To understand the compressible and incompressible flows of fluids
2.To understand the concepts of viscous flows
3.To understand the analysis of boundary layer.
4.To understand the types of flows.

Course Outcomes (CO):

On successful completion of the course, the students will able to:

- Familiarize basic terms used in fluid mechanics
- Understand the principles of fluid statics, kinematics and dynamics
- Understand flow characteristics and classify the flows and estimate various losses in flow through channels
- Analyze characteristics for uniform and non-uniform flows in open channels.

UNIT - I

INVISCID FLOW OF INCOMPRESSIBLE FLUIDS: Lagrangian and Eulerain Descriptions of fluid motion, Path lines, Stream lines, Streak lines, stream tubes – velocity of a fluid particle, types of flows, Equations of three dimensional continuity equation, Stream and Velocity potential functions.

Basic Laws of fluid Flow: Condition for irrotationality, circulation & vorticity Accelerations in Carte systems normal and tangential accelerations, Euler's, Bernouli equations in 3D– Continuity and Momentum Equations.

UNIT - II

Viscous Flow: Derivation of Navier,Stoke's Equations for viscous compressible flow – Exact solutions to certain simple cases: Plain Poisoulle flow, Coutte flow with and without pressure gradient , Hagen Poisoulle flow, Blasius solution.

UNIT - III

Boundary Layer Concepts : Prandtl's contribution to real fluid flows – Prandtl's boundary layer theory , Boundary layer thickness for flow over a flat plate – Approximate solutions – Creeping motion (Stokes) – Oseen's approximation,Von,Karman momentum integral equation for laminar boundary layer — Expressions for local and mean drag coefficients for different velocity profiles.

UNIT - IV

Introduction to Turbulent Flow: Fundamental concept of turbulence – Time Averaged Equations – Boundary Layer Equations , Prandtl Mixing Length Model , Universal Velocity Distribution Law: Van Driest Model –Approximate solutions for drag coefficients – More Refined Turbulence Models – k,epsilon model , boundary layer separation and form drag – Karman Vortex Trail, Boundary layer control, lift on circular cylinders.

Internal Flow: Smooth and rough boundaries – Equations for Velocity Distribution and frictional Resistance in smooth and rough Pipes – Roughness of Commercial Pipes – Moody's diagram.

UNIT - V

Sri Krishnadevaraya University College of Engineering & Technology
Ananthapuramu – 515 003 (A.P) India
Mechanical Engineering

Compressible Fluid Flow – I: Thermodynamic basics – Equations of continuity, Momentum and Energy , Acoustic Velocity, Derivation of Equation for Mach Number – Flow Regimes – Mach Angle – Mach Cone – Stagnation State. **Compressible Fluid Flow – II:** Area Variation, Property Relationships in terms of Mach number, Nozzles, Diffusers – Fanno and Releigh Lines, Property Relations – Isothermal Flow in Long Ducts – Normal Compressible Shock, Oblique Shock: Expansion and Compressible Shocks – Supersonic Wave Drag.
Text Books:
1. Fluid Mechanics / L.VictorSteeter / TMH 2. Fluid Mechanics / Frank M.White / MGH
Reference Books:
1. Fluid Mechanics and Machines/Modi and Seth/Standard Book House 2. Fluid Mechanics/Cohen and Kundu/Elsevier/5th edition 3. Fluid Mechanics/Potter/Cengage Learning 4. Fluid Mechanics/William S Janna/CRC Press 5. Fluid Mechanics / Y.A Cengel and J.M Cimbala/MGH 6. Boundary Layer Theory/ Schlichting H /Springer Publications 7. Dynamics & Theory and Dynamics of Compressible Fluid Flow/ Shapiro. 8. Fluid Dynamics/ William F. Hughes & John A. Brighton/TMH 9. Fluid Mechanics / K.L Kumar /S Chand & Co.

Sri Krishnadevaraya University College of Engineering & Technology
Ananthapuramu – 515 003 (A.P) India
Mechanical Engineering

Course Code	ADVANCED THERMODYNAMICS	L	T	P	C
		3	0	0	3
Semester		I			

Course Objectives:

- Solve theoretical and applied thermodynamics problems that are directly applicable to situations faced in research and industry.
- Significant emphasis is placed on the integration of recent thermodynamics-related research into the traditional resources in order to foster critical analysis of current work as it relates to fundamental principles.

Course Outcomes (CO):

On successful completion of the course, the students will able to:

1. Describe and calculate thermodynamic properties of single-phase and multi-phase systems
2. Apply the laws of statistical and classical thermodynamics to chemically reactive systems, kinetics, and combustion.
3. Relate course principles to solve problems regarding gas turbines, combustion, refrigeration, and solar energy.
4. Communicate engineering knowledge of thermodynamics through written and verbal means.

UNIT - I

AVAILABILITY AND IRREVERSIBILITY: Quality of Energy, available and unavailable energy, availability, surroundings work, reversible work and irreversibility, availability in a closed system, availability in a SSSF process in an open system, second law efficiencies of processes, second law efficiency of cycles and exergy balance equations.

UNIT - II

THERMODYNAMIC PROPERTY RELATIONS: Helmholtz and Gibbs Functions, two Mathematical Conditions for Exact Differentials, Maxwell Relations, Clapeyron Equation, Relations for Changes in Enthalpy, Internal Energy and Entropy, Specific Heat Relations, Generalized Relations/Charts for Residual Enthalpy and Entropy, Gibbs Function at zero Pressure: A Mathematical Anomaly, Fugacity, Fugacity Coefficient and Residual Gibbs Function, The Joule, Thomson Coefficient and Inversion Curve, Thermodynamic similarity.

UNIT - III

NON-REACTING MIXTURES OF GASES AND LIQUIDS: Measures of Composition in Multi Component Systems.

Gas Mixtures: Mixtures of ideal Gases, Gas-Vapor Mixtures, Application of First Law to Psychometric Processes, Real Gas Mixtures.

Liquid Mixtures/Solutions: Ideal Solutions, Real Solutions.

Thermodynamic Relations for Real Mixtures: Partial Properties, Relation for Fugacity and Fugacity Coefficient in Real Gas Mixtures, Relations for Activity and Activity Coefficient in Real Liquid Mixtures/Solutions.

UNIT - IV

PHASE EQUILIBRIUM: VAPOUR LIQUID EQUILIBRIUM OF MIXTURES: Phase Diagrams for Binary Mixtures, Vapor, Liquid Equilibrium in Ideal Solutions, Criteria for Equilibrium, Criterion foe phase Equilibrium, Calculation of Standard State Fugacity of Pure Component, Vapor Liquid Equilibrium at Low to Moderate Pressures, Determination of

Sri Krishnadevaraya University College of Engineering & Technology
Ananthapuramu – 515 003 (A.P) India
Mechanical Engineering

Constants of Activity Coefficient Equations, Enthalpy Calculations.
UNIT - V
CHEMICAL REACTIONS AND COMBUSTION: Thermo chemistry, Measures of Composition in Chemical Reactions, Application of First Law of Thermodynamics to chemical Reactions, the Combustion Process-Standard Heat/Enthalpy of Combustion, Reactions at actual Temperatures, adiabatic Flame Temperature, Entropy Change of Reacting Systems, Application of second Law of Thermodynamics to chemical Reactions,chemical equilibrium-Advancement of Chemical Reactions, Equilibrium Criterion in Chemical Reactions, equilibrium Constant and Law of Mass Action, Equilibrium Constant for Gas Phase Reactions in the standard state.
Text Books:
1. Basic and Applied Thermodynamics, P.K.Nag, TMH, 2019. 2. Thermodynamics, J.P Holman, Mc Graw Hill, 2017. 3. Thermodynamics ,CP Arora, Mc Graw Hill education (India pvt limited), 2016.
Reference Books:
1. Engg. Thermodynamics, PL.Dhar, Elsevier, 2008. 2. Thermodynamics, Sonnatag & Van Wylen, John Wiley & Sons, 2004. 3. Thermodynamics for Engineers, Doolittle-Messe, John Wiley & Sons, 2018. 4. Irreversible thermodynamics, HR De Groff, . 5. Thermal Engineering, Soman, PHI, 2011. 6. Thermal Engineering, Rathore, TMH, 2010. 7. Engineering Thermodynamics, Chatopadyaya, 2010.

Sri Krishnadevaraya University College of Engineering & Technology
Ananthapuramu – 515 003 (A.P) India
Mechanical Engineering

Course Code	ADVANCED GAS TURBINES (PE-I)	L	T	P	C
		3	0	0	3
Semester		I			

Course Objectives:

1. Develop the ability to use the turbine concepts for various applicants like steam nozzles, steam turbines etc.
2. Achieve an understanding of the basic concepts of centrifugal, axial, rotary compressors and axial flow gas turbines.

Course Outcomes (CO):

- On successful completion of this course the student will be able to understand the concept of Gas turbines and its applications.

UNIT - I

INTRODUCTION: Review of the fundamentals, Classification of turbo machines, Applications of gas turbines.
GAS TURBINE CYCLES FOR SHAFT POWER: Ideal shaft power cycles and their analysis, Practical shaft power cycles and their analysis.

UNIT - II

FUNDAMENTALS OF ROTATING MACHINES: Euler's energy equation, Components of energy transfer, Impulse and reaction machines, Degree of reaction, Flow over an airfoil, Lift and drag.
CENTRIFUGAL COMPRESSORS: Construction and principle of operation, Factors affecting stage pressure ratio, Compressibility effects, Surging and choking, Performance characteristics.

UNIT - III

AXIAL FLOW COMPRESSORS: Construction and principle of operation, Factors affecting stage pressure ratio, Degree of reaction, Three dimensional flow, Design process, Blade design, Stage performance, Compressibility effects, Off, design performance.

UNIT - IV

GAS TURBINE COMBUSTION SYSTEMS: Operational requirements, Factors affecting combustion chamber design, Combustion process, Flame stabilization, Combustion chamber performance, Practical problems, Gas turbine emissions.

UNIT - V

AXIAL AND RADIAL FLOW TURBINES: Construction and operation of axial flow turbines, Vortex theory, Estimation of stage performance, Overall turbine performance, Turbine blade cooling, Radial flow turbines.

Text Books:

1. Sarvanamuttoo, H.I.H., Rogers, G. F. C. and Cohen, H., Gas Turbine Theory, 7th Edition, Pearson Prentice Hall, 2017.
2. Ganesan, V., Gas Turbines, 3rd Edition, Tata McGraw Hill, 2017.

Reference Books:

1. Dixon, S.L., Fluid Mechanics and Thermodynamics of Turbomachinery, 7th Edition, Elsevier, 2014.
2. Flack, R.D., Fundamentals of Jet Propulsion with Applications, Cambridge University Press, 2011.
3. Yahya, S. M., Turbines, Compressors and Fans, 4th Edition, Tata McGraw Hill, 2017.

Sri Krishnadevaraya University College of Engineering & Technology
Ananthapuramu – 515 003 (A.P) India
Mechanical Engineering

Lefebvre, A.H. and Ballal D. R., Gas Turbine Combustion

Course Code	DESIGN OF THERMAL SYSTEMS (PE-I)	L	T	P	C
		3	0	0	3
Semester		I			

Course Objectives:

1. Knowtheconceptsofheatexchangersandbasicdesignmethodsofheatexchangers
2. Achieve an understanding of the basic concepts of Vaporizers, Evaporators and Re boilers, Extended Surfaces.

Course Outcomes (CO):

On successful completion of the course, the students will able to:

- Understand the concept of Heat exchanger design, extended surfaces and design of cooling towers etc

UNIT - I

Classification of heat exchangers: Introduction, Recuperation and Regeneration–Tubular heat exchangers: double pipe, shell and tube heat exchanger, Plate heat exchangers, Gasketed plate heat exchanger, spiral plate heat exchanger, Lamella heat exchanger, extended surface heat exchanger, Plate fin, and Tubular fin.
Basic Design Methods of Heat Exchangers: Introduction, Basic equations in design, Overall heat transfer coefficient – LMTD method for heat exchanger analysis– parallel flow, counter flow, multi pass, cross flow heat exchanger design calculations. Double Pipe Heat Exchanger.

UNIT - II

Shell and Tube Heat Exchangers: Tube layouts for exchangers, baffle Heat exchangers, calculation of shell and tube heat exchangers – shell side film coefficients, Shell side equivalent diameter, the true temperature difference in a 1-2 heat exchanger, influence of approach temperature on correction factor, shell side pressure drop, tube side pressure drop, Analysis of performanceof1-2heatexchanger, and design calculation of shell and tube heat exchangers. Flow arrangements for increased heat recovery, the calculations of2-4exchangers. Condensation of single vapors: Calculation of a horizontal condenser, vertical condenser, De-super heater condenser, vertical condenser–sub-cooler, horizontal condenser–vertical reflux type condenser, condensation of steam.

UNIT - III

Vaporizers, Evaporators and Re boilers: Vaporizing processes, forced circulation vaporizing exchangers, natural circulation vaporizing exchangers, calculations of are boiler.

UNIT - IV

Extended Surfaces: Longitudinal fins, weighted fin efficiency curve, calculation of a double pipe fin efficiency curve, calculation of a double pipe finned exchanger, calculation of a longitudinal fin shell and tube exchanger. Direct Contact Heat Exchanger: Cooling towers, relation between wet bulb and dew point temperatures, the Lewis number, and classification of cooling towers, cooling tower internals and the roll of fill, Heat balance

UNIT - V

Heat transfer by simultaneous diffusion and convection. Analysis of cooling tower requirements, Design of cooling towers, Determination of the number of diffusion units, calculation of cooling tower performance.

Text Books:

1. Process Heat Transfer, D.Q.Kern, TMH.

2. Cooling Towers, J.D.Gurney
3. Heat Exchanger Design, A.P. Fraas and M.N. Ozisick. John Wiely& sons, NewYork.

Reference Books:

1. Cooling Towers, J.D.Gurney 2. Heat Exchanger Design, A.P.Fraas and M.N.Ozisick. John Wiely& sons, NewYork.
2. Huber, Jack Spera, Nova Science Publishers

Sri Krishnadevaraya University College of Engineering & Technology
Ananthapuramu – 515 003 (A.P) India
Mechanical Engineering

Course Code	Alternative Fuel Technologies (PE-I)	L	T	P	C
		3	0	0	3
Semester		I			

Course Objectives:

- To know the concepts of Fossil fuels & kinetics for Solid, Liquid &Gaseous Fuels. To achieve an understanding of the basic concepts of combustion equipments

Course Outcomes (CO):

On successful completion of the course, the students will able to:

- Understand the concept to various fuels and combustion and effect of environment.

UNIT - I

Fossil fuels and their limitations Engine requirements; Potential alternative liquid and gaseous fuels.

UNIT - II

Methods of production; Properties, safety aspects, handling and distribution of various liquid alternative fuels like alcohols, vegetable oils, Di,methyl and Di,ethyl ether etc.

UNIT - III

Different ways of using alternative liquid fuels in engines, performance and emission characteristics; Conversion of vegetable oils to their esters and effect on engine performance.

UNIT - IV

Use of gaseous fuels like biogas, LPG, hydrogen, natural gas, producer gas etc. in SI/CI engines; Production, storage, distribution and safety aspects of gaseous fuels.

UNIT - V

Different approaches like duel fuel combustion and surface ignition to use alternative fuels in engines; Use of additives to improve the performance with alternative fuels; Hybrid power plants and fuel cell.

Text Books:

1. Alternative Fuels: The Future of Hydrogen, Second Edition**,** Michael Frank Hordeski, CRC Press

Reference Books:

1. Alternative Fuels for Transportation, A S Ramadhas, CRC Press
2. Alternative Fuels & Advanced Technology Vehicles: Incentives & Considerations
3. Thomas Huber, Jack Spera, Nova Science Publishers

Sri Krishnadevaraya University College of Engineering & Technology
Ananthapuramu – 515 003 (A.P) India
Mechanical Engineering

Course Code	Advanced Refrigeration & Air Conditioning (PE-II)	L	T	P	C
		3	0	0	3
Semester		I			

Course Objectives:

- To teach the students about the methods of Refrigeration and its types, Psychometric and its principles. Teaching the cycle analysis pertaining to various Refrigeration systems, Air conditioning systems, and cooling load calculations.

Course Outcomes (CO):

On successful completion of the course, the students will able to:

- Understand the concept to various fuels and combustion and effect of environment.
- Relate the performance of a vapour compression refrigeration cycles under specified inlet and outlet conditions. Identify the modifications required in an impossible reversed Carnot cycle to convert it into practical cycle for refrigeration applications.
- Demonstrate the working principle and coefficient of performance of a heat pump, heat engine and refrigerator Illustrate the working principles, limitations of practical aqua ammonia, LiBr Water and Electrolux vapour absorption refrigeration systems.
- Analyze theoretical and practical steam jet refrigeration cycles with T-S and P-h charts by stating merits, limitations, etc. Discuss the measures to protect the ozone layer through global control, eventually elimination of production and utilization of ozone depleting substances. Classify the equipment used for the refrigeration, air conditioning purposes with suitable materials and refrigerant pairs

UNIT - I

Refrigeration Cycles and Analysis: Development of Vapor Compression Refrigeration Cycle from Reverse Carnot Cycle- conditions for high COP-deviations from ideal vapor compression cycle, Multi- pressure Systems, Cascade Systems-Analysis.

UNIT - II

Main System Components: Compressor- Types, performance, Characteristics of Reciprocating Compressors, Capacity Control, Types of Evaporators & Condensers and their functional aspects, Expansion Devices and their Behavior with fluctuating load.
Refrigerants: Classification of Refrigerants, Refrigerant properties, Oil Compatibility, Environmental Impact-Montreal / Kyoto protocols-Eco Friendly Refrigerants. Different Types of Refrigeration Tools , Evacuation and Charging Unit , Recovery and Recycling Unit , Vacuum Pumps.

UNIT - III

Systems Balance and Controls: Estimation of Cooling Load, System Equilibrium and Cycling Controls, Electric Circuits in- Refrigerators, Window A/C, Types of motors, Relays.
Other Refrigeration Cycles: Vapor Absorption Systems-Aqua Ammonia & LiBr Systems,Steam Jet Refrigeration Thermo Electric Refrigeration, Air Refrigeration cycles.

UNIT - IV

Summer and Winter Air Conditioning: Air conditioning processes-RSHF, summer Air conditioning, Winter Air conditioning Bypass Factor. Applications with specified ventilation air quantity- Use of ERSHF, Application with low latent heat loads and high latent heat loads.

UNIT - V

Load Estimation and Air Conditioning Controls: Solar Radiation-Heat Gain through Glasses, Heat Transfer through Walls and Roofs-Total cooling load estimation. Controls of temperature, Humidity, and Airflow
Text Books:
1. Principles of refrigeration- Dossat R.J., John Wiley, S.I. Version (2001). 2. Refrigeration and Air conditioning-Stoecker W.F., McGraw-Hill Book, Company, 1989 3. 3. Refrigeration and Air conditioning- Jordan and Priester, 1985.
Reference Books:
1. Principles and Refrigeration- Goshnay W.B., Cambridge, University Press, 1985. 2. Solid state electronic controls for HVACR' -Langley, Billy C., 'Prentice-Hall 1986 3. Refrigeration and Air Conditioning- Arora C.P., Tata McGraw Hill Pub. Company 4. Handbook of Air Conditioning Systems design- Carrier Air Conditioning Co., McGraw Hill, 5. Refrigeration and Air Conditioning (3/e) - Langley Billy C., Engie wood Cliffs (N.J) PHI. 6. Fundamentals and equipment- 4 volumes-ASHRAE Inc. 2005. 7. Air Conditioning Engineering-Jones, Edward Amold pub. 2001

Sri Krishnadevaraya University College of Engineering & Technology
Ananthapuramu – 515 003 (A.P) India
Mechanical Engineering

Course Code	Finite Element Analysis in Thermal Engineering (PE-II)	L	T	P	C
		3	0	0	3
Semester		I			

Course Objectives:

1. To providethefundamentalconceptsofthetheoryofthefiniteelementmethod
2. To develop proficiency in the application of the finite element method (modeling, analysis, and interpretation of results) to realistic engineering problems through the use of a major commercial general-purpose finite element code.

Course Outcomes (CO):

On successful completion of the course, the students will able to:

1. To obtain an understanding of the fundamental theory of the FEA method;
2. To develop the ability to generate the governing FE equations for systems governed by partial differential equations;
3. To understand the use of the basic finite elements for structural applications using truss, beam, frame, and plane elements; and
4. To understand the application and use of the FE method for heat transfer problems

UNIT - I

Introduction to FEM: basic concepts, application of FEM, general description, advantages of FEM, comparison of FEM with other methods: finite difference method, Variational method, Gale kin Method, basic element shapes, interpolation function. Virtual energy principle, treatment of boundary conditions, solution of system of equations, basic equations of elasticity, strain displacement relations.

1-D structural problems: axial bar element, stiffness matrix, load vector, temperature effects, quadratic shape function, analysis of trusses – plane truss and space truss elements.

UNIT - II

Analysis of beams, frames – Hermite shape functions, stiffness matrix, load vector problems, analysis.

2-D problems – CST, force terms, stiffness matrix and load vector, boundary conditions, Iso-parametric element, Quadric element, shape functions, Numerical Integration, 3-D problems – Tetrahedron element, Jacobian matrix, stiffness matrix.

UNIT - III

Axis Symmetric formulations, Finite Element Modeling- Triangular element, Problem modeling and Boundary conditions

Dynamic considerations, Dynamic equations, consistent mass matrix, Eigen values, Eigen vector, natural frequencies, mode shapes, modal analysis.

UNIT - IV

Scalar field problems – Generalized Heat Conduction Equation – Variation Principle – Boundary Conditions – Internal heat generation, heat flux and convection - 1-D Steady state Heat conduction – Thermal load vector - 1-D fin element – Quadratic fin elements I D unsteady state heat conduction – Thermal load vector - 2-D steady state heat conduction – Concepts of 3D heat conduction Finite Element Formulation of Torsion, Potential flow, seepage and fluid flow in ducts.

UNIT - V

Sri Krishnadevaraya University College of Engineering & Technology
Ananthapuramu – 515 003 (A.P) India
Mechanical Engineering

Computer Implementation : Pre-processing , mesh generation, elements connecting, boundary conditions, input of material and processing characteristics – solutions and post processing- overview and application packages
Text Books:
1. Finite Element Methods, Alavala, PHI 2. Introduction to finite elements in engineering , Tirupathi K. Chandrapatla and Ashok D. Belagundu.
Reference Books:
1. An Introduction to Finite Element Methods, S.S. Rao , Pegamon, New York. 2. The Finite element method in Engineering science, O.C. Aienkowitz, Mc. Graw Hill. 3. Concepts and applications of finite element analysis, Robert Cook. 4. Finite Element Methods in Engineering analysis, K.J. Bathe. 5. The finite element method in Heat transfer analysis- Lewis R.W, Morgan.K, Thomas H.R. and Seetharaman K.N, John Wiley, 1994

Sri Krishnadevaraya University College of Engineering & Technology
Ananthapuramu – 515 003 (A.P) India
Mechanical Engineering

Course Code	FUELS & COMBUSTION TECHNOLOGY (PE-II)	L	T	P	C
		3	0	0	3
Semester		I			

Course Objectives:

- To know the concepts of stoichiometry & kinetics for Solid, Liquid &Gaseous Fuels. To achieve an understanding of the basic concepts of combustion equipments

Course Outcomes (CO):

On successful completion of the course, the students will able to:

- Understand the concept to various fuels and combustion and effect of environment.

UNIT - I

CHARACTERIZATION Fuels - Types and Characteristics of Fuels - Determination of Properties of Fuels – Fuels Analysis ProximateandUltimateAnalysis-MoistureDetermination-CalorificValue Gross & Net Calorific Values - Calorimetry - DuLong's Formula for CV Estimation -Flue gas Analysis - Orsat Apparatus - Fuel & Ash Storage & Handling – Spontaneous Ignition Temperatures.

UNIT - II

Solid Fuels Types - Coal Family - Properties - Calorific Value - ROM, DMMF, DAF and Bone Dry Basis - Ranking - Bulk & Apparent Density - Storage - Wash ability - Coking & Caking Coals – Renewable Solid Fuels - Biomass - Wood Waste - Agro Fuels – Manufactured Solid Fuels.

Liquid Fuels Types - Sources - Petroleum Fractions - Classification - Refining - Properties of Liquid Fuels - Calorific Value, Specific Gravity, Flash & Fire Point, Octane Number, Cetane Number etc, -Alcohols-TarSandOil Liquefaction of Solid Fuels.

UNIT - III

GASEOUSFUELS: Classification-Composition&Properties-EstimationofCalorificValue-GasCalorimeter. Rich & Lean Gas - Wobbe Index - Natural Gas - Dry & Wet Natural Gas - Stripped NG - Foul & Sweet NG - LPG - LNG - CNG - Methane - Producer Gas -Gasifiers - Water Gas - Town Gas - Coal Gasification - Gasification Efficiency - Non –Thermal Route-Biogas-Digesters -Reactions -Viability-Economics.

UNIT - IV

COMBUSTION:STOICHIOMETRY&KINETICS Stoichiometry - Mass Basis & Volume Basis - Excess Air Calculation - Fuel & Flue Gas Compositions Calculations -Rapid Methods - Combustion Processes -StationaryFlame - Surface or Flameless Combustion - Submerged Combustion - Pulsating & SlowCombustion Explosive Combustion. Mechanism of Combustion - Ignition & IgnitionEnergy -Spontaneous Combustion – Flame Propagation - Solid, Liquid& GaseousFuels Combustion - Flame Temperature - Theoretical, Adiabatic & Actual – Ignition Limits -Limits of Inflammability.

UNIT - V

COMBUSTIONEQUIPMENTS Coal Burning Equipments - Types - Pulverized Coal Firing - Fluidized Bed Firing -FixedBed&RecycledBed CycloneFiring-SpreaderStokers-VibratingGrateStokers - Sprinkler Stokers, Traveling Grate Stokers. Oil Burners - Vaporizing Burners, Atomizing Burners - Design of Burners. Gas Burners - Atmospheric Gas Burners – Air Aspiration Gas Burners - Burners Classification according to Flame Structures – Factors Affecting Burners& Combustion.

Sri Krishnadevaraya University College of Engineering & Technology
Ananthapuramu – 515 003 (A.P) India
Mechanical Engineering

Text Books:
1. SamirSarkar,Fuels&Combustion,2ndEdition,OrientLongman,1990 2. Bhatt,VoraStoichiometry,2ndEdition,TataMcgrawHill,1984 3. BlokhAG,HeatTransferin Steam BoilerFurnace,HemispherePublishingCorpn,1988.
Reference Books:
1. CivilDavies,CalculationsinFurnaceTechnology,PergamonPress,Oxford,1966. 2. SharmaSP, MohanChander, Fuels&Combustion, TataMcgrawHill, 1984

Sri Krishnadevaraya University College of Engineering & Technology
Ananthapuramu – 515 003 (A.P) India
Mechanical Engineering

Course Code	ADVANCED FLUID MECHANICS LAB – I	L	T	P	C
		0	0	3	1.5
Semester		I			

Course Objectives:

1. To introduce students to the working of compressors.
2. To impart knowledge on different types of turbines.
3. To impart knowledge on the working of different refrigeration systems.
4. To familiarize concepts of air conditioning systems and heat load concepts

Course Outcomes (CO):

On successful completion of the course, the students will able to:

1. Understand the concept to various heads and discharges through notches.

List of Experiments:

1. Calibration of Venturi meter.
2. Calibration of Orifice meter
3. Determination of Coefficient of discharge for a small orifice by constant head method.
4. Determination of Coefficient of discharge for a small orifice by variable head method.
5. Determination of loss of head in a sudden contraction.
6. Performance test on Impulse turbines
7. Performance test on reaction turbines (Francis turbine)
8. Impact of jet performance
9. Performance test on centrifugal pump, determination of operating point and efficiency
10. Performance test on Reciprocating pump, determination of operating point and efficiency
11. Calibration of Rota meter test rig.
12. Discharge through Orifice and mouth piece apparatus.
13. Metacentric height apparatus.
14. Bernoulli's theorem apparatus
15. Hydraulic flume- open channel apparatus.
16. Reynolds Experiment.
17. Gear pump test rig.
18. Discharge through Notches apparatus.
19. Discharge through Weirs apparatus.
20. Multi stage centrifugal pump test rig.
21. Tilting flume apparatus-3m and 5m.
22. Pitot tube apparatus.

Sri Krishnadevaraya University College of Engineering & Technology
Ananthapuramu – 515 003 (A.P) India
Mechanical Engineering

Course Code	THERMAL ENGINEERING LAB – I	L	T	P	C
		0	0	3	1.5
Semester		I			

Course Objectives:

1. To introduce students to the working of compressors.
2. To impart knowledge on COP.
3. To impart knowledge on the working of different refrigeration systems.
4. To familiarize concepts of air conditioning systems and heat load concepts

Course Outcomes (CO):

After completing this course, the students can

1. Understand the working of compressors.
2. Understand the working of different refrigeration systems.
3. Understand the working of different air conditioning systems

List of Experiments:

1. To find the exhaust emissions of an automobile (HC, CO, NOX) . 2.
2. Analysis of exhaust gases on IC engine. 3.
3. Combustion analysis of CI engine
4. To find Octane number of given blends of fuel.
5. Performance analysis of Heat Pipe
6. Two Phase flow heat transfer estimation.
7. To estimate the COP of a vapour compression refrigeration system (Refrigerator).
8. To find the solar flat plate collector efficiency.
9. To find direct solar incident flux absorbed by using Pyranometer or consentratic parabolic collector.
10. Case study for energy audit.
11. Flame propagation analysis of gaseous fuels.
12. Solar flat plate collector apparatus.
13. Evacuative tube concentrator.
14. Compressibility factor measurement set up.
15. Dryness fraction estimation of steam.

Sri Krishnadevaraya University College of Engineering & Technology
Ananthapuramu – 515 003 (A.P) India
Mechanical Engineering

Course Code	RESEARCH METHODOLOGY AND IPR	L	T	P	C
		2	0	0	2
Semester		I			

Course Objectives:

1. Identify an appropriate research problem in their interesting domain.
2. Understand ethical issues
3. Understand the Preparation of a research project thesis report.
4. Understand the law of patent and copyrights.
5. Understand the Adequate knowledge on IPR

Course Outcomes (CO):

On successful completion of the course, the students will able to:

1. Understand research problem formulation.
2. Analyze research related information
3. Follow research ethics
4. Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
5. Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
6. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

UNIT - I

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

UNIT - II

Effective literature studies approaches, analysis Plagiarism, Research ethics, Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

UNIT - III

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.

UNIT - IV

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

UNIT - V

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.

Text Books:

1. Stuart Melville and Wayne Goddard, "Research methodology: An introduction for science & engineering students'"

2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"

Reference Books:

1. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
2. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd, 2007.
3. Mayall, "Industrial Design", McGraw Hill, 1992.
4. Niebel, "Product Design", McGraw Hill, 1974.

Course Code	ENGLISH FOR RESEARCH PAPER WRITING	L	T	P	C
		2	0	0	0
Semester		I			

Sri Krishnadevaraya University College of Engineering & Technology
Ananthapuramu – 515 003 (A.P) India
Mechanical Engineering

Course Objectives:	
1. Understand the essentials of writing skills and their level of readability 2. Learn about what to write in each section 3. Ensure qualitative presentation with linguistic accuracy	
Course Outcomes (CO):	
On successful completion of the course, the students will able to: 1. Understand that how to improve your writing skills and level of readability 2. Learn about what to write in each section 3. Understand the skills needed when writing a Title Ensure the good quality of paper at very first-time submission	
UNIT - I	
Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness	
UNIT - II	
Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction	
UNIT - III	
Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check	
UNIT - IV	
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	
UNIT - V	
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. useful phrases, how to ensure paper is as good as it could possibly be the first- time submission	
Suggested Readings:	
1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books) 2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press 3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman'sbook . 4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011	

Course Code	ADVANCED IC ENGINES	L	T	P	C
		3	0	0	3

Sri Krishnadevaraya University College of Engineering & Technology
Ananthapuramu – 515 003 (A.P) India
Mechanical Engineering

Semester	**II**
Course Objectives:	
1. To understand the underlying principles of operation of different IC Engines and components. 2. To provide knowledge on pollutant formation, control, alternate fuel etc.	
Course Outcomes (CO):	
On successful completion of the course, the students will able to: 1. compare the operations of different IC Engine and components and can evaluate the pollutant formation, control, alternate fuel	
UNIT - I	
Introduction – Historical Review – Engine Types – Design and operating Parameters. **Cycle Analysis:** Thermo-chemistry of Fuel – Air mixtures, properties – Ideal Models of Engine cycles – Real Engine cycles - differences and Factors responsible for – Computer Modeling.	
UNIT - II	
GAS EXCHANGE PROCESSES: Volumetric Efficiency–Flow through ports – Supercharging and Turbo charging. **Charge Motion**: Mean velocity and Turbulent characteristics – Swirl, Squish – Pre-chamber Engine flows.	
UNIT - III	
ENGINE COMBUSTION IN S.I ENGINES: Combustion and Speed – Cyclic Variations – Ignition –Abnormal combustion Fuel factors, MPFI, SI engine testing. **COMBUSTION IN CI ENGINES**: Essential Features – Types off Cycle. Pr. Data – Fuel Spray Behavior – Ignition Delay – Mixing Formation and control, Common rail fuel injection system.	
UNIT - IV	
POLLUTANT FORMATION AND CONTROL: Nature and extent of problems – Nitrogen Oxides, Carbon monoxide, unburnt Hydrocarbon and particulate – Emissions – Measurement – Exhaust Gas Treatment, Catalytic converter, SCR, Particulate Traps, Lean, NOx, Catalysts.	
UNIT - V	
ENGINE HEAT TRANSFER: Importance of heat transfer, heat transfer and engine energy balance, Convective heat transfer , radiation heat transfer, Engine operating characteristics. Fuel supply systems for S.I. and C.I engines to use gaseous fuels like LPG, CNG and Hydrogen. **MODERN TRENDS IN IC ENGINES:** Lean Burning and Adiabatic concepts, Rotary Engines, Modification in I.C engines to suit Bio – fuels, HCCI and GDI concepts.	
Text Books:	
1. I.C. Engines / V.Ganesan/TMH 2. I.C. Engines Fundamentals/Heywood/TMH 3. I.C. Engines/G.K. Pathak & DK Chevan/ Standerd Publications 4. I.C. Engines /RK Rajput/Laxmi Publications	
Reference Books:	
1. Computer Simulation of C.I. Engine Process/ V.Ganesan/University Press 2. Fundamentals of IC Engines/HN Gupta/PHI/2nd edition 3. I.C. Engines/Fergnson/Wiley	

Sri Krishnadevaraya University College of Engineering & Technology
Ananthapuramu – 515 003 (A.P) India
Mechanical Engineering

4. 8. The I.C. Engine in theory and Practice Vol.I / Teylor / IT Prof. And Vol.II

Course Code	ADVANCED HEAT AND MASS TRANSFER	L	T	P	C
		3	0	0	3
Semester		II			

Course Objectives:

1. Develop the ability to use the heat transfer concepts for various applications like finned systems, turbulence flows, high speed flows.
2. Analyze the thermal analysis and sizing of heat exchangers and to learn the heat transfer coefficient for compact heat exchanges.
3. Achieve an understanding of the basic concepts of phase change processes and mass transfer.

Course Outcomes (CO):

On successful completion of the course, the students will able to:

1. Apply the law of thermodynamics to engines.

UNIT - I

BRIEF INTRODUCTION TO DIFFERENT MODES OF HEAT TRANSFER:
Conduction: General heat Conduction equation, initial and boundary conditions.Transient heat conduction: Lumped system analysis, Heisler charts, semi infinite solid,use of shape factors in conduction,2D transient heat conduction, product solutions.

UNIT - II

FINITE DIFFERENCE METHODS FOR CONDUCTION: ID & 2D steady state and Simple transient heat conduction problems, implicit and explicit methods.
FORCED CONVECTION: Equations of fluid flow, concepts of continuity, momentum equations, derivation of energy equation, methods to determine heat transfer coefficient: Analytical methods, dimensional analysis and concept of exact solution. Approximate method, ntegral analysis.

UNIT - III

EXTERNAL FLOWS: Flow over a flat plate: Integral method for laminar heat transfer coefficient for different velocity and temperature profiles. Application of empirical relations to variation geometries for laminar and turbulent flows.
INTERNAL FLOWS: Fully developed flow: Integral analysis for laminar heat transfer coefficient,types of flow, constant wall temperature and constant heat flux boundary conditions, hydrodynamic &thermal entry lengths; use of empirical correlations.

UNIT - IV

FREE CONVECTION: Approximate analysis on laminar free convective heat transfer, boussinesque approximation ,different geometries, combined free and forced convection.
BOILING AND CONDENSATION: Boiling curve, correlations, Nusselts theory of film condensation on a vertical plate, assumptions & correlations of film condensation for different geometries.
HEAT EXCHANGERS Types of Heat Exchangers, LMTD and NTU methods

UNIT - V

RADIATION HEAT TRANSFER: Radiant heat exchange in grey, non, grey bodies, with transmitting, Reflecting and absorbing media, specular surfaces, gas radiation, from flames.
MASS TRANSFER: Concepts of mass transfer, diffusion & convective mass transfer analogies, significance of non-dimensional numbers.

Sri Krishnadevaraya University College of Engineering & Technology
Ananthapuramu – 515 003 (A.P) India
Mechanical Engineering

Text Books:
1. Principles of Heat Transfer / Frank Kreith / Cengage Learning 2. Heat Transfer / Necati Ozisik / TMH
Reference Books:
1. Fundamentals of Heat and Mass Transfer,5th Ed. / Frank P. Incropera/John Wiley 2. Elements of Heat Transfer/E. Radha Krishna/CRC Press/2012 3. Introduction to Heat Transfer/SK Som/PHI 4. Heat Transfer / Nellis& Klein / Cambridge University Press / 2012. 5. Heat Transfer/ P.S. Ghoshdastidar/ Oxford Press 6. Engg. Heat & Mass Transfer/ Sarat K. Das/DhanpatRai 7. Heat Transfer/ P.K.Nag /TMH 8. Heat Transfer / J.P Holman/MGH

Course Code	Solar Energy Technologies (PE-III)	L	T	P	C
		3	0	0	3

Sri Krishnadevaraya University College of Engineering & Technology
Ananthapuramu – 515 003 (A.P) India
Mechanical Engineering

Semester	**II**
Course Objectives:	
1. Develop the ability to use the solar energy for various potential like sun, earth. 2. Analyze the flat, cylindrical, parabolic collectors. 3. Achieve the thermal energy storage and direct energy conversion.	
Course Outcomes (CO):	
On successful completion of the course, the students will able to: 1. Understand the concept of solar energy	
UNIT - I	
INTRODUCTION: Solar energy option, specialty and potential – Sun – Earth – Solar radiation, beam and diffuse – measurement – estimation of average solar radiation on horizontal and tilted surfaces – problems – applications. Capturing solar radiation – physical principles of collection – types – liquid flat plate collectors – construction details – performance analysis – concentrating collection – flat plate collectors with plane reflectors– cylindrical parabolic collectors – Orientation and tracking – Performance Analysis.	
UNIT - II	
DESIGN OF SOLAR WATER HEATING SYSTEM AND LAYOUT: Power generation – solar central receiver system – Heliostats and Receiver – Heat transport system – solar distributed receiver system – Power cycles, working fluids and prime movers, concentration ratio.	
UNIT - III	
THERMAL ENERGY STORAGE: Introduction – Need for – Methods of sensible heat storage using solids and liquids – Packed bed storage – Latent heat storage – working principle – construction – application and limitations. Other solar devices – stills, air heaters, dryers, Solar Ponds & Solar Refrigeration, active and passive heating systems.	
UNIT - IV	
DIRECT ENERGY CONVERSION: Solid, state principles – semiconductors – solar cells – performance – modular construction – applications. conversion efficiencies calculations.	
UNIT - V	
ECONOMICS: Principles of Economic Analysis – Discounted cash flow – Solar system – life cycle costs – cost benefit analysis and optimization – cost based analysis of water heating and photo voltaic applications.	
Text Books:	
1. Principles of solar engineering/ Kreith and Kerider/Taylor and Franscis/2nd edition	
Reference Books:	
1. Solar energy thermal processes/Duffie and Beckman/John Wiley & Sons 2. Solar energy: Principles of Thermal Collection and Storage/Sukhatme/TMH/2nd edition 3. Solar energy/Garg/TMH 4. Solar energy/Magal/McGraw Hill 5. Solar Thermal Engineering Systems /Tiwari and Suneja/Narosa 6. Power plant Technology/ El Wakil/TMH	

Sri Krishnadevaraya University College of Engineering & Technology
Ananthapuramu – 515 003 (A.P) India
Mechanical Engineering

Course Code	Advanced Power Plant Engineering (PE-III)	L	T	P	C
		3	0	0	3
Semester		II			

Course Objectives:

1. Learn the sources of energy
2. Methods of pollution control
3. Know the various power plants

Course Outcomes (CO):

On successful completion of the course, the students will able to:

1. Understand the concept of energy, pollution control and various types of power plants.

UNIT - I

Introduction to the sources of energy – resources and development of power in India.

STEAM POWER PLANT: Plant layout, working of different circuits, fuel handling equipments, types of coals, coal handling, choice of handling equipment, coal storage, ash handling systems. Combustion: properties of coal – overfeed and underfeed fuel beds, traveling grate stokers, spreader stokers, retort stokers, pulverized fuel burning system and its components, combustion needs and draught system, cyclone furnace, design and construction, dust collectors, cooling towers and heat rejection. corrosion and feed water treatment.

UNIT - II

GAS TURBINE PLANT: Introduction – classification , construction – layout with auxiliaries, combined cycle power plants and comparison. Cogeneration of Power and Process heat. Waste heat recovery systems.

HYDRO PROJECTS AND PLANT: Classification – typical layouts – plant auxiliaries – plant operation pumped storage plants.

UNIT - III

NUCLEAR POWER STATION: Nuclear fuel – breeding and fertile materials – nuclear reactor – reactor operation.

TYPES OF REACTORS: Pressurized water reactor, boiling water reactor, sodium,graphite reactor, fast breeder reactor, homogeneous reactor, gas cooled reactor, radiation hazards and shielding – radioactive waste disposal.

UNIT - IV

COMBINED OPERATIONS OF DIFFERENT POWER PLANTS: Introduction, advantages of combined working, load division between power stations, storage type hydro,electric plant in combination with steam plant, run,of,river plant in combination with steam plant, pump storage plant in combination with steam or nuclear power plant, co,ordination of hydro,electric and gas turbine stations, co,ordination of hydro,electric and nuclear power stations, co,ordination of different types of power plants.

POWER PLANT INSTRUMENTATION AND CONTROL: Importance of measurement and instrumentation in power plant, measurement of water purity, gas analysis, O_2 and CO_2 measurements, measurement of smoke and dust, measurement of moisture in carbon dioxide circuit, nuclear measurements.

UNIT - V

POWER PLANT ECONOMICS AND ENVIRONMENTAL CONSIDERATIONS: Capital cost, investment of fixed charges, operating costs, general arrangement of power distribution, load curves, load duration curve, definitions of connected load, maximum

Sri Krishnadevaraya University College of Engineering & Technology
Ananthapuramu – 515 003 (A.P) India
Mechanical Engineering

demand, demand factor, average load, load factor, diversity factor – related exercises. effluents from power plants and Impact on environment – pollutants and pollution standards – methods of pollution control.
Text Books:
1. A course in Power Plant Engineering /Arora and Domkundwar/Dhanpatrai & Co. 2. Power Plant Engineering /P.C.Sharma / S.K.Kataria Pub
Reference Books:
1. Power Plant Engineering: P.K.Nag/ II Edition /TMH. 2. Power station Engineering – ElWakil / McGrawHill. 3. An Introduction to Power Plant Technology / G.D. Rai/Khanna Publishers

Sri Krishnadevaraya University College of Engineering & Technology
Ananthapuramu – 515 003 (A.P) India
Mechanical Engineering

Course Code	Design Of Heat Exchanger (PE-III)	L	T	P	C
		3	0	0	3
Semester		II			

Course Objectives:

1. To learn the thermal and stress analysis on various parts of the heat exchangers.
2. To analyze the sizing and rating of the heat exchangers for various applications.

Course Outcomes (CO):

On successful completion of the course, the students will able to:

1. Design the heat exchanger based on the information provided for a particular application and do the cost economic analysis.

UNIT - I

FUNDAMENTALS OF HEAT EXCHANGER: Temperature distribution and its implications types – shell and tube heat exchangers – regenerators and recuperators – analysis of heat exchangers – LMTD and effectiveness method.

UNIT - II

FLOW AND STRESS ANALYSIS Effect of turbulence – friction factor – pressure loss – stress in tubes – header sheets and pressure vessels – thermal stresses, shear stresses - types of failures.

UNIT - III

DESIGN ASPECTS

Heat transfer and pressure loss – flow configuration – effect of baffles – effect of deviations from ideality – design of double pipe - finned tube - shell and tube heat exchangers - simulation of heat exchangers.

UNIT - IV

COMPACT AND PLATE HEAT EXCHANGERS

Types – merits and demerits – design of compact heat exchangers, plate heat exchangers – performance influencing parameters - limitations.

UNIT - V

CONDENSERS AND COOLING TOWERS

Design of surface and evaporative condensers – cooling tower – performance characteristics.

Text Books:

1. Sadik Kakac and Hongtan Liu, Heat Exchangers Selection, Rating and Thermal Design, CRC Press, 2002

Reference Books:

1. Arthur. P Frass, Heat Exchanger Design, John Wiley & Sons, 1988.
2. Taborek.T, Hewitt.G.F and Afgan.N, Heat Exchangers, Theory and Practice, McGraw-Hill Book Co. 1980.
3. Hewitt.G.F, Shires.G.L and Bott.T.R, Process Heat Transfer, CRC Press, 1994.

Sri Krishnadevaraya University College of Engineering & Technology
Ananthapuramu – 515 003 (A.P) India
Mechanical Engineering

Course Code	Pollution Control Technologies (PE-IV)	L	T	P	C
		3	0	0	3
Semester		II			

Course Objectives:

1. To impart knowledge on the atmosphere and its present condition, global warming and eco legislations.
2. To detail on the sources of air, water and noise pollution and possible solutions for mitigating their degradation.
3. To elaborate on the technologies available for generating energy from waste.

Course Outcomes (CO):

On successful completion of the course, the students will able to:

1. Understand detail on the sources of air, water and noise pollution and possible solutions for mitigating their degradation.

UNIT - I

Introduction: Introduction to air pollution, classification of pollutants, their effects, impact of environment on human.

Air Pollution Sources: Mobile and stationary sources, types of plume dispersion mechanisms, air quality measurement concepts.

UNIT - II

Control devices for particulate contaminants: gravitational settlement, centrifugal and wet collectors, fabric filters, cyclone separators, electrostatic precipitators

UNIT - III

Control devices for gaseous contaminants from stationary sources: adsorption, adsorption, condensation, combustion based pollution control systems.

UNIT - IV

Automotive Emission control: Types and construction of catalytic converters, emission control through operating parameters and engine design, alternative fuels for emission reduction.

UNIT - V

Laws and regulations: National and international standards for mobile and stationary sources of air pollution.

Text Books:

1. Howard S. Peavy, Donald Rowe; Environmental Engineering; Tata Mc-Graw Hill, 1989.

Reference Books:

1.

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Sri Krishnadevaraya University College of Engineering & Technology
Ananthapuramu – 515 003 (A.P) India
Mechanical Engineering

Course Code	Optimization Techniques & Its Applications (PE-IV)	L	T	P	C
		3	0	0	3
Semester		II			

Course Objectives:

1. To introduce the fundamental concepts of Optimization Techniques;
2. To provide the concepts of various classical and modern methods of for constrained and unconstrained problems in both single and multivariable.
3. To make the learners aware of the importance of optimizations in real sceneries

Course Outcomes (CO):

On successful completion of the course, the students will able to:

1. Formulate optimization problems
2. Understand and apply the concept of optimality criteria for various type of optimization problems;
3. Solve various constrained and unconstrained problems in single variable as well as multivariable;

UNIT - I

SINGLE VARIABLE NON,LINEAR UNCONSTRAINED O PTIMIZATION: One dimensional Optimization methods:, Uni,modal function, elimination methods, Fibonacci method, golden section method, interpolation methods,quadratic & cubic interpolation methods.

UNIT - II

MULTI VARIABLE NON,LINEAR UNCONSTRAINED OPTIMIZATION: Direct search method,Univariant method , pattern search methods,Powell's, Hook ,Jeeves, Rosenbrock search methods, gradient methods, gradient of function, steepest decent method, Fletcher Reeves method, variable metric method.

UNIT - III

LINEAR PROGRAMMING: Formulation,Sensitivity analysis. Change in the constraints, cost coefficients, coefficients of the constraints, addition and deletion of variable, constraints. Duality,importance of duality, solution of primal from dual.

UNIT - IV

NON TRADITIONAL OPTIMIZATION ALGORITHMS: Genetics Algorithm,Working Principles, Similarities and Differences between Genetic Algorithm & Traditional Methods. Simulated Annealing, Working Principle,Simple Problems.

UNIT - V

APPLICATIONS TO THERMAL SYSTEMS: Optimal design of heat exchangers, condensers, evaporator and IC Engines.

Text Books:

1. Optimization theory & Applications / S.S.Rao / New Age International.
2. Optimization for Engineering Design, Kalyanmoy Deb, PHI

Reference Books:

1. S.D.Sharma / Operations Research
2. Optimization Techniques /Benugundu & Chandraputla / Pearson Asia.
3. Design of Thermal Systems / W.F Stoecker/Mc Graw Hill Education

Sri Krishnadevaraya University College of Engineering & Technology
Ananthapuramu – 515 003 (A.P) India
Mechanical Engineering

Course Code	Renewable Energy Technologies (PE-IV)	L	T	P	C
		3	0	0	3
Semester		II			

Course Objectives:

1. Familiarize with basics of solar radiation, available solar energy and its measurement.
2. Familiarize with solar collectors, construction and operation of solar collectors.
3. Understand solar energy conversion systems, applications and power generation.

Course Outcomes (CO):

On successful completion of the course, the students will able to:

1. Gain Knowledge on basic concepts of solar radiation and solar collectors
2. Design of a community Biogas plant
3. Know solar heating/cooling technique, solar distillation and drying.

UNIT - I

INTRODUCTION: Energy Scenario, Survey of energy resources. Classification and need for conventional energy resources.

SOLAR ENERGY: Sun , Earth relationship, Basic matter to waste heat energy circuit, Solar Radiation, Attention, Radiation measuring instruments.

SOLAR ENERGY APPLICATIONS: Solar water heating. Space heating, Active and passive heating. Energy storage. Selective surface. Solar stills and ponds, solar refrigeration, Photovoltaic generation.

UNIT - II

GEOTHERMAL ENERGY: Structure of earth, Geothermal Regions, Hot springs. Hot Rocks, Hot Aquifers. Analytical methods to estimate thermal potential. Harnessing techniques, Electricity generating systems.

UNIT - III

DIRECT ENERGY CONVERSION: Nuclear Fusion,Fusion, Fusion reaction, P,P cycle, Carbon cycle, Deuterium cycle, Condition for controlled fusion, Fuel cells and photovoltaic. Thermionic & thermoelectric generation, MHD generator.

HYDROGEN GAS AS FUEL: Production methods, Properties, I.C. Engine applications, Utilization strategy, Performance.

UNIT - IV

BIO,ENERGY: Biomass energy sources. Plant productivity, Biomass wastes, aerobic and Anaerobic bioconversion processes, Raw material and properties of bio,gas, Bio,gas plant technology and status, the energetic and economics of biomass systems, Biomass gasification

UNIT - V

WIND ENERGY: Wind, Beaufort number, Characteristics, Wind energy conversion systems, Types, Betz model. Interference factor. Power coefficient, Torque coefficient and Thrust coefficient, Lift machines and Drag machines. Matching, Electricity generation.

ENERGY FROM OCEANS: Tidal energy, Tides , Diurnal and semi,diurnal nature, Power from tides, Wave Energy, Waves, Theoretical energy available. Calculation of period and phase velocity of waves, Wave power systems, Submerged devices. Ocean thermal Energy, Principles, Heat exchangers, Pumping requirements, Practical considerations.

Text Books:

1. Renewable Energy Resources/ John Twidell& Tony Weir/Taylor & Francis/2nd edition

Reference Books:

Sri Krishnadevaraya University College of Engineering & Technology
Ananthapuramu – 515 003 (A.P) India
Mechanical Engineering

1. Renewable Energy Resources, Basic Principles and Applications/ G.N.Tiwari and M.K.Ghosal/ Narosa Publications
2. Biological Energy Resources/ Malcolm Fleischer & Chris Lawis/ E&FN Spon
3. Renewable Energy Sources / G.D Rai /Khanna Publishers

Sri Krishnadevaraya University College of Engineering & Technology
Ananthapuramu – 515 003 (A.P) India
Mechanical Engineering

Course Code	ADVANCED HEAT & MASS TRANSFER LAB	L	T	P	C
		0	0	3	1.5
Semester		II			

Course Objectives:

1. Become familiar with the instruments and equipment for the measurement of thermal conductivity, heat transfer coefficient and other heat transfer parameters.

Course Outcomes (CO):

On successful completion of the course, the students will able to:

1. Become familiar with the measurement equipments and procedure for the measurement of thermal conductivity, heat transfer coefficient and other heat transfer parameters.

LIST OF EXPERIMENTS:

1. Forced Convection Apparatus: Determination of theoretical, experimental and empirical values of convection heat transfer coefficient for internal forced convection through a circular GI pipe
2. Emissivity Apparatus: Determination of surface emissivity of a given aluminium test plate at a given absolute temperature
3. Heat Pipe Demonstrator: Demonstration of near isothermal characteristic exhibited by a heat pipe in comparison to stainless steel and copper pipes
4. Abel's apparatus: Determination of flash and fire points of a given oil sample
5. Redwood Viscometer No. 1: Determination of kinematic and absolute viscosities of an oil sample given
6. Distillation apparatus: Determination of distillation characteristic of a given sample of gasoline
7. Two-Stage Reciprocating Air-Compressor: Determination of volumetric efficiency of the compressor as a function of receiver pressure
8. Pin-Fin Apparatus: Determination of temperature distribution, efficiency and effectiveness of the fin working in forced convection environment
9. Natural Convection Apparatus: Determination of experimental and empirical values of convection heat transfer coefficient from a Vertical Heated Cylinder losing heat to quiescent air
10. Composite Slab Apparatus: Determination of theoretical end experimental values of equivalent thermal resistance of a composite slab.
11. Critical heat flux apparatus.
12. Guarded heat flux apparatus.
13. Two phase heat transfer apparatus.
14. Shell and tube heat exchanger.
15. Unsteady state of heat transfer(Transient heat conduction).

Sri Krishnadevaraya University College of Engineering & Technology
Ananthapuramu – 515 003 (A.P) India
Mechanical Engineering

Course Code	THERMAL ENGINEERING LAB – II	L	T	P	C
		0	0	3	1.5
Semester		II			

Course Objectives:

1. To become familiar with the instruments and equipment for the measurement of exhaust emissions.
2. To become familiar with IC Engines measurement.
3. To become familiar with solar parameters.

Course Outcomes (CO):

On successful completion of the course, the students will able to:

1. Become familiar with the measurement equipments and procedure for exhaust emission, IC Engines and solar parameters

LIST OF EXPERIMENTS:

1. Single-Cylinder Kirloskar CI Diesel Engine: Constant Speed Performance Test on Single- Cylinder Kirloskar CI Diesel Engine.
2. Single-Cylinder Kirloskar CI Diesel Engine: Motoring Test on Single-Cylinder Kirloskar CI Diesel Engine.
3. Single-Cylinder Kirloskar CI Diesel Engine: Retardation Test on Single-Cylinder Kirloskar CI Diesel Engine.
4. Lister and Textool IC Engines: Valve and Port Timing Diagrams on 4-stroke and 2-stroke IC Engines.
5. Hindustan Petrol Engine: Morse Test on 4-Cylinder Hindustan Petrol Engine.
6. Perkins CI Diesel Engine: Morse Test on 4-Cylnder Perkins CI Diesel Engine.
7. MPFI Petrol Engine: Performance Test on MPFI Petrol Engine.
8. Bio Gas-Diesel operated Twin-Cylinder Kirloskar CI Diesel Engine: Performance Test on Bio Gas-Diesel operated Twin-Cylinder Kirloskar CI Diesel Engine.
9. Axial Flow Fan: Constant Speed Performance Test on Axial Flow Fan.
10. Centrifugal Blower: Constant Speed Performance Test on a Centrifugal Blower.
11. Solar Energy Simulator: Perform tests on solar energy simulator
12. PV Cell: Conduct test to findout efficiency and to find VI characteristics when conned in series and Parallel.
13. Four stroke three cylinder petrol engine test rig with hydraulic loading.
14. Four stroke four cylinder petrol engine test rig with eddy current dynamometer loading.
15. Four stroke four cylinder petrol engine test rig with hydraulic loading.
16. Four stroke four cylinder Diesel engine test rig with hydraulic loading.
17. Twin cylinder four stroke Diesel engine test rig with mechanical loading.
18. Twin cylinder four stroke Diesel engine test rig with electrical loading.

Sri Krishnadevaraya University College of Engineering & Technology
Ananthapuramu – 515 003 (A.P) India
Mechanical Engineering

Course Code	DISASTER MANAGEMENT	L	T	P	C
		2	0	0	2
Semester		II			

Course Objectives

1. Learn to demonstrate critical understanding of key concepts in disaster risk reduction and humanitarian response.
2. Critically evaluate disaster risk reduction and humanitarian response policy and practice from Multiple perspectives.
3. Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations
4. Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in

UNIT -I **INTRODUCTION:**

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

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

UNIT - 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.

UNIT - III **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.

UNIT - IV **RISK ASSESSMENT 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.

UNIT - V **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.

Suggested Reading

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

Sri Krishnadevaraya University College of Engineering & Technology
Ananthapuramu – 515 003 (A.P) India
Mechanical Engineering

Course Code	STRESS MANAGEMENT BY YOGA	L	T	P	C
		2	0	0	0
Semester		II			

Course Objectives: This course will enable students

1. To achieve overall health of body and mind
2. To overcome stress

Course Outcomes(CO):

On successful completion of the course, the students will able to:

1. Develop healthy mind in a healthy body thus improving social health also
2. Improve efficiency

UNIT -I

Definitions of Eight parts of yoga.(Ashtanga)

UNIT - II

Yam and Niyam.

UNIT - III

Do`s and Don'ts inlife.

i) Ahinsa, satya, astheya, bramhacharya and aparigraha
ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

UNIT - IV

Asanand Pranayam

UNIT - V

i) Various yoga poses and their benefits for mind & body
ii) Regularization of breathing techniques and its effects-Types of pranayam

SuggestedReading

1.'Yogic Asanas for Group Training-Part-I":Janardan Swami Yoga bhyasi Mandal, Nagpur
2."Rajayoga or conquering the Internal Nature" by SwamiVivekananda, Advaita Ashrama (Publication Department), Kolkata

Sri Krishnadevaraya University College of Engineering & Technology
Ananthapuramu – 515 003 (A.P) India
Mechanical Engineering

Course Code	Waste to Energy (PE-V)	L	T	P	C
		3	0	0	3
Semester		III			

Course Objectives:

1. Familiarize with basics of energy, available energy from waste .
2. Familiarize with bio mass.
3. Understand energy from bio gas.

Course Outcomes (CO):

On successful completion of the course, the students will able to:

1. Gain Knowledge on basic concepts of energy from waste.
2. Design of a community Biogas plant and bio mass plant

UNIT - I

INTRODUCTION TO ENERGY FROM WASTE: Classification of waste as fuel,Agro based, Forest residue, Industrial waste , MSW, Conversion devices, Incinerators, gasifiers, digestors

UNIT - II

BIOMASS PYROLYSIS: Pyrolysis, Types, slow fast, Manufacture of charcoal, Methods Yields and application, Manufacture of pyrolytic oils and gases, yields and applications.

UNIT - III

BIO MASS GASIFICATION: Gasifiers, Fixed bed system, Downdraft and updraft gasifier– Fluidized bed gasifiers, Design, construction and operation, Gasifier burner arrangement for thermal heating, gasifier engine arrangement and electrical power Equilibrium and kinetic consideration in gasifier operation.

UNIT - IV

BIO MASS COMBUSTION: Biomass stoves, Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation , Operation of all the above biomass combustors.

UNIT - V

BIO GAS: Properties of biogas (Calorific value and composition) , Biogas plant technology and status , Bio energy system , Design and constructional features , Biomass resources and their classification , Biomass conversion processes , Thermo chemical conversion , Direct combustion ,biomass gasification , pyrolysis and liquefaction , biochemical conversion , anaerobic digestion, Types of biogas Plants, Applications , Alcohol production from biomass, Bio diesel production, Urban waste to energy conversion , Biomass energy programmed in India.

Text Books:

1. Biogas Technology , A Practical Hand Book , Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
2. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley &Sons, 1996.

Reference Books:

1. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.

Sri Krishnadevaraya University College of Engineering & Technology
Ananthapuramu – 515 003 (A.P) India
Mechanical Engineering

Course Code	Computational Fluid Dynamics (PE- V)	L	T	P	C
		3	0	0	3
Semester		III			

Course Objectives:

1. To develop finite difference and finite volume discredited forms of the CFD equations.
2. To formulate explicit & implicit algorithms for solving the Euler Eqns & Navier Stokes Eqns.

Course Outcomes (CO):

On successful completion of the course, the students will able to:

1. Formulate explicit &implicit algorithms for solving the Euler Eqns & Navier Stokes Eqns.

UNIT - I

INTRODUCTION: Finite difference method, finite volume method, finite element method, governing equations and boundary conditions. Derivation of finite difference equations.
SOLUTION METHODS: Solution methods of elliptical equations – finite difference formulations, interactive solution methods, direct method with Gaussian elimination.
Parabolic equations, explicit schemes and Von Neumann stability analysis, implicit schemes, alternating direction implicit schemes, approximate factorization, fractional step methods, direct method with tridiagonal matrix algorithm.

UNIT - II

HYPERBOLIC EQUATIONS: Explicit schemes and Von Neumann stability analysis, implicit schemes, multi step methods, nonlinear problems, second order one-dimensional wave equations. Burgers equations: Explicit and implicit schemes, Runge-Kutta method.

UNIT - III

FORMULATIONS OF INCOMPRESSIBLE VISCOUS FLOWS: Formulations of incompressible viscous flows by finite difference methods, pressure correction methods, vortex methods.
TREATMENT OF COMPRESSIBLE FLOWS: Potential equation, Eluer equations, Navier- Stokes system of equations, flow-field, dependent variation methods, boundary conditions.

UNIT - IV

FINITE VOLUME METHOD: Finite volume method via finite difference method, formulations for two and three, dimensional problems.

UNIT - V

STANDARD VARIATIONAL METHODS: Linear fluid flow problems, steady state problems, Transient problems.

Text Books:

1. Computational fluid dynamics, T. J.Chung, Cambridge University press,2002.
2. Computational Fluid Dynamics by John D. Anderson, McGraw Hill Book Company 2017.

Reference Books:

1. Text book of fluid dynamics, Frank Chorlton, CBS Publishers &distributors, 1985.
2. Computational Techniques for Fluid Dynamics, Volume 1& 2 By C. A. J. Fletcher, Springer Publication, 2012

Sri Krishnadevaraya University College of Engineering & Technology
Ananthapuramu – 515 003 (A.P) India
Mechanical Engineering

Course Code	Cryogenic Engineering (PE- V)	L	T	P	C
		3	0	0	3
Semester		II			

Course Objectives:

1. Impart basic knowledge of low temperature generation, difficulties in maintain in glow temperature and solutions
2. Understand applications of cryogenic refrigeration
3. Understand storage of cryogenic liquids and equipments, instruments used

Course Outcomes (CO):

On successful completion of the course, the students will able to:

1. Upon the completion of the course student will be able to understand the use of cryogenic systems, real-time difficulties in storing cryogenic liquids

UNIT - I

INTRODUCTION: Insight on Cryogenics, Properties of Cryogenic fluids, Material properties at Cryogenic Temperatures. Applications of Cryogenics in Space Programs, Superconductivity, Cryo Metallurgy, Medical applications.

UNIT - II

LIQUE FACTION CYCLES Carnot Liquefaction Cycle, F.O.M. and Yield of Liquefaction Cycles. Inversion Curve JouleThomsonEffect.LindeHampsonCycle,PrecooledLindeHampsonCycle,Claudes Cycle Dual Cycle, Ortho- Para hydrogen conversion, Eollins cycle, Simpson cycle, Critical Components in Liquefaction Systems

UNIT - III

SEPARATIONOFCRYOGENICGASES Binary Mixtures,T-C and H-C Diagrams, Principle of Rectification, Rectification Column Analysis-Mc Cabe Thiele Method. Adsorption Systems for purification.

UNIT - IV

CRYOGENICREFRIGERATORS
J.T.Cryocoolers,StirlingCycleRefrigerators,G.M.Cryocoolers,PulseTubeRefrigerators Regenerators used in Cryogenic Refrigerators, Dilution refrigerators, Magnetic Refrigerators

UNIT - V

HANDLING OFCRYOGENS
CryogenicDewar,CryogenicTransferLines.InsulationsusedinCryogenicSystems,Instrumentation tomeasureFlow,LevelandTemperature

Text Books:

1. KlausD.TimmerhausandThomasM.Flynn,CryogenicProcessEngineering,PlenumPress,NewYork,1989
2. RandallF. Barron, Cryogenic Systems, McGraw-Hill,1985.

Reference Books:

1. ScottR.B., CryogenicEngineering,VanNostrandandCo.,1962.
2. HeraldWeinstock,Cryogenic Technology,1969.
3. RobertW.Vance,Cryogenic
4. Technology,Johnwiley&Sons,Inc.,NewYork,London

Sri Krishnadevaraya University College of Engineering & Technology
Ananthapuramu – 515 003 (A.P) India
Mechanical Engineering

Course Code	MECHATRONICS (OE)	L	T	P	C
		3	0	0	3
Semester		III			

Course Objectives:

To study fundamental concepts of Signal condition

1. To understand the concepts of precision mechanical systems
2. To Learn different electronic interface subsystems
3. To be familiar with microcontrollers overview.
4. To understand the concepts of programmable logic controllers

Course Outcomes (CO):

On successful completion of the course, the students will able to:

1. Understand the various concepts, terminologies of Signal condition
2. Understand the basics electronic interface subsystems
3. Understand and apply various precision mechanical systems
4. Understand various applications of microcontrollers overview
5. Understand the controlling of programmable logic and programmable motion.

UNIT - I

INTRODUCTION : Definition – Trends - Control Methods: Standalone , PC Based (Real Time Operating Systems, Graphical User Interface , Simulation) - Applications: SPM, Robot, CNC, FMS, CIM. SIGNAL CONDITIONING : Introduction – Hardware - Digital I/O, Analog input – ADC, resolution , speed channels Filtering Noise using passive components – Resistors, capacitors - Amplifying signals using OP amps – Software - Digital Signal Processing – Low pass , high pass , notch filtering.

UNIT - II

PRECISION MECHANICAL SYSTEMS : Pneumatic Actuation Systems - Electro-pneumatic Actuation Systems - Hydraulic Actuation Systems - Electro-hydraulic Actuation Systems - Timing Belts – Ball Screw and Nut - Linear Motion Guides - Linear Bearings - Harmonic Transmission - Bearings- Motor / Drive Selection.

UNIT - III

ELECTRONIC INTERFACE SUBSYSTEMS : TTL, CMOS interfacing - Sensor interfacing – Actuator interfacing – solenoids , motors Isoation schemes- opto coupling, buffer IC's - Protection schemes – circuit breakers , over current sensing , resetable fuses , thermal dissipation - Power Supply - Bipolar transistors / mosfets ELECTROMECHANICAL DRIVES : Relays and Solenoids - Stepper Motors - DC brushed motors – DC brushless motors - DC servo motors - 4-quadrant servo drives , PWM's - Pulse Width Modulation – Variable Frequency Drives, Vector Drives - Drive System load calculation

UNIT - IV

MICROCONTROLLERS OVERVIEW: 8051 Microcontroller , micro processor structure - DigitalInterfacing - Analog Interfacing - Digital to Analog Convertors - Analog to Digital Convertors - Applications. Programming –Assembly , C (LED Blinking , Voltage measurement using ADC).

UNIT - V

PROGRAMMABLE LOGIC CONTROLLERS : Basic Structure - Programming : Ladder diagram -Timers, Internal Relays and Counters - Shift Registers - Master and Jump Controls - Data Handling Analog input / output - PLC Selection - Application. Lecture Hrs: 09
PROGRAMMABLE MOTION CONTROLLERS : Introduction - System Transfer Function – Laplace transform and its application in analysing differential equation of a

control system - Feedback Devices :Position , Velocity Sensors - Optical Incremental encoders - Proximity Sensors : Inductive , Capacitive ,
Text Books:
1. A text book of Mechatronics by Er.R.K. RAJPUT ., S.CHAND publications 2. A text book of Mechatronics by Nitalgour Premchand Mahalik ., McGraw Hill publications
Reference Books:
1. A text book of Mechatronics by W.Bolton ., Pearson Publications