Academic Regulations Programme Structure and Detailed Syllabus

Bachelor of Technology (B.Tech.)in

Mechanical Engineering

(Four Year Regular Programme)

(Applicable for Batches admitted from 2022-23)

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

(Autonomous)

Bachupally, Kukatpally, Hyderabad- 500 090

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY HYDERABAD

Academic Regulations for B.Tech. (Regular) under GR22

(Applicable for Batches Admitted from 2022-23)

Under Graduate Degree Programme in Engineering and Technology (UG)

Gokaraju Rangaraju Institute of Engineering and Technology (GRIET) offers a 4-year (8 Semesters) Bachelor of Technology (B.Tech.) degree programme. The following programmes are offered in GRIET.

S.No	Department	Programme Code	Programme
1	Civil Engineering	01	B.Tech. Civil Engineering
2	Electrical and Electronics Engineering	02	B.Tech. Electrical and Electronics Engineering
3	Mechanical Engineering	03	B.Tech. Mechanical Engineering
4	Electronics and Communication Engineering	04	B.Tech. Electronics and Communication Engineering
5	Computer Science and Engineering	05	B.Tech. Computer Science and Engineering
6	Information Technology	12	B.Tech. Information Technology
7	Computer Science and Business System	32	B.Tech. Computer Science & Business System
8	Computer Science and Engineering (AIML)	66	B.Tech. Computer Science and Engineering (AIML)
9	Computer Science and Engineering (Data Science)	67	B.Tech. Computer Science and Engineering (Data Science)

GR22 Regulations shall govern the above programmes offered by the Departments with effect from the students admitted to the programmes in 2022-23 academic year is given below.

1. **Medium of Instruction:** The medium of instruction (including examinations and reports) is English.

2. **Admissions:** Admission to the undergraduate (UG) Programme shall be made subject to the eligibility, qualifications and specialization prescribed by the Telangana State Government/JNTUH University from time to time. Admissions shall be made either on the basis of the merit rank obtained by the student in the common entrance examination conducted by the Government/University or on the basis of any other order of merit approved by the Government/University, subject to reservations as prescribed by the Government/University from time to time.

3. **Programme Pattern:**

   a) Each Academic Year of study is divided into two semesters.
   b) Minimum number of instruction days in each semester is 90.
   c) Grade points, based on percentage of marks awarded for each course will form the basis for calculation of SGPA (Semester Grade Point Average) and CGPA (Cumulative Grade Point Average).
   d) The total credits for the Programme are 160.
   e) A student has a choice to register for all courses in a semester / one less or one additional course from other semesters provided the student satisfies prerequisites.
   f) All the registered credits except Mandatory and Value Added Courses will be considered for the calculation of final CGPA.
   g) Each semester has 'Continuous Internal Evaluation (CIE)' and 'Semester End Examination (SEE)'. Choice Based Credit System (CBCS) and Credit Based Semester System (CBSS) as indicated by UGC, and course structure as suggested by AICTE are followed. The terms 'subject' and 'course' imply the same meaning.
   h) **Course Classification:** All courses offered for all undergraduate programmes in B.Tech. degree programmes are broadly classified as follows.

S. No.	Broad Course Classification	Course Group/ Category	Course Description
1	BS	Basic Science	Includes Basic Science Courses
2	ES	Engineering Science	Includes Engineering Courses
3	HS	Humanities and Social Sciences	Includes Management Courses
4	PC	Professional Core	Includes Core Courses related to the parent discipline/department/ branch of Engineering
5	PE	Professional Elective	Includes Elective Courses related to the parent discipline/ department/ branch of Engineering
6	OE	Open Elective	Elective Courses from other technical and/or emerging subjects
7	PW	Project Work	Project work, seminar and internship in industry or elsewhere
8	MC	Mandatory Courses	Environmental Sciences, Induction training, Indian Constitution, Essence of Indian Traditional Knowledge, Co and Extra Curricular Activities
9	VAC	Value Added Courses	Courses on current industry relevant topics improving breadth and depth in domain

4. **Award of B.Tech. Degree:** The Undergraduate Degree of B.Tech. shall be conferred by Jawaharlal Nehru Technological University Hyderabad (JNTUH), Hyderabad, on the students who are admitted to the programme and fulfill all the following academic requirements for the award of the degree

   a) A student pursues the course of study and completes it successfully in not less than four academic years and not more than eight academic years.
   b) A student has to register for all the 160 credits and secure all credits (with CGPA ≥ 5).
   c) A student must fulfill all the academic requirements for the award of the degree.

5. Attendance Requirements:

a) A student shall be eligible to appear for the semester-end examinations if he/she puts in a minimum of 75% of attendance in aggregate in all the courses concerned in the semester.

b) Condonation of shortage of attendance in aggregate up to 10% (65% and above and below 75%) in a semester may be granted. A committee headed by Dean (Academic Affairs) shall be the deciding authority for granting the condonation.

c) Students who have been granted condonation shall pay a fee as decided by the Finance Committee.

d) Shortage of Attendance more than 10% (attendance less than 65% in aggregate) shall in no case be condoned.

e) Students whose shortage of attendance is not condoned in any semester are detained and are not eligible to take their end examinations of that semester. **They get detained and their registration for that semester shall stand cancelled**, including all academic credentials (internal marks etc.,) of that semester. **They will not be promoted to the next semester**. They may seek re-registration for all those subjects registered in that semester in which the student is detained, by seeking re-admission into that semester as and when offered; if there are any professional electives and/ or open electives, the same may also be reregistered if offered. However, if those electives are not offered in later semesters, then alternate electives may be chosen from the **same** set of elective subjects offered under that category.

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

6. Paper Setting, Evaluation of Answer Scripts, Marks and Assessment:

a) Paper setting and evaluation of the answer scripts shall be done as per the procedures laid down by the Academic Council from time to time.

b) Distribution and Weightage of marks

S. No	Components	Internal	External	Total
1	Theory	40	60	100
2	Practical	40	60	100
3	Graphics for Engineers	40	60	100
4	Mini Project	40	60	100
5	Project Work	40	60	100

c) Continuous Internal Evaluation and Semester End Examinations: The assessment of the student's performance in each course will be based on Continuous Internal Evaluation (CIE) and Semester-End Examination (SEE). The marks for each of the component of assessment are fixed as shown in the following Table.

Assessment Procedure:

S. No	Component of Assessment	Marks Allotted	Type of Assessment	Scheme of Examinations
1	Theory	40	Internal Examination & Continuous Evaluation	1) Two mid semester examination shall be conducted for 30 marks each for a duration of 120 minutes. Average of the two mid exams shall be considered **i) Subjective – 20 marks** **ii) Objective – 10 marks** 2) Continuous Evaluation is for each unit using **i) Assignment – 05 marks** **ii) Quiz/Subject Viva-voce/PPT/Poster Presentation/ Case Study on a topic in the concerned subject – 05 marks**
		60	Semester end examination	The semester-end examination is for a duration of 3 hours
2	Practical	40	Internal Examination & Continuous Evaluation	One internal lab examination towards the end of course for a duration of 90 minutes with a viva of 5 minutes. **i) Internal Exam-10 marks** **ii) Viva voce – 10 marks** **iii) Continuous Assessment- 10 marks** **iv) G-Lab on Board(G-LOB) (Case study inter threading of all experiments of lab)/ Laboratory Project/Prototype Presentation/App Development -10 marks**
		60	Semester end examination	The semester-end examination is for a duration of 3 hours. **i) write-up (algorithm/flowchart/procedure) as per the task/experiment/program - 10 marks** **ii) task/experiment/program-15 marks** **iii) evaluation of results -15 marks** **iv) write-up (algorithm/flowchart/procedure) for another task/experiment/program- 10 marks** **v) viva-voce on concerned laboratory course - 10 marks**

3	Graphics for Engineers	40	Internal Examination & Continuous Evaluation	1) Two mid semester examination shall be conducted for 15 marks each for a duration of 90 minutes. Average of the two mid exams shall be considered 2) Day-to-Day activity -15 marks 3) Continuous Evaluation using • **Assignment – 05 marks** • **Quiz/Subject Viva-voce/PPT/Poster Presentation/ Case Study on a topic in the concerned subject – 05 marks**
		60	Semester end examination	The semester-end examination is for a duration of 3 hours

d) Mini Project:

S. No	Component of Assessment	Marks Allotted	Type of Assessment	Scheme of Examinations
1	Mini Project	40	Continuous Evaluation & Internal Evaluation	1) The supervisor continuously assesses the students for 20 marks **i) Continuous Assessment – 15 marks** • Abstract Presentation - 3 marks • Architectural Design Presentation - 3 marks • Modules Presentation - 3 marks • Execution Cycle 1 Presentation - 3 marks • Execution Cycle 2 Presentation - 3 marks **ii) Report – 5 marks** 2) At the end of the semester, Mini Project shall be displayed in the road show at the department level. Mini Project is evaluated by Mini Project Review Committee for **10 marks**. 3) Technical Event Participation in project area/MOOCs Course in project area/ Paper Publication/Publishing or Granting of a Patent/Hackathon participation/ Book Publication – **10 marks**
		60	External Evaluation	The mini project report shall be presented before Project Review Committee in the presence of External Examiner and the same is evaluated for **60 marks**.

Note:

i) Mini Project Review Committee consists of HoD, Mini Project Coordinator and Supervisor.

ii) Plagiarism check is compulsory for mini project report as per the plagiarism policy of GRIET.

e) Internship/Skill Development Course/ Industrial Training: Internship/Skill Development Course/Industrial Training shall be done by the student immediately after II-Year II Semester Examinations and pursue it during summer vacation/semester break & during III Year without effecting regular course work. Internship/Skill Development Course/Industrial Training at reputed organization shall be submitted in a report form and presented before the committee in III-year II semester before end semester examination.

f) Project Work (Phase–I and Phase-II):

S. No	Component of Assessment	Marks Allotted	Type of Assessment	Scheme of Examinations
1	Project Work (Phase- I and Phase -II)	40	Continuous Evaluation & Internal Evaluation	1) The supervisor continuously assesses the students for 20 marks **i) Continuous Assessment – 15 marks** • Abstract Presentation - 3 marks • Architectural Design Presentation - 3 marks • Modules Presentation - 3 marks • Execution Cycle 1 Presentation - 3 marks • Execution Cycle 2 Presentation – 3 marks **ii) Report – 5 marks** 2) At the end of the semester, Project work shall be displayed in the road show at the department level. Project work is evaluated by Project Review Committee for **10 marks**. 3) Technical Event Participation in project area/ MOOCs Course in project area/ Paper Publication/Publishing or Granting of a Patent/Hackathon participation/Book Publication – **10 marks.**
		60	External Evaluation	The Project report shall be presented before Project Review Committee in the presence of External Examiner and the same is evaluated for **60 marks**.

Note:

i) Project Review Committee consists of HoD, Project Coordinator and Supervisor.

ii) Plagiarism check is compulsory for project work report (Phase I and Phase II) as per the plagiarism policy of GRIET.

iii) The above rules are applicable for both Phase I and Phase II.

g) The evaluation of courses having ONLY internal marks in I-Year I Semester and II Semester is as follows:

- I Year courses: The internal evaluation is for 50 marks and it shall take place during I Mid-Term examination and II Mid-Term examination. The average marks of two Mid-Term examinations is the final for 50 marks. Student shall have to earn 40%, i.e 20 marks out of 50 marks from average of the two examinations. There shall be NO external evaluation. The student is deemed to have failed, if he/she (i) is absent as per schedule, or (ii) secures less than 40% marks in this course.
- II Year II Semester *Real-Time/Field-based Research Project/Societal Related Project* course: The internal evaluation is for 50 marks and it shall take place during I Mid-Term examination and II Mid-Term examination. The average marks of two Mid-Term examinations is the final for 50 marks. Student shall have to earn 40%, i.e 20 marks out of 50 marks from average of the two examinations. There shall be NO external evaluation. The student is deemed to have failed, if he/she (i) does not submit a report on the Project, or (ii) does not make a presentation of the same before the internal committee as per schedule, or (ii) secures less than 40% marks in this course.

7. **Recounting of Marks in the End Examination Answer Books:** A student can request for recounting of his/her answer book on payment of a prescribed fee.

8. **Re-evaluation of the End Examination Answer Books:** A student can request for re-evaluation of his/her answer book on payment of a prescribed fee.

9. **Supplementary Examinations:** A student who has failed to secure the required credits can register for a supplementary examination, as per the schedule announced by the College for a prescribed fee.

10. **Malpractices in Examinations:** Disciplinary action shall be taken in case of malpractices during Mid/ End-examinations as per the rules framed by the Academic Council.

11. **Re-registration for mid examination:** A student shall be given one time chance to re-register for a maximum of two subjects in a semester:
    - If the internal marks secured by a student in Continuous Internal Evaluation marks for 40 (sum of average of 2 mid-term examinations, average of all assignments and Subject Viva-voce/ PPT/Poster Presentation/Case Study on a topic in the concerned subject) are less than 35% and failed in those subjects

    A student must re-register for the failed subject(s) for 40 marks within four weeks of commencement of the classwork when the course is offered next, it could be semester for first years and a year for others.

In the event of the student taking this chance, his/her Continuous Internal Evaluation marks for 40 and Semester End Examination marks for 60 obtained in the previous attempt stand cancelled.

12. Academic Requirements and Promotion Rules:

a) A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course, if student secures not less than 35% (14 marks out of 40), not less than 35% (21 marks out of 60 marks) in the semester end examination, and a minimum of 40% (40 marks out of 100 marks) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

The student is eligible to write Semester End Examination of the concerned subject/course if the student scores ≥ 35% (14 marks) of 40 Continuous Internal Examination (CIE) marks.
In case, the student appears for Semester End Examination (SEE) of the concerned subject/course but not scored minimum 35% of CIE marks (14 marks out of 40 internal marks), his/her performance in that subject/course in SEE shall stand cancelled inspite of appearing the SEE.

b) A student shall be promoted to the next year only when he/she satisfies the requirements of all the previous semesters.

S.No	Promotion	Conditions to be fulfilled
1	First year first semester to First year second semester	Regular course of study of First year first semester.
2	First year second semester to Second year first semester	**(i)** Regular course of study of First year second semester. **(ii)** Must have secured at least 50% credits up to First year secondsemester from all the relevant regular and supplementary examinations, whether the student takes those examinations or not.
3	Second year first semester to Second year second semester	Regular course of study of Second year firstsemester.
4	Second year second semester to Third year first semester	**(i)** Regular course of study of Second year second semester **(ii)** Must have secured at least 60% credits up to Second year second semester from all the relevant regular and supplementary examinations, whether the student takes those examinations or not.

5	Third year first semester to Third year second semester	Regular course of study of Third year first semester.
6	Third year second semesterto Fourth year first semester	**(i)** Regular course of study of Third year second semester. **(ii)** Must have secured at least 60% credits upto Third year second semester from all the relevant regular and supplementary examinations, whether the student takes those examinations or not.
7	Fourth year first semester toFourth year second semester	Regular course of study of Fourth year firstsemester.

c) Provision of opting 2 OE courses through online mode.
d) Choice of placement-oriented value-added courses in every semester from II year till IV year
e) Students can take a year break after second or third year to work on R&D
f) Under Mandatory Courses
  i) Co-Curricular activities -- 0.5 credit for publishing paper, publishing patent, attend seminar, technical competition and taking part in hackathon
  ii) Extra-Curricular activities -- 0.5 credit for sports represent University or part or college winning team a medal or cup in outside recognized inter collegiate or above tournaments or NSS activities or donated blood two times or 2 green campus events

13. Grade Points: A 10 - point grading system with corresponding letter grades and percentage of marks, as given below, is followed

Letter Grade	Grade Point	Percentage of marks
O (Outstanding)	10	Marks >= 90
A+ (Excellent)	9	Marks >= 80 and Marks < 90
A (Very Good)	8	Marks >= 70 and Marks < 80
B+ (Good)	7	Marks >= 60 and Marks < 70
B (Average)	6	Marks >= 50 and Marks < 60
C (Pass)	5	Marks >= 40 and Marks < 50
F (Fail)	0	Marks < 40
Ab (Absent)	0	

Letter grade 'F' in any Course implies failure of the student in that course and no credits of the above table are earned.

Computation of SGPA and CGPA:

The UGC recommends the following procedure to compute the Semester Grade Point Average

(SGPA) and Cumulative Grade Point Average (CGPA):

i) **Sk** the SGPA of **k**th semester (1 to 8) is the ratio of sum of the product of the number of credits and grade points to the total credits of all courses registered by a student, i.e.,

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

Where **Ci** is the number of credits of the **i**th course and **Gi** is the grade point scored by the student in the **i**th course and **n** is the number of courses registered in that semester.

ii) The CGPA is calculated in the same manner taking into account all the courses **m**, registered by student over all the semesters of a programme, i.e., up to and inclusive of **Sk**, where **k ≥ 2**.

$$CGPA = \sum_{i=1}^{m} (C_i * G_i) / \sum_{i=1}^{m} C_i$$

iii) The SGPA and CGPA shall be rounded off to 2 decimal points.

14. Award of Class: After a student satisfies all the requirements prescribed for the completion of the Degree and becomes eligible for the award of B.Tech. Degree by JNTUH, he/she shall be placed in one of the following four classes based on CGPA secured from the 160 credits.

S. No	Class Awarded	CGPA Secured
1	First Class with Distinction	CGPA >= 8.00 with no F or below grade/detention anytime during the programme
2	First Class	CGPA >= 8.00 with rest of the clauses of S.No 1 not satisfied
3	First Class	CGPA ≥ 6.50 and CGPA < 8.00
4	Second Class	CGPA ≥ 5.50 and CGPA < 6.50
5	Pass Class	CGPA ≥ 5.00 and CGPA < 5.50

Equivalence of grade to marks

Marks % = (CGPA -0.5)*10

15. Award of 2-Year B.Tech. Diploma Certificate

1. A student is awarded 2-Year UG Diploma Certificate in the concerned engineering branch on completion of all the academic requirements and earned all the 80 credits (within 4 years from the date of admission) upto B. Tech. – II Year – II Semester if the student want to exit the 4-Year B. Tech. program and requests for the 2-Year B.Tech (UG) Diploma Certificate.

2. The student **once opted and awarded for 2-Year UG Diploma Certificate, the student will be permitted to join** in B. Tech. III Year – I Semester and continue for completion of remaining years of study for 4-Year B. Tech. Degree. ONLY in the next academic year along with next batch students. However, if any student wishes to continue the study after opting for exit, he/she should register for the subjects/courses in III Year I Semester before commencement of classwork for that semester.

3. The students, who exit the 4-Year B. Tech. program after II Year of study and wish to re-join the B.Tech. program, must submit the 2 -Year B. Tech. (UG) Diploma Certificate awarded to him, subject to the eligibility for completion of Course/Degree.

4. A student may be permitted to take one year break after completion of II Year II Semester or B. Tech. III Year II Semester (with university permission through the principal of the college well in advance) and can re-enter the course in **next Academic Year in the same college** and complete the course on fulfilling all the academic credentials within a stipulated duration i.e. double the duration of the course (Ex. within 8 Years for 4-Year program).

16. **Withholding of Results:** If the student has not paid dues to the Institute/ University, or if any case of indiscipline is pending against the student, the result of the student (for that Semester) may be withheld and the student will not be allowed to go into the next semester. The award or issue of the Degree may also be withheld in such cases.

17. **Transitory Regulations**

A. For students detained due to shortage of attendance:

1. A Student who has been detained in I year of GR20 Regulations due to lack of attendance, shall be permitted to join I year I Semester of GR22 Regulations and he is required to complete the study of B.Tech. programme within the stipulated period of eight academic years from the date of first admission in I Year.
2. A student who has been detained in any semester of II, III and IV years of GR20 regulations for want of attendance, shall be permitted to join the corresponding semester of GR22 Regulations and is required to complete the study of B.Tech. within the stipulated period of eight academic years from the date of first admission in I Year. The GR22 Academic Regulations under which a student has been readmitted shall be applicable to that student from that semester. See rule (C) for further Transitory Regulations.

B. For students detained due to shortage of credits:

3. A student of GR20 Regulations who has been detained due to lack of credits, shall be promoted to the next semester of GR22 Regulations only after acquiring the required number of credits as per the corresponding regulations of his/her first admission. The total credits required are 160 including both GR20 & GR22 regulations. The student is required to complete the study of B.Tech. within the stipulated period of eight academic years from the year of first admission. The GR22 Academic Regulations are applicable to a student from the year of readmission. See rule (C) for further Transitory Regulations.

C. For readmitted students in GR22 Regulations:

4. A student who has failed in any subject under any regulation has to pass those subjects in the same regulations.
5. The maximum credits that a student acquires for the award of degree, shall be the sum of the total number of credits secured in all the regulations of his/her study including GR22 Regulations. **There is NO exemption of credits in any case**.
6. If a student is readmitted to GR22 Regulations and has any subject with 80% of syllabus common with his/her previous regulations, that particular subject in GR22 Regulations will be substituted by another subject to be suggested by the college academic administration.

Note:

If a student readmitted to GR22 Regulations and has not studied any courses/topics in his/her earlier regulations of study which is prerequisite for further subjects in GR22

Regulations, then the college shall conduct remedial classes to cover those courses/topics for the benefit of the students.

18. Transfer of students from the Constituent Colleges of JNTUH or from other Colleges / Universities:

a) Transfer of students from the Constituent Colleges of JNTUH or from other Colleges/ Universities shall be considered only on case-to-case basis.

b) There shall be no branch transfers after the completion of admission process.

c) The students seeking transfer to GRIET from various other Universities/institutions have to pass the failed courses which are equivalent to the courses of GRIET, and also pass the courses of GRIET which the students have not studied at the earlier institution. Further, though the students have passed some of the courses at the earlier institutions, if the same courses are prescribed in different semesters of GRIET, the students have to study those courses in GRIET in spite of the fact that those courses are repeated.

d) The transferred students from other Universities/institutions to GRIET who are on rolls are to be provided one chance to write the CBT (internal marks) in the **equivalent course(s)** as per the clearance (equivalence) letter issued by the University.

19. General Rules

a. The academic regulations should be read as a whole for the purpose of any interpretation.

b. In the case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Academic Council is final.

c. In case of any error in the above rules and regulations, the decision of the Academic Council is final.

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

Academic Regulations for B.Tech. (Lateral Entry) under GR22
(Applicable for Batches Admitted from 2023-24)

1. All regulations as applicable for B.Tech. 4-year degree programme (Regular) will hold good for B.Tech. (Lateral Entry Scheme) except for the following rules:

a) Pursued programme of study for not less than three academic years and not more than six academic years.

b) A student should register for all 120 credits and secure all credits. The marks obtained in all 120 credits shall be considered for the calculation of the final CGPA.

c) Students who fail to fulfil all the academic requirements for the award of the degree within six academic years from the year of their admission, shall forfeit their seat in B.Tech. programme.

2. Academic Requirements and Promotion Rules:

a) A student shall be deemed to have satisfied the minimum academic requirements and earned the credits allotted to each theory or laboratories if he/she secures not less than 35% of marks in the Semester-end Examination and a minimum of 40% of the sum total of the Internal Evaluation and Semester-end Examination taken together.

b) A student shall be promoted to the next year only when he/she satisfies the requirements of all the previous semesters.

S. No.	Promotion	Conditions to be fulfilled
1	Second year first semester to Second year second semester.	Regular course of study of Second year first semester.
2	Second year second semester to Third year first semester.	(i) Regular course of study of Second year second semester. (ii) Must have secured at least 50% credits up to Second year second semesterfrom all the relevant regular and supplementary examinations, whether the student takes those examinations or not.
3	Third year first semester to Third year second semester.	Regular course of study of Third year first semester.
4	Third year second semester to Fourth year first semester.	(i) Regular course of study of Thirdyear second semester. (ii) Must have secured at least 60% credits up to third year second semester from all the relevant regular and supplementary examinations, whether the student takes those examinations or not.
5	Fourth year first semester to Fourth year second semester.	Regular course of study of Fourth year first semester.

3. **Award of Class:** After a student satisfies all the requirements prescribed for the completion of the Degree and becomes eligible for the award of B.Tech. Degree by JNTUH, he/she shall be placed in one of the following four classes based on CGPA secured from the 120 credits.

S. No	Class Awarded	CGPA Secured
1	First Class with Distinction	CGPA >= 8.00 with no F or below grade/ detention anytime during the Programme
2	First Class	CGPA >= 8.00 with rest of the clauses of S.no 1 not satisfied
3	First Class	CGPA $\geq$ 6.50 and CGPA < 8.00
4	Second Class	CGPA $\geq$ 5.50 and CGPA < 6.50
5	Pass Class	CGPA $\geq$ 5.00 and CGPA < 5.50

Academic Regulations for B.Tech. with Minors Programme under GR22

(Applicable for Batches Admitted from 2022-23)

1. Objectives

The key objectives of offering B. Tech. with Minor program are:

- To expand the domain knowledge of the students in one of the other programmes of engineering.
- To increase the employability of undergraduate students keeping in view of better opportunity in interdisciplinary areas of engineering & technology.
- To provide an opportunity to students to pursue their higher studies in the inter-disciplinary areas in addition to their own programme of study.
- To offer the knowledge in the areas which are identified as emerging technologies/thrust areas of Engineering.

2. Academic Regulations for B.Tech. Degree with Minor programmes

a) The weekly instruction hours, internal & external evaluation and award of grades are on par with regular 4 -Years B.Tech. programme.

b) For B.Tech. with Minor, a student needs to earn additional 18 credits (over and above the required 160 credits for B.Tech. degree). All these 18 credits need to be completed in III year and IV year only.

c) After registering for the Minor programme, if a student is unable to earn all the required 18 credits in a specified duration (twice the duration of the course), he/she shall not be awarded Minor degree. However, if the student earns all the required 160 credits of B.Tech., he/she will be awarded only B.Tech. degree in the concerned programme.

d) There is no transfer of credits from Minor programme courses to regular B.Tech. degree course and vice versa.

e) These 18 credits are to be earned from the additional Courses offered by the host department in the college as well as from the MOOCS platform.

f) For the course selected under MOOCS platform following guidelines may be followed:

- **i)** Prior to registration of MOOCS courses, formal approval of the courses, by the University is essential. University before the issue of approval considers the parameters like the institute / agency which is offering the course, syllabus, credits, duration of the programme and mode of evaluation etc.
- **ii)** Minimum credits for MOOCS course must be equal to or more than the credits specified in the Minor course structure provided by the University.
- **iii)** Only Pass-grade/marks or above shall be considered for inclusion of grades in minor grade memo.
- **iv)** Any expenses incurred for the MOOCS courses are to be met by the students only.

g) The option to take a Minor programme is purely the choice of the student.

h) The student shall be given a choice of withdrawing all the courses registered and/or the credits earned for Minor programme at any time; and in that case the student will be awarded only B.Tech. degree in the concerned programme on earning the required credits of 160.

i) The student can choose only one Minor programme along with his/her basic engineering degree. A student who chooses an Honors programme is not eligible to choose a Minor programme and vice-versa.

j) A student can graduate with a Minor if he/she fulfils the requirements for his/her regular B.Tech. programme as well as fulfils the requirements for Minor programme.

k) The institute shall maintain a record of students registered and pursuing their Minor programmes, minor programme-wise and parent programme -wise. The same report needs to be sent to the University once the enrolment process is complete.

l) The institute / department shall prepare the time-tables for each Minor course offered at their respective institutes without any overlap/clash with other courses of study in the respective semesters.

3. Eligibility conditions for the student to register for Minor programme

a) A student can opt for B.Tech. programme with Minor programme if she/he has no active backlogs till II Year I Semester (III semester) at the time of entering into III year I semester.

b) Prior approval of mentor and Head of the Department for the enrolment into Minor programme, before commencement of III year I Semester (V Semester), is mandatory

c) If more than 50% of the students in a programme fulfil the eligibility criteria (as stated above), the number of students given eligibility should be limited to 50%.

4. Registration for the courses in Minor Programme

a) At the beginning of each semester, just before the commencement of classes, students shall register for the courses which they wish to take in that semester.

b) The students should choose a course from the list against each semester (from Minors course structure) other than the courses they have studied/registered for regular B.Tech. programme. No course should be identical to that of the regular B.Tech. course. The students should take the advice of faculty mentors while registering for a course at the beginning of semester.

c) The maximum No. of courses for the Minor is limited to two (three in case of inclusion of lab) in a semester along with regular semester courses.

d) The registration fee to be collected from the students by the College is **Rs. 1000/-** per one credit.

e) A fee for late registration may be imposed as per the norms.

5. Minor courses and the offering departments

S. No.	Minor Programme	Eligible programme of students	@Offering Department	Award of Degree
1.	Artificial Intelligence & Machine Learning	All programmes, except B.Tech. in CSE (AI&ML) /B.Tech. (AI&ML)/ B.Tech. (AI)/ B.Tech. CSE(AI)	CSE	"B.Tech. in programme name with Minor in Artificial Intelligence & Machine Learning"

GOKARAJURANGARAJUINSTITUTE OF ENGINEERINGANDTECHNOLOGY

(Autonomous)

Bachupally, Kukatpally, Hyderabad–500090, India. (040)65864440

MECHANICAL ENGINEERING

B. Tech (ME) – GR22 Course Structure

I B. Tech I Semester

S.No	BOS	Group	Course Code	Course Name	Credits				Hours				Int.	Ext	Total Marks
					L	T	P	Total	L	T	P	Total			
1	Maths	BS	GR22A1001	Linear Algebra and Function Approximation	3	1	0	4	3	1	0	4	40	60	100
2	Chemistry	BS	GR22A1005	Engineering Chemistry	3	1	0	4	3	1	0	4	40	60	100
3	English	HS	GR22A1006	English	2	0	0	2	2	0	0	2	40	60	100
4	CSE	ES	GR22A1007	Programming forProblem Solving	2	1	0	3	2	1	0	3	40	60	100
5	ME	ES	GR22A1011	Graphics for Engineers	1	0	2	3	1	0	4	5	40	60	100
6	Chemistry	BS	GR22A1015	Engineering Chemistry Lab	0	0	1.5	1.5	0	0	3	3	40	60	100
7	CSE	ES	GR22A1017	Programming forProblem Solving Lab	0	0	1.5	1.5	0	0	3	3	40	60	100
8	English	HS	GR22A1016	English Language and CommunicationSkills Lab	0	0	1	1	0	0	2	2	40	60	100
		TOTAL			**11**	**3**	**6**	**20**	**11**	**3**	**12**	**26**	**320**	**480**	**800**
8	Mgmt	MC	GR22A1022	Design Thinking	0	0	0	0	2	0	0	2	40	60	100

I B. Tech II Semester

S.No	BOS	Group	Course Code	Course Name	Credits				Hours				Int.	Ext	Total Marks
					L	T	P	Total	L	T	P	Total			
1	Maths	BS	GR22A1002	Differential Equations and Vector Calculus	3	1	0	4	3	1	0	4	40	60	100
2	Physics	BS	GR22A1004	Engineering Physics	3	1	0	4	3	1	0	4	40	60	100
3	ME	ES	GR22A1010	Engineering Mechanics	3	1	0	4	3	1	0	4	40	60	100
4	CSE	ES	GR22A1012	Data Structures	2	1	0	3	2	1	0	3	40	60	100
5	Physics	BS	GR22A1014	Engineering Physics Lab	0	0	1.5	1.5	0	0	3	3	40	60	100
6	CSE	ES	GR22A1020	Data Structures Lab	0	0	1	1	0	0	2	2	40	60	100
7	ME	ES	GR22A1021	Engineering Workshop	1	0	1.5	2.5	1	0	3	4	40	60	100
		TOTAL			**12**	**4**	**4**	**20**	**12**	**4**	**08**	**24**	**280**	**420**	**700**

II B.Tech I Semester

S.No	BOS	Group	Course Code	Course Name	Credits				Hours				Int.	Ext.	Total Marks
					L	T	P	Total	L	T	P	Total			
1	ME	PC	GR22A2038	Kinematics of Machinery	3	0	0	3	3	0	0	3	40	60	100
2	ME	PC	GR22A2039	Metallurgy and Material Science	3	0	0	3	3	0	0	3	40	60	100
3	EEE	PC	GR22A1009	Basic Electrical Engineering	2	1	0	3	2	1	0	3	40	60	100
4	ME	PC	GR22A2040	Strength of Materials	3	0	0	3	3	0	0	3	40	60	100
5	ME	PC	GR22A2041	Thermodynamics	3	0	0	3	3	0	0	3	40	60	100
6	ME	PC	GR22A2042	Machine and Production Drawing Lab	0	0	2	2	0	0	4	4	40	60	100
7	ME	PC	GR22A2043	Strength of Materials Lab	0	0	1.5	1.5	0	0	3	3	40	60	100
8	ME	PC	GR22A2044	Metallurgy and Material Science Lab	0	0	1.5	1.5	0	0	3	3	40	60	100
Total					**15**	**0**	**5**	**20**	**15**	**0**	**10**	**25**	**320**	**480**	**800**
9	ME	MC	GR22A2001	Environmental Science	0	0	0	0	2	0	0	2	40	60	100

II B.Tech II Semester

S. No	BOS	Group	Course Code	Course Name	Credits				Hours				Int.	Ext.	Total Marks
					L	T	P	Total	L	T	P	Total			
1	ME	PC	GR22A2045	Thermal Engineering	3	0	0	3	3	0	0	3	40	60	100
2	ME	PC	GR22A2046	Fluid Mechanics and Fluid Machines	3	0	0	3	3	0	0	3	40	60	100
3	ME	PC	GR22A2047	Dynamics of Machinery	3	0	0	3	3	0	0	3	40	60	100
4	Maths	BS	GR22A2009	Computational Mathematics for Engineers	3	0	0	3	3	0	0	3	40	60	100
5	ME	PC	GR22A2048	Manufacturing Engineering	2	1	0	3	2	1	0	3	40	60	100
6	ME	PC	GR22A2049	Thermal Engineering Lab	0	0	2	2	0	0	4	4	40	60	100
7	ME	PC	GR22A2050	Manufacturing Engineering Lab	0	0	1.5	1.5	0	0	3	3	40	60	100
8	ME	PC	GR22A2051	Fluid Mechanics and Fluid Machines Lab	0	0	1.5	1.5	0	0	3	3	40	60	100
Total					**14**	**1**	**5**	**20**	**14**	**1**	**10**	**25**	**320**	**480**	**800**
9	Mgmt	MC	GR22A2003	Constitution of India	0	0	0	0	2	0	0	2	40	60	100

III Year I Semester

S. No	BOS	Group	Course Code	Course Name	Credits				Hours				Int.	Ext	Total Marks
					L	T	P	Total	L	T	P	Total			
1	ME	PC		Machine Design	2	1	0	3	2	1	0	3	40	60	100
2	Mgmt	HS		Economics and Accounting for Engineers	3	0	0	3	3	0	0	3	40	60	100
3	ME	PC		Manufacturing Technology	3	0	0	3	3	0	0	3	40	60	100
4	ME	PC		Applied Thermodynamics	2	0	0	2	3	0	0	3	40	60	100
5	ME	PE-I		Professional Elective-I	3	0	0	3	3	0	0	3	40	60	100
6	ME	OE-I		Open Elective-I	3	0	0	3	3	0	0	3	40	60	100
7	ME	PC		Manufacturing Technology Lab	0	0	1.5	1.5	0	0	3	3	40	60	100
8	ME	PC		Computer Aided Modeling and 3D Printing Lab	0	0	1.5	1.5	0	0	3	3	40	60	100
Total					**16**	**1**	**3**	**20**	**17**	**1**	**6**	**24**	**320**	**480**	**800**
9	Mgmt	MC		Value Ethics and Gender Culture	0	0	0	0	2	0	0	2	40	60	100

PROFESSIONAL ELECTIVE – I				
S. No.	BOS	Group	Course Code	Course
1	ME	PE		Industry 4.0
2	ME	PE		Solid Mechanics
3	ME	PE		Automobile Engineering
4	ME	PE		Intelligent Manufacturing Systems

OPEN ELECTIVE – I				
S. No.	BOS	Group	Course Code	Course
1	ME	OE		Industrial Automation and Control

III B.Tech II Semester

S. No	BOS	Group	Course Code	Course Name	Credits				Hours				Int.	Ext	Total Marks
					L	T	P	Total	L	T	P	Total			
1	ME	PC		Design of Machine Elements	3	0	0	3	3	0	0	3	40	60	100
2	ME	PC		Heat Transfer	2	1	0	3	2	1	0	3	40	60	100
3	ME	PC		Industrial Engineering and Management	3	0	0	3	3	0	0	3	40	60	100
4	ME	PE-II		Professional Elective-II	3	0	0	3	3	0	0	3	40	60	100
5	ME	OE-II		Open Elective-II	3	0	0	3	3	0	0	3	40	60	100
6	ME	PC		Metrology Lab	0	0	1.5	1.5	0	0	3	3	40	60	100
7	ME	PC		Heat Transfer Lab	0	0	1.5	1.5	0	0	3	3	40	60	100
8	ME	PW		Mini Project and Internship	0	0	2	2	0	0	4	4	40	60	100
Total					**14**	**1**	**5**	**20**	**14**	**1**	**10**	**25**	**320**	**480**	**800**

PROFESSIONAL ELECTIVE – II				
S. No.	BOS	Group	Course Code	Course
1	ME	PE		Metrology and Surface Engineering
2	ME	PE		Computational Fluid Dynamics
3	ME	PE		Renewable Energy Resources
4	ME	PE		Microprocessors applications in Manufacturing

OPEN ELECTIVE – II				
S. No.	BOS	Group	Course Code	Course
1	ME	OE		Advanced Composite Materials

IV B.Tech I Semester

S.No	BOS	Group	Course Code	Course Name	Credits				Hours				Int.	Ext.	Total Marks
					L	T	P	Total	L	T	P	Total			
1	ME	PC		CAD/CAM	3	0	0	3	3	0	0	3	40	60	100
2	ME	PC		Instrumentation and Control Systems	3	0	0	3	3	0	0	3	40	60	100
3	ME	PE-III		Professional Elective-III	3	0	0	3	3	0	0	3	40	60	100
4	ME	PE-IV		Professional Elective-IV	3	0	0	3	3	0	0	3	40	60	100
5	ME	OE-III		Open Elective-III	3	0	0	3	3	0	0	3	40	60	100
6	ME	PC		Instrumentation and Control Systems Lab	0	0	2	2	0	0	4	4	40	60	100
7	ME	PC		Computer Aided Analysis and Manufacturing Lab	0	0	2	2	0	0	4	4	40	60	100
8	ME	PW		Project Work-Phase I	0	0	6	6	0	0	12	12	40	60	100
Total					**15**	**0**	**10**	**25**	**15**	**0**	**20**	**35**	**320**	**480**	**800**

PROFESSIONAL ELECTIVE – III				
S. No.	BOS	Group	Course Code	Course
1	ME	PE		Computer Integrated Manufacturing
2	ME	PE		Tribology
3	ME	PE		Finite Element Analysis
4	CSE	PE		Internet of Things

PROFESSIONAL ELECTIVE – IV				
S. No.	BOS	Group	Course Code	Course
1	ME	PE		Robotics
2	CSE	PE		Artificial Intelligence
3	ME	PE		Refrigeration and Air-Conditioning
4	ME	PE		Mechatronics

OPEN ELECTIVE – III				
S. No.	BOS	Group	Course Code	Course
1	ME	OE		Optimization Techniques

IV B.Tech II Semester

S.No	BOS	Group	Course Code	Course Name	Credits				Hours				Int.	Ext	Total Marks
					L	T	P	Total	L	T	P	Total			
1	ME	PC		Additive Manufacturing	3	0	0	3	3	0	0	3	40	60	100
2	ME	PE-V		Professional Elective-V	3	0	0	3	3	0	0	3	40	60	100
3	ME	PE-VI		Professional Elective-VI	3	0	0	3	3	0	0	3	40	60	100
4	ME	PW		Project Work-Phase II	0	0	6	6	0	0	12	12	40	60	100
Total					9	0	6	**15**	**9**	**0**	**12**	**21**	**160**	**240**	**400**

PROFESSIONAL ELECTIVE – V				
S. No.	BOS	Group	Course Code	Course
1	ME	PE		Micro and Nano Manufacturing
2	CSE	PE		Augmented Reality and Virtual Reality
3	ME	PE		Turbomachinery
4	ME	PE		Un-Conventional Machining Processes

PROFESSIONAL ELECTIVE – VI				
S. No.	BOS	Group	Course Code	Course
1	ME	PE		Production Planning and Control
2	ME	PE		Mechanical Vibrations
3	ME	PE		Power Plant Engineering
4	CSE	PE		Block Chain Technology

PROFESSIONAL ELECTIVES			
MANUFACTURING	**DESIGN**	**THERMAL**	**AUTOMATION**
Industry 4.0	Solid Mechanics	Automobile Engineering	Intelligent Manufacturing Systems
Metrology and Surface Engineering	Computational Fluid Dynamics	Renewable Energy Resources	Microprocessors Applications in Manufacturing
Computer integrated Manufacturing	Tribology	Finite Element Analysis	Internet of Things
Robotics	Artificial Intelligence	Refrigeration and Air-Conditioning	Mechatronics
Micro and Nano Manufacturing	Augmented Reality and Virtual Reality	Turbomachinery	Un-Conventional Machining Processes
Production Planning and Control	Mechanical Vibrations	Power Plant Engineering	Block Chain Technology

OPEN ELECTIVES FOR GR22 REGULATIONS

THREAD 1	THREAD 2	OFFERED BY
1. Soft Skills and Interpersonal Communication 2. Human Resource Development and Organizational Behavior 3. Cyber Law and Ethics 4. Economic Policies in India	1. Principles of E-Commerce	**CSE**
	2. Business Analytics	
	3. Augmented Reality and Virtual Reality	
	1. Internet of Things	**CSE (AIML)**
	2. Augmented Reality and Virtual Reality	
	3. Human Computer Interaction	
	1. Augmented Reality and Virtual Reality	**CSE (DS)**
	2. Internet of Things	
	3. Human Computer Interaction	
	1. Services Science and Service Operational Management 2. IT Project Management 3. Marketing Research and Marketing Management	**CSBS**
	1. Artificial Intelligence	**IT**
	2. Introduction to Data Science	
	3. Human Computer Interaction	
	1. Non-Conventional Energy Sources	**EEE**
	2. Machine Learning	
	3. Artificial Intelligence Techniques	
	1. Principles of Communication	**ECE**
	2. Sensor Technology	
	3. Cellular and Mobile Communications	
	1. Industrial Automation and Control	**ME**
	2. Advanced Composite Materials	
	3. Optimization Techniques	
	1. Engineering Materials for Sustainability	**CE**
	2. Geographic Information Systems and Science	
	3. Environmental Impact Assessment and Life Cycle Analyses	

I YEAR
I SEMESTER

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

LINEAR ALGEBRA AND FUNCTION APPROXIMATION

Course Code: GR22A1001 **L/T/P/C: 3/1/0/4**
I Year I Semester

Prerequisites: Elementary knowledge of vectors, matrices and pre-calculus

Course Objectives

1. Comprehend the concepts of linearity and linear systems, which form the core for many engineering concepts
2. Interpret the matrix eigenvalue problem and relate the theory to pattern recognition problems
3. Distinguish between various techniques of matrix factorization and the significance of unit rank decomposition principle
4. Discuss the differential calculus of multi variable functions which leads to function optimization.
5. Apply tools for function approximation problems that arising in engineering

Course Outcomes

1. Work with the essential tools of vector and matrix algebra
2. Compute eigenvalues and vectors for engineering applications
3. Illustrate matrix decomposition techniques to determine the exact or approximate solutions of a linear algebraic system.
4. Develop the skill of finding multivariable function optima
5. Illustrate the concepts of function approximation with measurement of error

UNIT I

Fundamentals of Vector and Matrix algebra: Operations on vectors and matrices- Orthogonal projection of vectors- Exact and generalized inverse of a matrix- Rank of a matrix- Linear independence of vectors- Structured square matrices (Symmetric, Hermitian, skew-symmetric, skew-Hermitian, orthogonal and unitary matrices)- Vector and matrix norms

Solution of a linear algebraic system of equations (homogeneous and non-homogeneous) using Gauss elimination

UNIT II

Matrix eigenvalue problem and Quadratic forms: Determination of eigenvalues and eigenvectors of a matrix, properties of eigenvalues and eigenvectors (without proof)- Similarity of matrices- Diagonalization of a matrix- Orthogonal diagonalization of a symmetric matrix- Definiteness of a symmetric matrix

Quadratic Forms- Definiteness and nature of a quadratic form- Reduction of a quadratic form to the canonical form using an orthogonal transformation

UNIT III

Matrix decomposition and Least squares solution of algebraic systems: LU decomposition- Cholesky decomposition- Gram-Schmidt orthonormalization process- QR factorization- Eigen decomposition of a symmetric matrix- Singular value decomposition Least squares solution of an over determined system of equations using QR factorization and the generalized inverse- Estimation of the least squares error

UNIT IV

Multivariable differential calculus and Function optimization:

Partial Differentiation- Chain rule- Total differentiation- Jacobian- Functional dependence. Multivariable function Optimization- Taylor's theorem for multivariable functions- Unconstrained optimization of functions using the Hessian matrix- Constrained optimization using the Lagrange multiplier method.

UNIT V

Function approximation tools in engineering:

Function approximation using Taylor's polynomials- Properties of Chebyshev polynomials- Uniform approximation using Chebyshev polynomials.

The principle of least squares- Function approximation using polynomial, exponential and power curves using matrix notation- Estimating the Mean squared error

Text Books:

1. Advanced Engineering Mathematics, 5th edition, R.K.Jain and S.R.K.Iyengar, Narosa publishing house
2. Higher Engineering Mathematics- B.S.Grewal- Khanna publications

References:

1. Introduction to Linear Algebra, Gilbert Strang, 5th edition, Wellesley,2017.
2. Numerical methods for scientific and engineering computation, M.K.Jain, S.R.K.Iyengar,
3. R.K.Jain- 3rd edition- New Age publishers
4. Applied Mathematics, Vol. I & II, P. N. Wartikar and J. N. Wartikar, Pune Vidyarthi Griha Prakashan, 2010

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

ENGINEERING CHEMISTRY

Course Code: GR22A1005 **L/T/P/C: 3/1/0/4**
I Year I Semester

Course Objectives

1. Relate how the basic concepts and principles of chemistry can be applied to practical utility in a broader perspective of the society.
2. Distinguish the ranges of electromagnetic spectrum and its interaction with matter and to develop knowledge of various spectroscopic techniques at atomic and molecular levels.
3. Identify and apply various principles of electrochemistry, corrosion and water treatment which are essential for an engineer in industry
4. Acquire knowledge of existence of different organic molecules in different stereo chemical orientations useful for understanding reaction pathways.
5. Bring adaptability to the concepts of chemistry and to acquire the required skills to become a perfect engineer.

Course Outcomes

1. Analyze microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces.
2. Relate electromagnetic spectra used for exciting different molecular energy levels in various spectroscopic techniques and their application in medicine and other fields.
3. Recognize various problems related to electrochemistry and corrosion in industry and is able to explain different prevention techniques and apply concepts of chemistry in engineering.
4. Know the origin of different types of engineering materials used in modern technology and interpret different problems involved in industrial utilization of water.
5. Understand the processing of fossil fuels for the effective utilization of chemical energy.

UNIT I

Atomic and Molecular Structure

Atomic and Molecular orbitals - Definition, examples and comparison, Molecular orbital theory- postulates and MO energy diagrams of N_2 and O_2.

Theories of Metallic bonding – Free electron theory, Resonance theory, Molecular orbital theory, Valence Bond Theory – Postulates and Limitations, Bonding in $[Ni(CO)_4]$, $[Ni(Cl)_4]^{2-}$, $[Ni(CN)_4]^{2-}$, $[Co(NH_3)_6]^{3+}$, and $[CoF_6]^{3-}$. Crystal Field Theory, Crystal Field Splitting of transition metal ion d-orbitals in octahedral, tetrahedral and square planar geometries.

UNIT II

Spectroscopic Techniques and Applications

Regions of Electromagnetic spectrum. Molecular spectroscopy: Rotational Spectroscopy: Rotation of molecules, Rotational spectra of rigid diatomic molecules, Selection rules.

Vibrational Spectroscopy: The vibrating diatomic molecule, Simple and anharmonic oscillators of a diatomic molecule, Selection rules, Applications of IR spectroscopy.

NMR Spectroscopy: Criteria for NMR activity (Magnetic and non-magnetic nuclei), Basic concepts and Principle of ^1H NMR spectroscopy, Chemical shift- Shielding and Deshielding, Magnetic Resonance Imaging.

UNIT III

Batteries and Corrosion

Batteries: Primary and Secondary types, Lithium ion and Lead acid batteries. Fuel cells: Definition, Hydrogen-Oxygen fuel cell and Microbial Fuel cell – working principle and applications.

Corrosion: Definition, causes and effects of corrosion, Theories of chemical and electro chemical corrosion with mechanism, Differential metal corrosion - Galvanic corrosion, Differential aeration corrosion - pitting corrosion, Factors affecting corrosion – Nature of metal (Position of metal, Relative areas, Purity and Passivity), Nature of Environment (pH, Temperature and Humidity), Corrosion control methods: Cathodic protection (sacrificial anodic and impressed current cathodic protection), Metallic coatings: Hot dipping-galvanization and tinning.

UNIT IV

Engineering Materials and Water Technology

Semiconductors: Si and Ge - preparation, purification and crystal growth by zone refining and Czochralski pulling methods, Doping – Epitaxy, Diffusion and Ion implantation.

Plastics: Comparison between thermoplastics and thermosets, Fabrication of plastics - compression moulding and injection moulding. Conducting polymers – Definition, classification and applications.

Water: Hardness - Causes, types and units. Boiler troubles-scales and sludges, caustic embrittlement. Water purification: Demineralization by Ion-exchange process, Desalination by reverse osmosis method.

UNIT V

Stereochemistry and Energy Resources

Stereochemistry: Elements of symmetry-plane of symmetry, centre of symmetry, alternating axis of symmetry. Chirality, Enantiomers – tartaric acid, Diastereomers- 2,3-dichloropentane, Conformational analysis of n-butane. Structure, synthesis and pharmaceutical applications of aspirin and ibuprofen.

Energy sources: Fossil Fuels: Coal –types, analysis of coal- proximate and ultimate analysis and their significance, Petroleum-its composition, Cracking – Definition, Fluid bed catalytic cracking, Knocking and its mechanism in Internal Combustion engine, Octane rating, Hydrogen gas generation by Electrolysis process.

Text Books:

1. Engineering chemistry by P.C. Jain and M. Jain; Dhanpat Rai Publishing Company (P) Ltd., New Delhi.
2. Textbook of Engineering Chemistry by A. Jayashree, Wiley Publications

Reference Books:

1. Organic Chemistry by Morrison, Boyd & Bhattacharjee (Pearson Pubs)
2. Engineering Chemistry by O.G.Palanna, Tata McGraw Hills Private Ltd.
3. Fundamentals of Molecular Spectroscopy, by C.N. Banwell. McGraw Hill Publication
4. A Textbook of Engineering Chemistry by Shashi Chawla, Dhanpat Rai Publishing Company (P) Ltd., New Delhi.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

ENGLISH

Course Code: GR22A1006 **L/T/P/C: 2/0/0/2**
I Year I Semester

Course Objectives

1. Improve the language proficiency of students in English with an emphasis on Vocabulary, Grammar, Reading and Writing skills.
2. Equip students to study academic subjects more effectively and critically using the theoretical and practical components of English syllabus.
3. Develop study skills and communication skills in formal and informal situations.
4. Understand the importance of defining, classifying and practice the unique qualities of professional writing style.
5. Employ the acquired knowledge in classroom with reference to various social and professional spheres thus leading to a life-long learning process

Course Outcomes

1. Use English Language effectively in spoken and written forms.
2. Comprehend the given texts and respond appropriately.
3. Communicate confidently in various contexts and different cultures.
4. Acquire proficiency in English including reading and listening comprehension, writing and speaking skills.
5. Listen and respond appropriately.

UNIT I

Where the Mind is without Fear poem by Rabindranath Tagore

Vocabulary: The Concept of Word Formation -- The Use of Prefixes and Suffixes.

Grammar: Identifying Common Errors in Writing with Reference to Articles and Prepositions.

Reading: Reading and Its Importance- Techniques for Effective Reading

Writing: Sentence Structures -Use of Phrases and Clauses in Sentences-Importance of Proper Punctuation - Techniques for writing precisely - Paragraph writing - Do's and Don'ts of Paragraph Writing - Creating Coherence-Organizing Principles of Paragraphs in Documents.

UNIT II

The Last Leaf by O. Henry

Vocabulary: Synonyms and Antonyms.

Grammar: Modal Auxiliaries - Identifying Common Errors in Writing with Reference to Noun-pronoun Agreement and Subject-verb Agreement.

Reading: Sub-skills of Reading- Skimming and Scanning

Writing: Précis Writing, Describing Objects, Places and Events – Classifying - Providing Examples or Evidence

UNIT III

'Blue Jeans' from the prescribed textbook 'English for Engineers' published by Cambridge University Press.

Vocabulary: Acquaintance with Prefixes and Suffixes from Foreign Languages in English to form Derivatives-Words from Foreign Languages and their Use in English.

Grammar: Identifying Common Errors in Writing with Reference to Misplaced Modifiers and Tenses.

Reading: Improving Comprehension Skills – Techniques for Good Comprehension

Writing: Format of a Formal Letter-Writing Formal Letters E.g. Letter of Complaint, Letter of Requisition and Letter of permission, Use of phrases for formal and informal letter writing and Email etiquette

UNIT IV

'What Should You Be Eating' from the prescribed textbook 'English for Engineers' published by Cambridge University Press.

Vocabulary: Standard Abbreviations in English and Phrasal Verbs

Grammar: Redundancies and Clichés in Oral and Written Communication.

Reading: Comprehension- Intensive Reading and Extensive Reading

Writing: Writing Introduction and Conclusion -Essay Writing- Argumentative and Discursive essay – Picture Composition

UNIT V

'How a Chinese Billionaire Built Her Fortune' from the prescribed textbook 'English for Engineers' published by Cambridge University Press.

Vocabulary: One Word Substitutes, Technical vocabulary and their usage

Grammar: Common Errors in English

Reading: Reading Comprehension-Exercises for Practice

Writing: What is Report Writing - Technical Reports vs General Reports – Importance of Report Writing – Structure and characteristics of Report Writing - Relevance of Reports to Engineers

Text Books:

1. Sudarshana, N.P. and Savitha, C. (2018). English for Engineers. Cambridge University Press.

References:

1. Swan, M. (2016). Practical English Usage. Oxford University Press.
2. Kumar, S and Lata, P. (2018). Communication Skills. Oxford University Press.
3. Wood, F.T. (2007). Remedial English Grammar. Macmillan.
4. Zinsser, William. (2001). On Writing Well. Harper Resource Book.
5. Hamp-Lyons, L. (2006). Study Writing. Cambridge University Press.
6. Exercises in Spoken English. Parts I –III. CIEFL, Hyderabad. Oxford University Press.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

PROGRAMMING FOR PROBLEM SOLVING

Course Code: GR22A1007 **L/T/P/C: 2/1/0/3**
I Year I Semester

Course Objectives

1. Interpret the various steps in problem solving and program development.
2. Recall and reuse the fundamentals, syntax and semantics of C programming language.
3. Illustrate problem solving using arrays, strings, structures and pointers.
4. Demonstrate structured and modular programming approach in solving problems.
5. Interpret code and debug the given problems using files.

Course Outcomes

1. Design algorithms and flowcharts for problem solving and illustrate the fundamentals of C language.
2. Identify and apply control structures and arrays to solve problems.
3. Discover the need for strings and functions in problem solving and apply it.
4. Analyze the need for pointers and structures in C and implement for solutions.
5. Interpret working with files, preprocessor directives and command line arguments in C.

UNIT I

Introduction to Programming:

Introduction to Algorithms: Representation of Algorithm, Flowchart, Pseudo code with examples, compiling and executing programs, syntax and logical errors.

Introduction to C Programming Language: Structure of C program, keywords, variables, constants, datatypes, operators, precedence and associativity, expression evaluation, implicit and explicit type conversion, formatted and unformatted I/O.

UNIT II

Decision Making and Arrays:

Branching and Loops: Conditional branching with simple if, if-else, nested if else, else if ladder, switch-case, loops: for, while, do-while, jumping statements: goto, break, continue, exit.

Arrays: one and two dimensional arrays, creating, accessing and manipulating elements of arrays. **Searching:** Introduction to searching, Linear search and Binary search.

UNIT III

Strings and Functions:

Functions: Introduction to structured programming, function declaration, signature of a function, parameters and return type of a function, categories of functions, parameter passing techniques, passing arrays and strings to functions, recursion, merits and demerits of recursive functions, storage classes.

Strings: Introduction to strings, operations on characters, basic string functions available in C - strlen, strcat, strcpy, strrev, strcmp, String operations without string handling functions, arrays of strings.

UNIT IV

Pointers and Structures:

Pointers: Idea of pointers, declaration and initialization of pointers, pointer to pointer, void pointer, null pointer, pointers to arrays and structures, function pointer.

Structures and Unions: Defining structures, declaring and initializing structures, arrays within structures, array of structures, nested structures, passing structures to functions, unions, typedef.

UNIT V

File handling and Preprocessor in C:

Files: Text and binary files, creating, reading and writing text and binary files, random access to files, error handling in files.

Preprocessor: Commonly used preprocessor commands like include, define, undef, if, ifdef, ifndef, elif, command line arguments, enumeration data type.

TEXT BOOKS:

1. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
2. B.A. Forouzan and R.F. Gilberg C Programming and Data Structures, Cengage Learning, (3rd Edition)

REFERENCE BOOKS:

1. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India
2. R.G. Dromey, How to solve it by Computer, Pearson (16th Impression)
3. Programming in C, Stephen G. Kochan, Fourth Edition, Pearson Education
4. Herbert Schildt, C: The Complete Reference, Mc Graw Hill, 4th Edition

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

GRAPHICS FOR ENGINEERS

Course Code: GR22A1011 **L/T/P/C: 1/0/4/3**
I Year I Semester

Course Objectives

1. Provide basic conventions and standards used in Graphics for Engineers.
2. Impart knowledge on different projection methods.
3. Draw multi views of a plane object located in different orientations.
4. Identify and draw 2d views of a solid objects in different positions.
5. Apply solid modelling features and concepts to draw and develop industrial components like springs, gears etc.

Course Outcomes

1. Interpret industrial drawings and read working drawings.
2. Draw engineering objects like springs using AutoCAD.
3. Imagine and create multi-views of 2-d plane figures.
4. Construct and interpret multi-views of 3-d solid objects with proper dimensioning, scaling etc.
5. Draw and create pictorial views and model the industrial objects like gears and bearings with solid modelling commands available in AutoCAD tool.

UNIT I

Engineering Graphics with CAD– Introduction engineering graphics and significance of computer aided design CAD software, advanced commands, dimensioning and tolerancing, fundamentals of 2-D construction.

UNIT II

Orthographic projection – Introduction, definition, and classification of projections; pictorial and multi-view, significance of first and third angle methods of projections; **Projections of points** (in all quadrants) and **straight lines** (inclined to one reference plane only).

UNIT III

Projections of planes - definition and types of plane figures (triangle, square, pentagon, hexagon, and circle); projections of plane (inclined to one reference plane only).

UNIT IV

Projections of solids - definition and types of solid objects (prism, cylinder, pyramid, and cone); projections of solid (axis inclined to one reference plane only); creation of threads, washers, keys, and springs.

UNIT V

Isometric views – construction of isomeric views of planes (polygons) and solids (prism, cylinder, pyramid, and cone); fundamentals of 3-d drawings, world coordinate system, solid modelling and commands, creation of gears and bearings; conversion of 3-d to 2-d views and construction of 3-d view from 2-d views (simple objects)

Text Books:

1. Engineering Graphics and Design by Kaushik Kumar / Apurbakumar Roy / Chikesh
2. Engineering Drawing by N.D.BHATT/CHAROTAR PUBLISHING HOUSE PVT LTD

Reference Books:

1. Engineering Graphics Essentials with AutoCAD 2018 Instruction by Kirstie Platenberg/SDC publications.
2. Engineering Drawing by Basanth Agrawal/ C M Agrawal/ McGraw Hill Education
3. Engineering Drawing by K.Venu Gopal/New Age Publications.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

ENGINEERING CHEMISTRY LAB

Course Code: GR22A1015 **L/T/P/C: 0/0/3/1.5**
I Year I Semester

Course Objectives

1. Introduce practical applications of chemistry concepts to solve engineering problems.
2. Determine the rate constant of reactions from concentrations as a function of time.
3. Measure the molecular or ionic properties such as conductance, redox potentials.
4. Synthesize a drug molecule to learn how organic compounds are prepared in industry.
5. Know the laboratory practices implemented in a research and industrial chemistry laboratory setting.

Course Outcomes

1. Ability to perform experiments illustrating the principles of chemistry relevant to the study of science and engineering.
2. Determination of parameters like hardness and chloride content in water, measurement of redox potentials and conductance.
3. Understand the kinetics of a reactions from a change in concentrations of reactants or products as a function of time.
4. Synthesize a drug molecule as an example of organic synthesis methods widely used in industry.
5. Determination of physical properties like adsorption and viscosity.

List of Experiments:

1. Determination of Total Hardness of water by complexometric method using EDTA
2. Determination of Chloride content of water by Argentometry
3. Redox titration: Estimation of Ferrous ion using standard KMnO4 by Permanganometry
4. Estimation of HCl by Conductometric titrations
5. Estimation of Ferrous ion by Potentiometry using dichromate
6. Determination of Rate constant of acid catalyzed reaction of methyl acetate
7. Adsorption of Acetic acid by charcoal
8. Determination of Surface tension of liquid by using Stalagmometer
9. Determination of Viscosity of liquid by using Ostwald's Viscometer
10. Determination of Partition Coefficient of Acetic acid between n-butanol and water
11. Synthesis of Aspirin
12. Synthesis of Paracetamol

Reference Books:

1. Vogel's text book of Practical organic chemistry, 5th Edition.
2. Senior Practical Physical Chemistry, B.D. Khosala, A. Gulati and V. Garg (R. Chand & Co., Delhi)
3. Text book on experiments and Calculations in Engineering Chemistry-S.S.Dara.
4. An introduction to practical chemistry, K.K. Sharma and D.S. Sharma (Vikas Publications, New Delhi)

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

PROGRAMMING FOR PROBLEM SOLVING LAB

Course Code: GR22A1017 **L/T/P/C: 0/0/3/1.5**
I Year I Semester

Course Objectives

1. Analyze various IDE's to create, edit, compile, run and debug programs.
2. Develop programs to solve basic problems by choosing fundamental concepts in C like operators.
3. Build C programs using suitable control structures.
4. Develop modular, reusable and readable C programs using the concepts like functions, arrays and strings.
5. Design programs using structures, pointers and files.

Course Outcomes

1. Translate algorithms into a working program and analyse and debug the codes using basics of C language.
2. Develop programs by choosing appropriate control structures.
3. Select and apply the concept of arrays and strings for problem solving.
4. Demonstrate problem solving using modular programming and pointers.
5. Solve the problems using structures, files and pre-processor directives.

TASK 1

1. Write a C program to convert days into years, weeks and days.(Assume a year has 365 days).
2. Write a C program to find greatest and smallest among three numbers using conditional operator.
3. Write a C program to enter P, T, R and calculate Compound Interest.

TASK 2

1. Write a C program to swap two numbers using the following:
   (i) Using third variable
   (ii) Without using third variable
   (iii) Using bitwise operators
2. Write a C program to do the following using implicit and explicit type conversion
   (i) Convert Celsius temperature to Fahrenheit
   (ii) Convert Fahrenheit temperature to Celsius
   (iii) Find area of a triangle given sides a,b,c

TASK 3

1. Write a C program to add two numbers without using arithmetic operators in C.
2. Write a C program to determine whether a number is a power of 2 or not using bitwise operator and ternary operator.
3. Write a C program to check whether a number is even or odd using bitwise operator and ternary operator.

TASK 4

1. Write a C program to find the roots of a quadratic equation using if-else.
2. Write a C program to input electricity unit charges and calculate total electricity bill according to the given condition:
   For first 50 units Rs. 0.50/unit
   For next 100 units Rs.
   0.75/unit For next 100 units
   Rs. 1.20/unit For unit above
   250 Rs. 1.50/unit
   An additional surcharge of 20% is added to the bill
1. Write a menu driven C program to implement a simple arithmetic calculator.
2. Write a C program to display number of days in month using switch case (The input is month number 1 -12).

TASK 5

1. Write a C program check whether a given number is Perfect number or not.
2. Write a C program check whether a given number is Palindrome number or not.
3. Write a C program check whether a given number is Armstrong number or not.
4. Write a C program check whether a given number is Strong number or not.

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TASK 6

1. Write a C program to display the following patterns:

```
(i)          (ii)                (iii)
* * * *          1                   1
*     *        2   3                 2  2
*     *      4   5   6               3  3 3
* * * *    7   8   9   10            4  4 4  4
```

2. Write a C program to generate the prime numbers between x and y where x and y are starting and ending values to be supplied by the user.
3. Write a C program to calculate the sum of following series:
   (i) $S1=1+x/1!-x^2/2!+x^3/3!-x^4/4!+\ldots..xn/n!$ (ii) $S2=x^1/1+x^3/3+x^5/5+\ldots.+x^n/n$

TASK 7

1. Write a C program to find sum, average and minimum and maximum in a list of numbers.
2. Write a C program to implement Linear search.
3. Write a C program to implement Binary search.

TASK 8

1. Write a C program to implement matrix addition.
2. Write a C program to implement matrix multiplication.

TASK 9

1. Write a C program to display binary equivalent of a given decimal number using functions.
2. Write a C program to implement transpose of a matrix using functions
3. Write a C program using functions that compares two strings to see whether they are identical or not. The function returns 1 if they are identical, 0 otherwise.

TASK 10

1. Write a C program to implement factorial of a given integer using recursive and non-recursive functions.
2. Write a C program to find the GCD (greatest common divisor) of two given integers using recursive and non-recursive functions.
3. Write a C program to print first 'n' terms of Fibonacci series using recursive and non-recursive functions.

TASK 11

1. Write a C program to implement the following with and without string functions:
   (i) Reverse a string (ii) Concatenate 2 strings.
2. Write a C program to read a string and determine whether it is palindrome or not.
3. Write a C program to sort the 'n' strings in the alphabetical order.

TASK 12

1. Write a C program to implement function pointer to find sum and product of two numbers.
2. Write a C program to sort list of numbers using pointers.

TASK 13

1. Define a structure Student, to store the following data about a student: rollno(int), name(string) and marks. Suppose that the class has 'n' students. Use array of type Student and create a function to read the students data into the array. Your program should be menu driven that contains the following options :
   (i) Print all student details
   (ii) Search student by rollno
   (iii) Print the names of the students having the highest test score
2. Write a C program that uses structures and functions to perform addition and product of two complex numbers? (use structures and functions)

TASK 14

1. Write a C program to merge two files into a third file.
2. Write a C program to count number of characters in a file and also convert all lower case characters to upper case and display it
3. Write a C program to append a file and display it

TASK 15

1. Write a C program to find sum of 'n' numbers using command line arguments.
2. Write a C program to implement following pre-processor directives:
   i. define ii. undef iii. ifdef iv. ifndef.
3. Write a C program to create a user defined header file to find sum, product and greatest of two numbers.

Text Books:

1. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
2. B.A. Forouzan and R.F. Gilberg C Programming and Data Structures, Cengage Learning, (3rd Edition)

Reference Books:

1. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India
2. R.G. Dromey, How to solve it by Computer, Pearson (16th Impression)
3. Programming in C, Stephen G. Kochan, Fourth Edition, Pearson Education
4. Herbert Schildt, C: The Complete Reference, McGraw Hill, 4th Edition

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

ENGLISH LANGUAGE AND COMMUNICATION SKILLS LAB

Course Code: GR22A1016 **L/T/P/C: 0/0/2/1**
I Year I Semester

Course Objectives

1. Facilitate computer-assisted multi-media instruction enabling individualized and independent language learning
2. Sensitize students to the nuances of English speech sounds, word accent, intonation rhythm and Neutralization of accent for intelligibility
3. Bring about a consistent accent and intelligibility in students' pronunciation of English by providing an opportunity for practice in speaking
4. Improve the fluency of students in spoken English and neutralize their mother tongue influence
5. Train students to use language appropriately for public speaking and interviews

Course Outcomes

1. Interpret the role and importance of various forms of communication skills.
2. Demonstrate the skills needed to participate in a conversation that builds knowledge collaboratively by listening carefully and respect others point of view.
3. Utilize various media of verbal and non-verbal communication with reference to various professional contexts.
4. Recognize the need to work in teams with appropriate ethical, social and professional responsibilities.
5. Speak and pronounce English intelligibly

English Language and Communication Skills Lab (ELCS) shall have two parts:

1. Computer Assisted Language Learning (CALL) Lab
2. Interactive Communication Skills (ICS) Lab

Exercise I
CALL Lab:
Understand: Introduction to Phonetics – Speech Sounds – Consonant and Vowel Sounds.
Practice: Introduction to Phonetics – Speech Sounds – Vowels and Consonants.
ICS Lab:
Understand: Ice Breaking and JAM.
Practice: Ice-Breaking Activity and JAM Session. Introducing oneself and others

Exercise II
CALL Lab:
Understand: Structure of Syllables – Word Stress and Rhythm– Weak Forms and Strong Forms in Context.
Practice: Basic Rules of Word Accent - Stress Shift - Weak Forms and Strong Forms in Context.
ICS Lab:
Understand: Features of Good Conversation – Non-verbal Communication.
Practice: Situational Dialogues – Role-Play- Expressions in Various Situations –Making Requests and Seeking Permissions- Telephone Etiquette

Exercise III
CALL Lab: Errors in Pronunciation-the Influence of Mother Tongue (MTI).
Understand: Intonation--Errors in Pronunciation-the Influence of Mother Tongue (MTI).
Practice: Common Indian Variants in Pronunciation – Differences in British and American Pronunciation.

ICS Lab:
Understand: Debates- argumentative vs persuasive - Public Speaking – Exposure to Structured Talks.
Practice: Debates- Making a Short Speech – Extempore.

Exercise IV
CALL Lab:
Understand: Presentation Skills – Elements of Presentation – Organizing Content – Use of Power Point – Slides Preparation
Practice: Presentation Skills

ICS Lab:
Understand: How to make informal and Formal Presentations
Practice: Collages / Poster Presentations-Power point presentations

Exercise V
CALL Lab:
Understand: Listening Skills and its importance-– Purpose- Process- Types- Barriers of Listening - Listening for General/Specific Details.
Practice: Listening Comprehension Tests.
ICS Lab:
Understand: Mind map - Story Telling - Narrating a story using mind maps
Practice: Weaving Stories

Minimum Requirement of infrastructural facilities for ELCS Lab:
1. Computer Assisted Language Learning (CALL) Lab
2. Interactive Communication Skills (ICS) Lab

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

DESIGN THINKING

Course Code: GR22A1022 **L/T/P/C: 2/0/0/0**

I Year I Semester

Course Objectives

1. Define Design Thinking and understand its mindsets
2. Explain Design Thinking Methodology
3. Apply Ideation Tools
4. Discover the concept of Empathy
5. Explain how to design products

Course Outcomes

1. Find various DT mindsets
2. Extend DT methodology towards defining the problem
3. Identify Tools for Innovation
4. Develop Empathy Maps
5. Build Prototypes

UNIT I

Introduction to Design Thinking: LRI Assessment, Introduction to Design Thinking, Understanding the Mindsets-Empathy, Optimism, Embrace Ambiguity, Make it, Learn from Failure, Iterate, Create Confidence, Creativity Convergent & Divergent Thinking

UNIT II

Design Thinking Methodology: The 5 Stages of the Design Thinking Process-Empathise, Define (the problem), Ideate, Prototype, and Test

UNIT III

Ideation tools & exercises. Sample Design Challenge, Design Challenge Themes, Story telling and Tools for Innovation and creativity.

UNIT IV

Empathize-Understand customers, Empathy Maps, Empathise-Step into customers shoes- Customer Journey Maps, Define- Analysis & Drawing Inferences from Research

UNIT V

The Design Challenge: Define the Design Challenge, Prototyping & Iteration-Feasibility Study, Testing-Documentation and the Pitching

Text Books :

1, Design Thinking for Strategic Innovation: What They Can't Teach You at Business or Design School - Idris Mootee.

Reference Books:

1. Zero to One: Note on Start-Ups, or How to Build the Future
2. The Lean Startup: How Constant Innovation Creates Radically Successful Businesses
3. Start With Why: How Great Leaders Inspire Everyone To Take Action

I YEAR
II SEMESTER

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

DIFFERENTIAL EQUATIONS AND VECTOR CALCULUS

Course Code: GR22A1002 **L/T/P/C: 3/1/0/4**
I Year II Semester

Course Objectives
1. Solve engineering problems governed by linear differential equations
2. Learn the skill of evaluating multiple integrals needed for applications arising in science and engineering
3. Interpret the principles of vector differential calculus for some field theory concepts
4. Make use of line integrals for evaluating work done by a field
5. Develop the skill of utilizing special vector integral theorems for fast determination of work done and flux

Course Outcomes
1. Classify the differential equations of first order and solve them analytically
2. Solve linear differential equations of higher order under various forcing functions
3. Evaluate double and triple integrals and apply them to some problems in geometry
4. Apply principles of vector differentiation and line integration for some field related problems
5. Apply classical vector integral theorems for fast evaluation of work done around closed curves and flux across closed surfaces

UNIT I
ORDINARY DIFFERENTIAL EQUATIONS OF THE FIRST ORDER
Linear Differential Equations of the first order: Solution of Exact, Linear and Bernoulli equations, modelling Newton's law of cooling, growth and decay models, modelling of R-L circuit

UNIT II
ORDINARY DIFFERENTIAL EQUATIONS OF HIGHER ORDER
Solution of homogeneous and non-homogeneous linear differential equations with constant coefficients, complimentary functions, particular integrals and the method of variation of parameters
Solution of Linear Differential Equations with variable coefficients: Cauchy's and Legendre's homogeneous equations

UNIT III
MULTIPLE INTEGRALS
Double integrals: Evaluation of Double Integrals, change of order of integration (only Cartesian form), change of variables (Cartesian and polar coordinates)
Triple Integrals: Evaluation of triple integrals, Change of variables (Cartesian to Spherical and Cylindrical polar coordinates)
Application of double integral to find the area of a lamina and volume of a solid, application of the triple integral to find the volume of a solid

UNIT IV
VECTOR DIFFERENTIATION AND LINE INTEGRATION
Vector differentiation:Scalar and vector point functions, Concepts of gradient,

divergence and curl of functions in Cartesian framework, solenoidal field, irrotational field, scalar potential
Vector line integration: Evaluation of the line integral, concept of work done by a force field, Conservative fields

UNIT V
SURFACE INTEGRATION AND VECTOR INTEGRAL THEOREMS Surface integration: Evaluation of surface and volume integrals, flux across a surface
Vector integral theorems: Green's, Gauss and Stokes theorems (without proof) and their applications

Text Books

1. R.K.Jain: and S.R.K.Iyengar, Advanced Engineering Mathematics, Narosa publishing house, Fourth edition 2014
2. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010
3. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006
4. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9thEdition, Pearson, Reprint, 2002.

Reference Books:

1. GRIET reference manual
2. Paras Ram, Engineering Mathematics, 2nd Edition, CBS Publishes
3. S. L. Ross, Differential Equations, 3rd Ed., Wiley India, 1984.
4. Calculus Early Transcendental 9E by James Steward, Daniel Clegg, Saleem Watson, CENGAGE Publications

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

ENGINEERING PHYSICS

Course Code: GR22A1004 **L/T/P/C: 3/1/0/4**
I Year II Semester

Course Objectives:
1. Explain the interaction of light with matter through interference and diffraction phenomena.
2. Discuss the use of lasers as light sources in optical fiber applications.
3. Outline the behavior of free electrons in materials.
4. Describe the properties and fabrication methods of nanomaterials.
5. Recognize the basic concepts of acoustics and ultrasonic.

Course Outcomes:
1. Apply the principles of interference and diffraction of light in engineering applications.
2. Analyze the properties of Laser and its propagation in different types of optical fibers.
3. Classify materials based on the theory of Kronig Penny model.
4. Enumerate the nature and characterization of nanomaterials and its applications.
5. Use the concepts of acoustics and non-destructive testing in solving engineering problems.

UNIT I

Wave Optics: Superposition of waves, Interference of light by wave front splitting: Young's double slit experiment, Interference in thin films by reflection, Interference of light by amplitude splitting: Newton's rings, Difference between interference and diffraction, Fraunhofer diffraction from a single slit, Diffraction grating, Grating spectrum, Determination of wavelength of light using diffraction grating.

UNIT II

Lasers: Introduction, Characteristics of lasers, Lasing action, Essential components of laser, Construction and working: Ruby laser, He-Ne laser and Semiconductor laser, Applications of lasers.

Fiber Optics: Introduction, Principle and Structure of an optical fiber, Basic components in optical fiber communication system, Comparison of optical fibers over conventional cables, Types of optical fibers, Acceptance angle-Numerical aperture, Losses associated with optical fibers, Applications of optical fibers.

UNIT III

Introduction to solids:, Bloch's theorem, Kronig – Penny model and its conclusions, E-K diagram, Brillion Zones, Effective mass of electron, Classification of solids on the basis of energy bands, Intrinsic and extrinsic semiconductors, Direct and Indirect band gap semiconductors.

UNIT IV

Nanomaterials: Introduction, Quantum confinement, Surface to volume ratio, Classification of Nanomaterials, Synthesis methods: Top-Down technique-Ball milling method, Bottom–Up technique- Sol-Gel method, Characterization techniques: SEM, TEM and EDAX.

UNIT V

Acoustics: Basic requirements of acoustically good hall, Reverberation and Reverberation

time, Sabine's formula for Reverberation time, Measurement of absorption coefficient of a material, Factors affecting the architectural acoustics and their remedies.

Ultrasonics: Introduction, Classification of ultrasonic waves: Longitudinal waves, Transverse waves, Surface waves and Plate waves, Production of ultrasonic waves: Piezoelectric method and Magnetostriction method, Properties of ultrasonic waves, Applications of ultrasonics: SONAR and NDT - Pulse echo method.

Teaching methodologies:

- White board and marker
- Power Point Presentations
- Video lectures

Text Books:

1. Engineering Mechanics, 2nd edition- MK Harbola, Cengage Learning
2. Mechanics, D S Mathur and P S Hemne, S Chand
3. Engineering Physics, P.K Palanisamy, Scitech Publishers.
4. Ajoy Ghatak, "Optics", McGraw Hill Education, 2012

References:

1. H. J. Pain, "The physics of vibrations and waves", Wiley, 2006
2. O. Svelto, "Principles of Lasers"
3. "Introduction to Mechanics", M.K.Verma, Universities Press
4. I. G. Main, "Vibrations and waves in physics', 3rd Edition, Cambridge University Press, 2018
5. Applied Physics, T. Bhīma Sankaram, BSP Publishers.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

ENGINEERING MECHANICS

Course Code: GR22A1010 **L/T/P/C: 3/1/0/4**
I Year II Semester

Course Objectives

1. Explain the resolution of a system of forces, compute their resultant and solve problems using equations of equilibrium.
2. Perform analysis of bodies lying on rough surfaces.
3. Locate the centroid of a body and compute the area moment of inertia and mass moment of inertia of standard and composite sections.
4. Determine the forces in the members of the trusses.
5. Explain the concepts of work-energy method, impulse-momentum and its applications to translation, rotation and plane motion.

Course Outcomes

1. Determine resultant of forces acting on a body and analyze equilibrium of a body subjected to a system of forces.
2. Solve problem of bodies subjected to friction.
3. Find the location of centroid and calculate moment of inertia of a given section.
4. Determine the forces in the members of the trusses
5. Solve problems using work energy equations for translation, fixed axis rotation and plane motion of rigid bodies.

UNIT I

INTRODUCTION TO ENGINEERING MECHANICS - FORCE SYSTEMS

Basic concepts, Particle equilibrium in 2-D & 3-D; Rigid Body equilibrium; System of Forces, Coplanar Concurrent Forces, Components in Space – Resultant- Moment of Forces and its Application; Couples and Resultant of Force System, Equilibrium of System of Forces, Free body diagrams, Equations of Equilibrium of Coplanar Systems ; Static Indeterminacy

UNIT II

FRICTION: Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, wedge friction, screw Centroid and Centre of Gravity-Centroid of Lines, Areas and Volumes from first principle, centroid of composite sections; Centre of Gravity and its implications.

UNIT III

AREA MOMENT OF INERTIA: Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections; Product of Inertia, Parallel Axis Theorem, Perpendicular Axis Theorem, Mass Moment of Inertia , Inertia of Masses - Transfer Formula for Mass Moments of Inertia – Mass moment of inertia of composite bodies.

UNIT IV

ANALYSIS OF TRUSSES: Introduction, Classification of trusses, Assumptions made in the analysis of perfect truss, Methods of Analysis of Trusses- Method of Joints and Method of Sections. Principle of Virtual Work: Equilibrium of ideal systems, efficiency of simple

machines, stable and unstable equilibriums.

UNIT V

REVIEW OF PARTICLE DYNAMICS: Rectilinear motion, Plane curvilinear motion (rectangular, path, and polar coordinates). 3-D curvilinear motion, Relative and constrained motion; Newton's 2nd law (rectangular, path, and polar coordinates). Work- kinetic energy, power, potential energy. Impulse-momentum (linear, angular), Impact (Direct and oblique).

Text Books:

1. Reddy Vijay Kumar K. and J. Suresh Kumar (2010), Singer's Engineering Mechanics– Statics & Dynamics
2. A. Nelson, "Engineering Mechanics: Statics & Dynamics", Tata McGraw-Hill Education, 2009.

Reference Books:

1. Timoshenko S.P and Young D.H., "Engineering Mechanics", McGraw Hill International Edition, 1983.
2. Andrew Pytel, JaanKiusalaas, "Engineering Mechanics", Cengage Learning, 2014.
3. Beer F.P & Johnston E.R Jr. "Vector Mechanics for Engineers", TMH, 2004.
4. Hibbeler R.C & Ashok Gupta, "Engineering Mechanics", Pearson Education, 2010.
5. Tayal A.K., "Engineering Mechanics – Statics & Dynamics", Umesh Publications, 2011.
6. Basudeb Bhattacharyya, "Engineering Mechanics", Oxford University Press, 2008.
7. Meriam. J. L., "Engineering Mechanics", Volume-II Dynamics, John Wiley & Sons, 2008.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

DATA STRUCTURES

Course Code: GR22A1012 **L/T/P/C:2/1/0/3**
I Year II Semester

Course Objectives

1. Illustrate various sorting techniques and analyze the order of complexities of algorithms.
2. Demonstrate operations of linear data structures like stacks and queues and their applications.
3. Develop algorithms to implement various linked lists operations and distinguish static and dynamic allocations.
4. Demonstrate operations of non-linear data structures, trees and graphs.
5. Realize the merits and demerits and applications of various data structures.

Course Outcomes

1. Implement various sorting techniques and analyze the computational complexity of algorithms.
2. Analyze the basics of data structures and its types and translate to programs the operations on stack and queue and their applications.
3. Develop algorithms for various operations on linked lists and convert them to programs.
4. Interpret operations on non-linear data structure binary tree and BST.
5. Summarize the operations on graphs and apply graph traversals techniques and outline hashing techniques.

UNIT I

Algorithms and Complexities: Analysis of algorithms, Basic concept of order of complexity, Asymptotic Notations: Big Oh notation, Omega notation, Theta notation, little oh notation and little omega notation.

Sorting: Bubble sort, Insertion Sort, Selection Sort, Quick Sort, Merge Sort, Radix Sort, Counting sort.

UNIT II

Stacks: Introduction to Data Structures and types, Stack – Operations: pop, push, display, peek, Representation and implementation of stack operations using arrays, stack applications, recursion, infix to postfix transformation, evaluating postfix expressions.

Queues: Queue – Operations: enqueue, dequeue, display, representation and implementation of queue operations using array, applications of queues, circular queues - representation and implementation.

UNIT III

LIST: Introduction, dynamic memory allocation, self-referential structures, single linked list, advantages and disadvantages of single linked list, single linked list vs arrays, representation of a linked list in memory, operations-insertion, deletion, display, search.

Types and applications: Circular linked list, double linked list, implementation of stack, queue using linked list.

UNIT IV

Trees: Basic tree concepts, Binary trees**:** properties, types, representation of binary trees using arrays and linked lists, traversals of binary tree.

Binary Search Tree –Representation and implementation of operations, Binary Search Tree Traversals (recursive), creation of binary tree and BST from given traversals.

UNIT V

Graphs: Definition, basic terminology, representation of graphs, graph traversal techniques –Breadth First Traversal, Depth First Traversal.

Hashing - Introduction to hashing, hash function and types, hash table, implementation, collision resolution techniques–separate chaining, linear probing, quadratic probing, double hashing (only examples – no implementation).

Text Books:

1. Data Structures, 2/e, Richard F, Gilberg, Forouzan, Cengage
2. Data Structures and Algorithms, 2008, G.A.V.Pai, TMH

Reference Books:

1. Data Structures with C, Seymour Lipschutz, TMH
2. Classic Data Structures, 2/e, Debasis, Samanta, PHI, 2009
3. Fundamentals of Data Structures in C, 2/e, Horowitz, Sahni, Anderson Freed, University Press

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

ENGINEERING PHYSICS LAB

Course Code: GR22A1014 **L/T/P/C: 0/0/3/1.5**
I Year II Semesters

Course Objectives

1. Experiment with resonance phenomena using mechanical and electrical sources.
2. Analyze the mechanical properties of solid materials.
3. Recall the basic properties of light through hands on experience.
4. Apply the theoretical concepts of Lasers and optical fibers in practical applications.
5. Outline the characteristics of various semiconducting materials.

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Course Outcomes

1. Estimate the frequency of tuning fork, spring constant through coupled oscillation and analyze the resonance phenomena in LCR circuit.
2. Compare the rigidity modulus of wires of different materials using Torsional pendulum.
3. Interpret the properties of light like interference and diffraction through experimentation.
4. Asses the characteristics of Lasers and infer the losses in optical fibers.
5. Identify the type of semiconductor by measuring energy gap.

List of Experiments:

1. Melde's experiment: To determine the frequency of a turning fork using Melde's arrangement.
2. Torsional pendulum: To determine the rigidity modulus of the given wire using Torsional pendulum.
3. Newton's rings: To determine the wave length of the light source by forming Newton's rings.
4. Diffraction grating: To determine the wavelength of the light source by using diffraction grating.
5. Dispersive power: To determine the dispersive power of prism by using spectrometer.
6. Determination of wavelength of light by Laser diffraction method.
7. LCR Circuit: To determine the resonant frequency and quality factor of LCR circuit in series and parallel.
8. LASER: To study the V-I characteristics of LASER source.
9. Optical fiber: To determine the bending losses of Optical fibers.
10. Energy gap of P-N junction diode: To determine the energy gap of a semiconductor diode.

Note: Any 8 experiments are to be performed.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

DATA STRUCTURES LAB

Course Code: GR22A1020 **L/T/P/C: 0/0/2/1**
I Year II Semester

Course Objectives

1. Interpret sorting techniques.
2. Design programs on stack and queue operations and their applications.
3. Construct programs for linked lists operations using dynamic memory allocation.
4. Develop modular, reusable and readable C programs for tree operations.
5. Implement graph representations and graph traversal techniques

Course Outcomes

1. Construct executable C programs for sorting techniques.
2. Implement stack and queue data structures and their applications.
3. Interpret various linked list operations to produce executable codes.
4. Develop working procedure for operations on BST using DMA.
5. Demonstrate graph operations and hashing techniques.

TASK 1

a. Implement Bubble sort using a C program.
b. Implement Selection sort using a C program.
c. Implement Insertion sort using a C program.

TASK 2

a. Develop a C program for Quick sort.
b. Demonstrate Merge sort using a C program.
c. Design a C program for Radix Sort.

TASK 3

a. Write a C program to implement Stack operations using arrays.
b. Write a C program to implement Queue operations using arrays.
c. Write a C program to implement Circular Queue operations using arrays

TASK 4

a. Write a C program to convert infix expression to postfix expression.
b. Write a C program to evaluate a postfix expression.

TASK 5

a. Write a C program to check for balanced parenthesis.
b. Write a C program to implement priority queue using arrays.

TASK 6

a. Implement the following operations on Single Linked List using a C program.
    i. create
    ii. insert
    iii. delete
    iv. search
    v. display

TASK 7

a. Write a C program to implement Circular Linked List operations – create, insert, delete and display.

TASK 8

a. Write a C program to implement Double Linked List operations – create, insert, delete and display.

TASK 9

a. Implement a C program for Stack using Linked list.
b. Implement a C program for Queue using Linked list.

TASK 10

a. Implement the following operations on Binary Search Tree
   i. create
   ii. insert
   iii. search
   iv. delete

TASK 11

a. Implement the following operations on Binary Search Tree
   i. count-nodes
   ii. height
   iii. minimum node
   iv. maximum node

TASK 12

a. Develop a C code for preorder, inorder and postorder traversals of a Binary Search Tree using recursion.
b. Design a C program for level order traversal of a Binary Search Tree.

TASK 13

a. Write a C program to implement Adjacency Matrix of a given graph.
b. Write a C program to implement Adjacency List of a given graph.

TASK 14

a. Implement a C program for DFS traversal on graph.
b. Implement a C program for BFS traversal on graph.

TASK 15

a. Implement a C program for the following operations on Hashing:
   i. insert
   ii. delete
   iii. search
   iv. display

Teaching methodologies:

- Power Point Presentations
- Tutorial Sheets
- Assignments

Text Books:

1. Data Structures, 2/e, Richard F, Gilberg, Forouzan, Cengage
2. Data Structures and Algorithms, 2008, G.A.V.Pai, TMH

References:

1. Data Structures with C, Seymour Lipschutz, TMH
2. Classic Data Structures, 2/e, Debasis, Samanta, PHI, 2009
3. Fundamentals of Data Structures in C, 2/e, Horowitz, Sahni, Anderson Freed, University Press

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

ENGINEERING WORKSHOP

Course Code: GR22A1021 **L/T/P/C: 1/0/ 3/2.5**
I Year II Semester

Course objectives

1. Prepare and practice of scientific principles underlying the art of manufacturing in workshop/manufacturing practices.
2. Demonstrate basic knowledge of various tools and their use in different sections.
3. Make students to execute applications of various tools in carpentry.
4. Make students recognize applications of manufacturing methods casting, forming machining, joining and advanced manufacturing methods.
5. Develop generate safety rules, safe practices and workshop dress code.

Course Outcomes

1. Develop various trades applicable to industries / Manufacturing practices.
2. Create Hands on experience for common trades.
3. Improve to fabricate components with their own hands.
4. Develop practical knowledge on the dimensional accuracies and dimensional tolerances possible with various manufacturing processes.
5. To build the requirement of quality of work life on safety and organizational needs.

TRADES FOR EXERCISES: At least two exercises from each trade:

1. Carpentry
2. Fitting Shop
3. Tin-Smithy
4. Casting
5. Welding Practice
6. House-wiring
7. Black Smithy
8. **VIDEO LECTURES**: Carpentry, Fitting operations, Tin-Smithy, Casting, Welding, Electrical and Electronics, Black Smithy, Plumbing, Power tools in construction and Wood Working, Manufacturing Methods,

Text/ Reference Books:

1. Workshop Practice /B. L. Juneja / Cengage
2. Workshop Manual / K. Venugopal /Anuradha.

Reference Books:

1. Work shop Manual - P. Kannaiah/ K. L. Narayana/SciTech
2. Workshop Manual / Venkat Reddy/BSP
3. Workshop Manual/K. Venugopal/Dr.V. Prabhu Raja/G.Sreekanjan

II YEAR
I SEMESTER

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

KINEMATICS OF MACHINERY

Course Code: GR22A2038 **L/T/P/C: 3/0/0/3**
II Year I Semester

Course Objectives

1. Understand the kinematics and rigid-body dynamics of kinematically driven machine components.
2. Understand the motion of linked mechanisms in terms of the displacement, velocity and acceleration at any point in a rigid link.
3. Able to design some linkage mechanisms and cam systems to generate specified output motion.
4. Understand the kinematics of gear trains.
5. Estimate of transmission of power by belts drives.

Course Outcomes

1. Identify, select and design various types of linkage mechanisms for obtaining specific motion with lower pairs and higher pairs.
2. Analyze analytical and graphical aspects of linkage mechanisms for optimal functioning.
3. Drawing displacement diagrams and cam profile diagram for followers executing different types of motions for various configurations of followers.
4. Evaluate gear tooth geometry and select appropriate gears for the required applications.
5. Understand the concept of friction in bearings, clutches, brakes and belt drives.

UNIT I

Classification of mechanisms, Basic kinematic concepts and definitions-Degree of freedom, mobility- Grashof's law, Kinematic inversions of four bar chain and slider crank chains-Limit positions- Mechanical advantage-Transmission angle- Description of some common mechanisms- Quick return mechanism, straight line generators-Universal Joint-Rocker mechanisms

UNIT II

Displacement, velocity and acceleration analysis of simple mechanisms, graphical velocity analysis using instantaneous centers, velocity and acceleration analysis using loop closure equations-kinematic analysis of simple mechanisms-slider crank mechanism dynamics- Coincident points-Coriolis component of acceleration-introduction to linkage synthesis-three position graphical synthesis formation and path generation.

UNIT III

Classification of cams and followers-Terminology and definitions-Displacement diagrams- Uniform velocity, parabolic, simple harmonic and cycloidal motions-derivatives of follower motions-specified contour cams-circular and tangent cams-pressure angle and undercutting, sizing of cams, graphical and analytical disc cam profile synthesis for roller and flat face followers.

UNIT IV

Involute and cycloidal gear profiles, gear parameters, fundamental law of gearing and conjugate action, spur gear contact ratio and interference/ under cutting-helical, bevel, worm, rack & pinion gears, epicyclic and regular gear train kinematics.

UNIT V

Surface contacts-sliding and rolling friction-friction drives-bearings and lubrication-friction clutches-belt and rope drives-friction in brakes.

Text Books:

1. Thomas Bevan, Theory of Machines, 3 edition, CBS Publishers & Distributors, 2005.
2. Cleghorn W.L.Mechanisms of Machines, Oxford University Press, 2005.

Reference Books:

1. Robert L.Norton, Kinematics and Dynamics of Machinery, Tata Mc Graw Hill, 2009.
2. Ghosh A. and Mallick A.K., Theory of Mechanisms and Machines, Affiliated East-West Pvt. Ltd, New Delhi, 1988.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

METALLURGY AND MATERIAL SCIENCE

Course Code: GR22A2039 **L/T/P/C: 3/0/0/3**
II Year I Semester

Course Objectives

1. Understand the concepts of fundamental science and engineering relevant to materials, various mechanical property measurements.
2. Categorize the various equilibrium diagrams and describe the changes which occur on metals.
3. Explain the concepts on various heat treatment operations.
4. Categorize the various ferrous and nonferrous metals with their properties and applications.
5. Expose the concepts on composites, ceramics materials with their properties and applications.

Course Outcomes

1. Relate crystal structures and identify the suitable method for mechanical property measurements.
2. Relate the equilibrium transformation diagrams for various metals.
3. Utilize appropriate techniques in treating a metal with proper heat treatment operations.
4. Have knowledge on different types of ferrous and nonferrous metals.
5. Identify the suitable composite and ceramic material for the required application.

UNIT I

Structure of metals & mechanical property measurements: Bonds in Solids, crystallization of metals, grain and grain boundaries, effect of grain boundaries on the properties of metal, determination of grain size. Imperfection in solids: Point, line, interstitial and volume defects; dislocation strengthening mechanisms and slip systems, Tensile, compression and torsion tests; Young's modulus, true and engineering stress-strain curves, Hardness: Rockwell, Brinell and Vickers and their relation to strength.

UNIT II

Alloys & Phase diagrams: Necessity of alloying, Solid solutions, Types of Solid Solutions, Hume Rothery's rule, Intermediate alloy phases, effects of various alloying elements on steels, Iron – Iron carbide phase diagram, eutectic, eutectoid, peritectic, peritectoid reactions, and micro structural aspects of ledeburite, Austenite, Ferrite, Martensite and Cementite.

UNIT III

Heat treatment of steel: Annealing, Tempering, Normalizing, Hardening, Jominey quench Test for Hardenability, Continuous cooling curves and interpretation of final microstructures, austempering, martempering, case hardening, carburizing, nitriding, cyaniding, carbo-nitriding, flame, induction & cryogenic hardening.

UNIT IV

Ferrous & Non ferrous metals: Steels, Types of steels, Properties and applications of Plain carbon steels, stainless steel and tool steels, maraging steels, cast irons; grey, white, malleable and spheroidal cast irons, copper and its alloys, aluminium and its alloys, Nickel based super alloys, Titanium and its alloys.

UNIT V

Ductile, brittle failures, composites & ceramics: Stress strain curves for brittle and ductile materials, differences between brittle and ductile fractures, Griffith criterion, Fatigue failure, SN curve, ceramics and its properties, glasses, cermets, abrasive materials, Composite materials: Classification of composites, various methods of manufacture of composites, particle–reinforced materials, fibre-reinforced materials, metal ceramic mixtures, metal–matrix composites and Carbon–Carbon composites.

Text Books:

1. W.D.Callister, 2006, "Materials Science and Engineering-An Introduction", 6th Edition, Wiley India.
2. Kenneth G.Budinski and Michael K.Budinski, "Engineering Materials", Prentice Hall

Reference Books:

1. V.Raghavan, "Material Science and Engineering', Prentice Hall of India Private Limited, 1999.
2. U.C.Jindal, "Engineering Materials and Metallurgy", Pearson, 2011.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

BASIC ELECTRICAL ENGINEERING

Course Code: GR22A10 **L/T/P/C: 3/0/0/3**
II Year I Semester

Course Objectives

1. Introduce the fundamentals of Electrical Engineering.
2. Solve the problems in the applications of DC circuits.
3. Implement the basic concepts in AC circuits.
4. Provide foundation in theory and applications of Transformers, AC and DC machines.
5. Understand the principals involved in Sensors.

Course Outcomes

1. Illustrate the basic electric circuits.
2. Analyze various parameters of AC circuits.
3. Solve electric circuits with suitable theorems.
4. Interpret Magnetic circuits &electromechanical energy conversion.
5. Choose appropriate LT switchgear used for electrical installations.

UNIT I

BASIC COMPONENTS AND ELECTRIC CIRCUITS

Charge, Current, Voltage, Power, Passive components, Voltage and Current sources, dependent and independent sources, fundamentals of circuit Laws, Source Transformation, Passive components in series and parallel, Mutual coupling, Dot Convention in coupled circuits. Delta – star conversion.

UNIT II

A.C CIRCUITS

Representation of sinusoidal waveforms, average and rms values, phasor representation, real power, reactive power, apparent power, power factor, analysis of RL, RC and RLC circuits. Series circuits, Parallel circuitsand Resonance.

UNIT III

NETWORK ANALYSIS

Nodal and Mesh Analysis, Linearity and Superposition, Thevenin's and Norton's theorems, Maximum powertransfer theorem and Reciprocity theorem

UNIT IV

INTRODUCTION TO MAGNETIC CIRCUITS AND ELECTROMECHANICAL ENERGY CONVERSION

Force - voltage and Force - Current analogy, Comparison of Electric and Magnetic circuits, Magnetic circuitsfor Transformer and rotating machines.

Energy Conversion Process – Concept of Energy and Co – energy, mechanical force in the electromagnetic system, singly excited, doubly excited, electromechanical system, and dynamic equation.

UNIT V

ELECTRICAL INSTALLATIONS COMPONENTS

Components of LT Switchgear: Switch Fuse Unit (SFU), MCB (Miniature Circuit Breaker), ELCB (Earth Leakage Circuit Breaker), MCCB (Moulded Case Circuit Breaker), Types of Wires

and Cables, Earthing, power factor improvement (using capacitors).

Text Books

1. D.P. Kothari and I.J. Nagrath “Basic Electrical Engineering”, Third edition 2010, TataMcGraw Hill.
2. A. Sudhakar and Shyam Mohan “Basic Electrical Engineering”, McGraw Hill Education.
3. P. S. Bimbhra, “Electrical Machinery”, Khanna Publishers, 2011.
4. Vincent Deltoro “Electrical Engineering Fundamentals”, Second Edition, Prentice HallIndia, 1989.

Reference Books

1. C. K. Alexander and M. N. O. Sadiku, “Electric Circuits”, McGraw Hill Education,2004.
2. K. V. V. Murthy and M. S. Kamath, “Basic Circuit Analysis”, Jaico Publishers, 1999.
3. A.Chakrabarti “Circuit Theory (Analysis and Synthesis)”Dhanpat Rai & Co.
4. E. Hughes, “Electrical and Electronics Technology”, 10th Edition, Pearson, 2010
5. D.C. Kulshreshtha, “Basic Electrical Engineering”, McGraw Hill, 2009.

GOKARAJU RANGARAJU INSTITUTE OF ENGIN.EERING AND TECHNOLOGY

STRENGTH OF MATERIALS

Course Code: GR22A2040 **L/T/P/C: 3/0/0/3**
II Year I Semester

Prerequisites: Knowledge in Engineering Mechanics (statics)

Course Objectives

1. Provide the basic concepts and principles of strength of materials.
2. Study stresses, strains and elastic constraints of different materials.
3. Gain knowledge about shear stress and bending moment of different types of beams subjected to various loads.
4. Gain the knowledge about the effect of torsion on shafts.
5. Understand the flexural and shear stress concepts for different materials and shapes of structures.

Course Outcomes

1. Understand the theory of elasticity including strain displacement and Hooke's law relationships.
2. Analyse the shear Force and bending moment diagrams with various types of loads.
3. Analyse the stresses due to maximum shear Force and maximum bending moment acting on the beams
4. solve the torsion problems in bars, Calculate the slope and deflections in beams subjected to transverse loads.
5. Analyse various situations involving structural members subjected to combined stresses

UNIT I

Simple stresses & strains: Concept of stresses & strains (linear, lateral, shear, thermal and volumetric), Hooke's law, Poisson's ratio, Modulus of Elasticity, Modulus of Rigidity, Bulk Modulus. Stress-strain diagrams for ductile & brittle materials, Proof stress, True stress & strain - Various strengths of material- Yield strength, Ultimate tensile strength, Factor of safety, Strain energy-Gradual, sudden and Impact Loads. Concept of stress state, relation between elastic constants, Axial forces, stresses and strains in determinate and indeterminate composite bars, bars under axial loads and self-weight.

UNIT II

Shear force and Bending moment diagrams: Shear forces and bending moments of determinate beams due to concentrated loads, uniformly distributed loads, uniformly varying loads and couples, Relation between shear Force and Bending Moment diagrams for cantilevers, simply supported beams, and their construction- Maximum bending moment & point of contraflexure.

UNIT III

Bending stresses: Theory of simple bending, assumptions, derivation of flexural formula, Bending of common cross sections (rectangular, I,T,C) with respective centroidal & parallel axes, bending stress distribution diagrams, moment of resistance

and section modulus.

Shear stresses: Concept, derivation of shear stress distribution formula, shear stress distribution diagrams for I, T and C symmetrical sections, maximum and average shear stresses, shear connection between flange & web.

UNIT IV

Torsional stresses: Derivation of torsion equation, stresses, strain & deformations in solid & hollow Shafts, homogeneous & composite circular cross section subjected to twisting moment, stresses due to combined torsion, bending & axial force on shafts.

Slope and Deflection of beams: Relation between BM & slope, slope & deflection of determinate beams, double integration method (Macaulay's method), Moment Area method- derivation of formula for slope & deflection for standard cases

UNIT V

Principal stresses and strains: Normal and shear stresses on any oblique plane - Concept of principal planes, derivation for principal stresses and maximum shear stress, position of principal planes & planes of maximum shear, graphical solution using Mohr's circle of stresses, combined effect of axial force, bending moment & torsional moment on circular shafts (solid as well as hollow).

Text Books:

1. A Text book of Strength of Materials (in S.I units): R.K Bansal,Laxmi Publications
2. Strength of Materials:Rattan, McGraw-Hill Education (India) Pvt Limited

Reference Books:

1. Mechanics of Materials – E.P. Popov
2. Strength of Materials – Timoshenko
3. Mechanics of Solids & Structures – D,W.A. Rees
4. Strength of Materials – D. S. Prakash Rao

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

THERMODYNAMICS

Course Code: GR22A2041 **L/T/P/C: 3/0/0/3**
II Year I Semester

Prerequisites:
Basic Knowledge in Physics, Differentiation, Integration, Fundamental units and dimensions.

Course Objectives
1. Acquire knowledge of the fundamentals of thermodynamics and temperature scales
2. Apply First law of thermodynamics to various thermal engineering devices
3. Explain second law of thermodynamics and concept of entropy
4. Explain the various properties of steam
5. Apply the knowledge of thermodynamics to air standard cycles, vapour power cycle and analyze the properties of gas mixtures.

Course Outcomes
1. Apply the knowledge of thermodynamics to temperature scales.
2. Solve the practical thermodynamic problems by applying first law and steady flow energy equation
3. Analyze the problems on heat engines, refrigeration and entropy by applyingsecond law of thermodynamics
4. Evaluate the thermodynamic properties of the steam
5. Evaluate the performance of air standard cycles and vapor power cycle

UNIT I
Introductory Concepts and Energy: System, Control Volume, Surrounding, Boundaries, Universe, Types of Systems, Macroscopic and Microscopic viewpoints, Concept of Continuum, Thermodynamic Equilibrium, State, Property, Process, Cycle – Reversibility – Quasi – static Process, Irreversible Process, Causes of Irreversibility – Energy in State and in Transition, Types, Work and Heat, Point and Path function. Zeroth Law, First Law of Thermodynamics and Steady Flow Energy Equation: Zeroth Law of Thermodynamics – Concept of quality of Temperature – Principles of Thermometry –Reference Points – Const. Volume gas Thermometer – Scales of Temperature, Ideal Gas Scale – PMM I – Joule's Experiments – First law of Thermodynamics, First law applied to a Process –applied to a flow system – Steady Flow Energy Equation, Limitations of the First Law.

UNIT II
Second Law of Thermodynamics and Entropy: Thermal Reservoir, Heat Engine, Heat pump, Parameters of performance, Second Law of Thermodynamics, Kelvin-Planck and Clausius Statements and their Equivalence /Corollaries, PMM-II, Carnot cycle and its significance, Thermodynamic scale of Temperature, Clausius Inequality, Entropy, Principle of Entropy Increase – Energy Equation, Availability and Irreversibility – Thermodynamic Potentials, Gibbs and Helmholtz Functions, Maxwell Relations – Elementary Treatment of the third Law of Thermodynamics.

UNIT III
Pure Substances and Perfect Gas Laws:
Pure Substances, P-V-T- surfaces, T-S and h-s diagrams, Mollier Charts, Phase

Transformations – Triple point at critical state properties during change of phase, Dryness Fraction – Clausius – Clapeyron Equation Property tables. Mollier chart – Various Thermodynamic processes and energy Transfer – Steam Calorimetry. Perfect Gas Laws – Equation of State, specific and Universal Gas constants – various Non-flow processes, properties, end states, Heat and Work Transfer, changes in Internal Energy – Throttling and Free Expansion Processes – Flow processes – Deviations from perfect Gas Model – Vander Waals Equation of State – Compressibility charts.

UNIT IV

Mixtures of Perfect Gases and Air conditioning Concepts: Mixtures of perfect Gases – Mole Fraction, Mass fraction, Gravimetric and volumetric Analysis – Dalton‟s Law of partial pressure, Avogadro‟s Laws of additive volumes – Mole fraction , Volume fraction and partial pressure, Equivalent Gas constant, Molecular Internal Energy, Enthalpy, Specific heat and Entropy of Mixture of perfect Gases and Vapour. **Air conditioning Concepts:** Psychrometric Properties – Atmospheric air, Dry bulb Temperature, Wet Bulb Temperature, Dew point Temperature, Thermodynamic Wet Bulb Temperature, Specific Humidity, Relative Humidity, saturated Air, Vapour pressure, Degree of saturation – Adiabatic Saturation , Carrier‟s Equation – Psychometric chart.

UNIT V

Power Cycles: Gas Power cycles: Otto, Diesel, Dual Combustion cycles, Sterling Cycle, Atkinson Cycle, Ericcson Cycle, Lenoir Cycle, Brayton and Rankine cycles - Performance Evaluation – Description and representation on P–V and T-S diagram, Thermal Efficiency, Mean Effective Pressure on Air standard basis.

Refrigeration Cycles: Reversed Carnot Cycle-Bell- Coleman cycle, Vapour compression cycle-performance Evaluation.

Teaching Methodology: 1. Power Point Presentations , white board & marker

Text Books:

1. Engineering Thermodynamics / PK Nag /TMH, III Edition
2. Fundamentals of Thermodynamics – Sonntag, Borgnakke and van wylen / John Wiley & sons (ASIA) Pte Ltd.

Reference Books

1. Engineering Thermodynamics – Jones & Dugan
2. Thermodynamics – An Engineering Approach – Yunus Cengel& Boles /TMH
3. Thermodynamics – J.P.Holman / McGrawHill
4. An introduction to Thermodynamics / YVC Rao / New Age
5. Thermal Engineering by Dr R K Rajput, Laksmi Publications

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

MACHINE AND PRODUCTION DRAWING LAB

Course Code: GR22A2042 **L/T/P/C: 0/0/4/2**
II Year I Semester

Course Objectives

1. Develop an understanding of the conventional representation of different materials and machine parts.
2. Analyze the various limits, fits, tolerances and surface roughness symbols adopted in the production drawings.
3. Provide an understanding on various forms of screw threads, nuts, bolts, joints and rivets.
4. Create assembly drawings of machine parts from the given part drawings.
5. Create part drawing assemblies by using specifications and standards.

Course Outcomes

1. Understand the conventions used in Machine & production drawing.
2. Construct the machine elements including couplings, cotters, riveted, and bolted joints.
3. Determine limits and fits and allocate tolerances for machine components.
4. Construct an assembly drawing using part drawings of machine components.
5. Apply concepts and methods in the preparation of production drawings.

UNIT I
CONVENTIONAL REPRESENTATION

Materials, Machine elements, screw, riveted and welded joints. Springs, gears. Electrical, hydraulic and pneumatic circuits. Types of section – drawing of sections and auxiliary sectional views, Stack tolerance.

UNIT II

a) Forms of screw threads, bolts, nuts, stud bolts, tap bolts, set screws.
b) Cotter joint and knuckle joint.
c) Rivetted joints for plates.

UNIT III

a) Universal, Oldham coupling, journal and foot step bearings
b) Limits, fits and tolerance
c) Surface roughness and its indication

UNIT IV
ASSEMBLY DRAWINGS

Drawings of assembled views for the part drawings of the following using conventions and easy drawing proportions. Engine parts – stuffing boxes, eccentric, petrol engine connecting rod.

UNIT V
PART DRAWINGS

Drawing of parts from assembly drawings with indications of size, tolerances, roughness, form and position errors etc. Part Drawing Assemblies- Plummer block,

Screw jack, Lathetail stock.

Text Books:

1. Machine Drawing –K.L.Narayana, P.Kannaiah & K. Venkata Reddy / New Age/ Publishers
2. Production Drawing – K.L. Narayana & P. Kannaiah/ New Age.

Reference Books:

1. Machine Drawing – Dhawan, S. Chand Publications
2. Machine drawing with Auto CAD-Pohit and ghosh, PE
3. Machine Drawing – N. D. Bhatt
4. Machine Drawing – Rajput
5. Geometric dimensioning and tolerancing-James D. meadows/ B.S Publications
6. Engineering Metrology, R.K Jain, Khanna publications

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

STRENGTH OF MATERIALS LAB

CourseCode: GR22A2043 **L/T/P/C: 0/0/3/1.5**
II Year I Semester

Prerequisites: Fundamentals of Engineering Mechanics, Mechanics of materials.

Course Objectives

1. Opportunity to apply loads to various materials under different equilibrium conditions.
2. Perform tests on materials in tension, compression, torsion, bending, and impact.
3. Reinforce classroom theory by having the student to perform required tests, analyze subsequent data, and present the results in a professionally prepared report.
4. Study engineering properties of materials, force-deformation, and stress-strain relationship.
5. Gain a fundamental understanding of the concepts of stress and strain by analysis of solids and structures.

Course Outcomes

1. Determine the Young's modulus for ductile materials and analyze the compression strength of both ductile and brittle materials.
2. Analyze the various points on stress strain diagram and calculate the modulus of elasticity of ductile materials.
3. Calculate & compare the hardness values for various materials.
4. Experiment on a spring to interpret the stiffness and rigidity modulus.
5. Apply the concept of impact loading and to determine impact values for various materials.

List of Experiments:

Task-1: To conduct hardness test on given material using Brinnel's Hardness testing equipment

Task-2: To conduct hardness test on given material using Rockwell's Hardness testing machine

Task-3: To conduct hardness test on given material using Vicker's Hardness testing machine

Task-4: To perform the following tests on the given material using UTM (Universal Testing Machine) : Tension test to determine young's modulus and Shear test to determine ultimate shear strength

Task-5: To determine the stiffness and modulus of rigidity of the spring wire by performing Spring Test

Task-6: To perform compression test on cube to analyze compression strength of the material

Task-7: To determine the Young's modulus of the given structural material using Cantilever Beam set-up

Task-8: To determine the Young's modulus of given structural material using simply supported Beam set-up

Task-9: To determine the Young's modulus of given structural material by Maxwell's Reciprocal Theorem

Task-10: To determine the Young's modulus of given structural material using

Continuous Beam set-up
Task-11: To determine the Torsional strength and stiffness of a material using Torsion testing machine.
Task-12: To determine impact strength of the given material using Impact testing equipment (Izod and Charpy).

Teaching Methodology:
Experimental Test rigs

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

METALLURGY AND MATERIAL SCIENCE LAB

Course Code: GR22A2044 **L/T/P/C: 0/0/3/1.5**
II Year I Semester

Course Objectives

1. Know the micro structure of different materials.
2. Determine the properties of materials at higher elevated temperatures.
3. Importance of heat treatment process on various metals.
4. Gain knowledge on various materials for product based on microstructure.
5. Recognize the difference between ferrous and nonferrous metals with their properties.

Course Outcomes

1. Relate properties to microstructure.
2. Choose suitable metals and alloys for industrial applications.
3. Find out the hardness of various treated and untreated metals.
4. Tell the chemical composition of various ferrous and nonferrous metals.
5. Select a suitable heat treatment process for a material.

List of Experiments:

1. Preparation and study of microstructure of Mild steel and Low carbon steel.
2. Preparation and study of microstructure of Medium Carbon Steel and High carbon steel.
3. Preparation and study of microstructure of Stainless steel.
4. Preparation and study of microstructure of Grey cast iron and White cast Iron.
5. Preparation and study of microstructure of Malleable cast iron and Spheroidal graphite cast iron.
6. Preparation and study of microstructure of Aluminium.
7. Preparation and study of microstructure of copper.
8. Preparation and study of microstructure of Titanium.
9. Preparation and study of the microstructure of Inconel.
10. Hardenability of steels by Jominy End Quench test.
11. Preparation and microscopic examination of heat treated metal samples.
12. Preparation and microscopic examination of case hardened metal samples.

Teaching Methodology:

- Experimental Test rigs & Microscopes

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING & TECHNOLOGY

ENVIRONMENTAL SCIENCE

Course Code: GR22A2001 **L/T/P/C:2/0/0/0**
II Year I Semester

Course Pre-Requisites: Basic knowledge of environmental issues

Course Objectives

1. Recognize the impacts of human interventions towards environment
2. Understand how science and scientific method work to address environmental problems
3. List out the benefits in creating a sustainable environment
4. Sketch out various activities in achieving a cleaner environment
5. Emphasize the role of an individual for a better planet to live

Course Outcomes

1. Gain a variety of experiences & acquire a basic knowledge about the environment & its allied
2. problems
3. Interpret the key components in safe guarding the environment
4. Evolve an individual vision of harmonious interaction with natural world.
5. Appraise the quality of environment in order to create a healthy atmosphere
6. Familiarize with the individual responsibilities towards green revolution

UNIT I
INTRODUCTION AND AWARENESS ACTIVITIES
Environmental Science: Introduction, Definition, scope and importance.
AWARENESS ACTIVITIES
Small group meetings about:

- Water management
- Waste water treatment
- Projects Vs Environment
- Zero waste management
- Circular economy
- Impact of Science & Technology on Environment
- E-waste management
- Biodiversity loss
- Renewable Energy

UNIT II
SLOGAN AND POSTER MAKING EVENT

- Food waste management
- Rain water harvesting
- Climate change
- Green Power
- Water conservation

- Green at work
- Role of IT in environment and human health
- Sustainable development

UNIT III
EXPERT LECTURES ON ENVIRONMENTAL SCIENCE

- Environmental Impact Assessment
- Industrial waste treatment
- Regenerative farming/Organic farming/Vertical gardens/Hydroponics
- Circular Economy

UNIT IV
CLEANLINESS DRIVE

- Indoor air pollution
- Vehicular pollution
- Visual pollution
- Waste management at home
- Composting
- Plastic recycling

UNIT V
CASE STUDIES

- HPCL and LG Polymers disasters in Vizag
- Oleum gas leak in Delhi
- Mathura Refinery & Taj Mahal
- Conservation of Hussain Sagar lake
- The Cleanliest city of India-Surat
- Green Buildings in India
- KBR park in Hyderabad (Environmental protection Vs Development)
- Fluorosis and remediation
- Evaluation of STP or ETP operation in Hyderabad
- Ecotourism & its impacts
- Positive Impact on Environment due to Lockdown Forced by Corona Pandemic

Text Books:

1. Environmental Studies for UG Courses, Erach Bharucha, UGC Publications, Delhi, 2004.
2. Textbook of Environmental Studies, Deeksha Dave, S. S. Katewa, Cengage Delmar Learning India Pvt., 2012.

Reference Books:

1. Introduction to Environmental Science, Y. Anjaneyulu, BS Publications, 2004.
2. Environmental Studies, Anubha Kaushik & C. P. Kaushik, 4th Edition, New Age International Publishers

II YEAR
II SEMESTER

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

THERMAL ENGINEERIG

Course Code: GR22A2045 **L/T/P/C: 3/0/0/3**
II Year II Semester

Course Objectives

1. Apply the laws of Thermodynamics to analyze air standard cycles.
2. Understand and evaluate the performance analysis of the major components and systems of IC engines and their applications.
3. Analyze the processes to improve the performance of IC engines with respect to fuel economy and control emissions in global, environmental and social context.
4. Explore to the components and working principles of rotary, reciprocating, dynamic and axial compressors.
5. Evaluation of parameters which influence the performance of the compressors in power plants, gas turbines and jet propulsions etc., for better engineering practice.

Course Outcomes

1. Ability to understand the concept on working principles and their functions of various components of internal combustion engine.
2. Ability to improve the analytical skills in finding the engineering solutions and redesign the system by combustion, electrical and electronic systems and fuel technology to improve the fuel efficiency of the engine.
3. Ability to adopt the resources available at optimum level in order to achieve the better efficiency in the performance of different types of air compressors duly reducing the operational losses.
4. Ability to explain the function and working principles of reciprocating, rotary, compressors and elaborate the factors influence performance of the compressors by analytical.
5. Ability to explain the function and working principles of dynamic and axial compressors and elaborate the factors influence performance of the compressors by analytical and graphical methods using velocity triangles.

UNIT I

Introduction and Analysis of Actual Cycles I.C. ENGINES: Classification - Working principles, Valve and Port Timing Diagrams, Air – Standard air-fuel and actual cycles. Comparison of Air Standard and Actual Cycles, Time Loss Factor, Heat Loss Factor, Exhaust Blow down-Loss due to Gas exchange process, Volumetric Efficiency. Loss due to Rubbing Friction, Actual and Fuel-Air Cycles of CI Engines. Engine systems, cooling and lubrication systems.

UNIT II

Combustion S.I. Engines: Fuel system components, Carburetor, Fuel Injection System, Ignition systems Normal Combustion and abnormal combustion – Importance of flame speed and effect of engine variables – Type of Abnormal combustion, pre-ignition and knocking – Fuel requirements and fuel rating, anti knock additives – combustion chamber – requirements, types.

C.I. Engines: Four stages of combustion – Delay period and its importance – Effect of engine variables – Diesel Knock– Need for air movement, suction, compression and combustion induced turbulence – open and divided combustion chambers and nozzles

used – fuel requirements and fuel rating.

UNIT III

Testing and Performance Parameters of performance - measurement of cylinder pressure, fuel consumption, air intake, exhaust gas composition, Brake power – Determination of frictional losses and indicated power – Performance test – Heat balance sheet and chart.

UNIT IV

Reciprocating and Rotary Compressors Compressors: Classificationpositive displacement and roto dynamic machinery-Power producing and power absorbing machines, fan, blower and compressor-positive displacement and dynamic types-reciprocating and rotary types.

Reciprocating: Principle of operation, work required, Isothermal efficiency volumetric efficiency and effect of clearance, stage compression, under cooling, saving of work, minimum work condition for stage compression.

Rotary (Positive displacement type): Roots Blower, vane sealed compressor, Lysholm compressor –mechanical details and principle of working – efficiency considerations.

UNIT – V

Dynamic and Axial Flow Compressors Dynamic Compressors: Centrifugal compressors: Mechanical details and principle of operation –velocity and pressure variation. Energy transfer-impeller blade shape-losses, slip factor, power input factor, pressure coefficient and adiabatic coefficient – velocity diagrams – power.

Axial Flow Compressors: Mechanical details and principle of operation – velocity triangles and energy transfer per stage degree of reaction, work done factor - isentropic efficiency- Pressure rise calculations –Polytropic efficiency.

Text Books

1. I.C. Engines / V. GANESAN- TMH
2. Thermal Engineering / Rajput / Lakshmi Publications

Reference Books

1. I C Engines – Mathur & Sharma – DhanpathRai& Sons.
2. Engineering fundamentals of IC Engines – Pulkrabek / Pearson /PHI
3. Thermal Engineering / Rudramoorthy– TMH
4. Thermodynamics & Heat Engines / B. Yadav/ Central Book

Teaching Methodology: Power point Presentations, Working models, white board & marker

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

FLUID MECHANICS AND FLUID MACHINES

Course Code: GR22A2046 **L/T/P/C: 3/0/0/3**
II Year II Semester

Course Objectives
1. Explain the Concept and application of mass and momentum conservation laws for fluid flows.
2. Understand the importance of dimensional analysis.
3. Obtain the velocity and pressure variations in various types of simple flows.
4. Analyze the flow in water pumps and turbines.
5. Study and apply the Energy conservation laws for fluid flow applications.

Course Outcomes
1. Apply concept of mathematics, science and engineering in fluid flows.
2. Use the governing equations of fluid flow and apply the same to simple flow problems.
3. Explain the mathematical formulation of various flow problems.
4. Analyze the boundary layer concept to the fluid flow problems.
5. Execute the concept of fluid and models of fluids for flow problems.

UNIT I
Definition of fluid, Newton's law of viscosity, Units and dimensions- Properties of fluids, mass density, specific volume, specific gravity, viscosity, compressibility and surface tension, Control volume- application of continuity equation and momentum equation, incompressible flow, Bernoulli's equation and its applications.

UNIT II
Exact flow solutions in channels and ducts, Couette and Poiseuille flow, laminar flow throughcircular conduits and circular annuli-concept of boundary layer– measurement of boundary layer thickness–Darcy Weisbach equation, friction factor, Moody's diagram.

UNIT III
Need for dimensional analysis–methods of dimension analysis - Rayleigh and buckingham π theorem–Similitude–types of similitude -Dimensionless parameters–application of dimensionless parameters–Model analysis.

UNIT IV
Centrifugal pumps, working principle, work done by the impeller, multi stage pumps-performance curves. Euler's equation–theory of roto-dynamic machines–various efficiencies–velocity components at entry and exit of the rotor, velocity triangles—Cavitation in pumps-Reciprocating pump–working principle, slip, percentage of slip, power required to drive the pump.

UNIT V
Basics of hydroelectric power plant - Classification of water turbines, heads and efficiencies, velocity triangles-Axial, radial and mixed flow turbines- Pelton wheel, Francis turbine and Kaplan turbines, working principles– draft tube-Specific speed,

unit quantities, performance curves for turbines–governing of turbines.

Text Books:

1. Hydraulics, fluid mechanics and Hydraulic machinery MODI and SETH.
2. Fluid Mechanics and Hydraulic Machines by R K Rajput.Laxmi Publications(P) Ltd.,

Reference Books:

1. A Textbook of Fluid Mechanics and Hydraulic Machines by Dr R.K. Bansal, Laxmi Publications(P) Ltd.,
2. Introduction to Fluid Mechanics and Fluid Machines By S K Som, Gautam Biswas, McGrawHill.
3. Fluid Mechanics and Hydraulic machines by R K Bansal, Laxmi publications.
4. Fluid Mechanics & Hydraulic Machines: Problems & Solutions by K.Subrmanya/TMH private limited.
5. Hydraulic Machines by Banga & Sharma, Khanna Publishers.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

DYNAMICS OF MACHINERY

Course Code: GR22A2047 **L/T/P/C: 3/0/0/3**
II Year II Semester

Course Objectives

1. Understand the concept of gyroscopic couple and its effect on aero plane, ship, two and four wheel drive.
2. Introduce the approaches and mathematical models used in static and dynamic analysis of machinery
3. Impart the knowledge of Various Governors, Brakes and operation of Dynamometers.
4. Understand the concepts of balancing of rotating masses and reciprocating masses.
5. Introduce of mathematical models and solution methods to study Vibration of the mechanical systems

Course Outcomes

1. Analyze complete motion analysis of machines in running condition and able to know gyroscope and its effects.
2. Design various mechanisms of machines which were used in real life and explain how to get equilibrium condition of machine members while the machine is in running condition.
3. Apply the knowledge regarding use of Governor, brakes and operation of Dynamometers.
4. Explain how to balance forces and moments produced by rotating or reciprocating masses of machine members.
5. Analyze the vibrations, which is the major disturbance in machines while in the running condition and also precautions to reduce vibration.

UNIT I

Gyroscopes: Introduction, Precisional angular motion, Gyroscopic couple, effect of gyroscopic couple on an aeroplane, effect of gyroscopic couple on a naval ship during steering, gyroscopic couple on a naval ship during pitching, Gyroscopic couple on a naval ship during rolling, stability of a four wheel drive moving in a curved path, stability of a two wheel vehicle taking a turn.

UNIT II

Static Force Analysis: Introduction, Static Equilibrium, Equilibrium of Two-force and three force members, Member with Two force.

Dynamic force Analysis: Introduction, D'Alemberts principle, Equivalent Offset inertia force, Dynamic analysis of Four bar and Single slider mechanisms, Piston effort, Turning moment on crank shaft, Inertia of connecting rod, Inertia forces in reciprocating Engines.

UNIT III

Governors: Introduction, types of governors, Watt governor, Porter governor, Proell governor, Hartnell governor, Wilson-Hartnell governor, Spring controlled gravity governor, Inertia governors, Sensitiveness of governor, Hunting, Isochronism,

Stability,effort of governor, Power of governor, Controlling force.

Brakes and Dynamometers: Types of brakes: Simple block brake, band and block brake internal expanding shoe brake-effect of braking of a vehicle. Dynamometers – absorption and transmission types. General description and methods of operation.

UNIT IV

Balancing of Rotating Masses: Balancing of rotating masses in single and different planes.

Balancing of Reciprocating Masses: Primary, Secondary, and higher balancing of reciprocating masses, Analytical and graphical methods. Unbalanced forces and couples - examination of "V" multi cylinder in line and radial engines for primary and secondary balancing, locomotive balancing–Hammer blow, Swaying couple, variation of tractive efforts.

UNIT V

Vibrations: Free Vibration of mass attached to vertical spring – Transverse loads – vibrations of beams with concentrated and distributed loads. Dunkerly's method – Raleigh's method. Whirling of shafts – critical speed – torsional vibrations – one, two and three rotor systems.

Text books:

1. Theory of Machines / S.S Ratan/ Mc. GrawHill Publ.
2. Theory of machines/Khurmi/S.Chand.

References:

1. Theory of Machines by Thomas Bevan/ CBS
2. Theory of Machines / R.K Bansal
3. Theory of Machines Sadhu Singh Pearson's Edition
4. Theory of Machines /Shigley/ Oxford.
5. Theory of machines – PL. Balaney/khanna publishers.
6. Mechanism and Machine Theory / JS Rao and RV Dukkipati / New Age

Teaching Methodology:

- Power point Presentations
- Working models
- white board & marker

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

COMPUTATIONAL MATHEMATICS FOR ENGINEERS

Course Code: GR22A2009 **L/T/P/C: 3/0/0/3**
II Year II Semester

Course Objectives

1. Distinguish between analytical and numerical solutions arising in mathematics
2. Learn methods that provide solutions to problems not possessing an analytical solution
3. Acquire skills to estimate derivatives and integrals numerically
4. Understand the usefulness of the principle of least squares
5. Understand the principles of numerical techniques require to solve ODE and PDE

Course Outcomes

1. Apply well known techniques to find real roots of an equation and linear algebraic systems by iterative methods
2. Apply interpolation and numerical differentiation techniques for univariate data
3. Solve problems related to numerical integration and least squares approximations of a function
4. Choose appropriate numerical techniques to solve IVP and BVP in ODE
5. Distinguish between various numerical methods to solve PDE arising in the context of heat conduction

UNIT I

Root finding and Numerical solution of linear algebraic systems

Finding the real root of algebraic and transcendental equations by Regula-Falsi and Newton Raphson methods -Gauss Jacobi and Gauss Seidel iterative methods to solve a linear algebraic system with error analysis

UNIT II

Interpolation - Cubic spline- Differentiation

Interpolation with non-uniform data: Newton divided differences formula, operational calculus, Interpolation with uniform data- Newton and Gauss formulas, Fitting natural cubic spline to data

Numerical differentiation for uniform and non-uniform data

UNIT III

Numerical integration and Curve approximations

Numerical integration by Trapezoidal rule, Simpson's 1/3rd and $3/8^{th}$ rules – The Principle of least squares, Fitting a straight line, parabola, exponential and power curve, Simple and Multiple linear regression with 2 independent variables

UNIT-IV

Numerical solution of initial and boundary value problems in ODE

Taylor's series method, Picard's method, Euler method, Modified Euler method and R-K fourth order methods to solve initial value problems in ODE - Finite differences method to solve boundary value problems in ODE

UNIT-V

Numerical solution initial and boundary value problems in PDE

Solution of Laplace's equation by Jacobi, Gauss-Seidel method and Successive over relaxation (SOR) methods, Solution of Heat equation by the finite difference method.

Text Books:

1. M.K.Jain, S.R.K. Iyengar, R.K.Jain-.Numerical methods for scientific and engineering computation-New Age International publishers-Fourth edition-2—3
2. Robert J.Schilling and Sandra L.Harries- Applied numerical methods for engineers using MATLAB and C-Thomson Brooks/Cole-2002.

Reference Books:

1. S.S.Sastry- Introductory methods of numerical analysis- Prentice Hall (India)- Fourth edition- 2010

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

MANUFACTURING ENGINEERING

Course Code: GR22A2048 **L/T/P/C: 2/1/0/3**
II B.Tech II Semester

Prerequisites: Basic knowledge in engineering workshop practices

Course Objectives

1. Impart knowledge about principles/methods of casting with detail design of gating/riser system needed for casting
2. Impart knowledge about process during welding and weldability aspects of different common engineering materials.
3. Impart knowledge about different forming processes and requirements for achieving good quality components.
4. Introduce the sheet metal forming techniques and its applications
5. Introduction to various plastic parts manufacturing methods used.

Course Outcomes

1. Impart knowledge on role and value of production and identify basic production processes.
2. Introduction to methods of joining that shows a comprehensive understanding of tools, materials, equipment, and processes.
3. Apply critical thinking skills for development and evaluating sheet metal forming processes.
4. Identify and use the materials, tools, machines, and techniques used in various forming processes.
5. Demonstrate various ways of producing plastic products and its equipment details.

UNIT I

Metal Casting Processes: Sand casting process – Sand moulds - Type of patterns – Pattern materials– Pattern allowances –Types of Moulding sand – Properties of moulding sand, Methods of Sand testing – Core making–Moulding machines–Types of moulding machines - Melting furnaces–Working principle of Special casting processes–Shell, investment casting – Ceramic mould– Lost Wax process – Pressure die casting – Centrifugal casting – CO2 process– Sand Casting defects – Inspection methods.

UNIT II

Joining Processes: Classification of welding process- Fusion welding processes-Types of Gas welding–Equipments used–Flame characteristics–Filler and Flux materials-Arc welding equipments - Electrodes – Coating and specifications–Principles of Resistance welding–Spot, seam welding, Projection welding–Percussion welding-Flux cored–Submerged arc welding–Electro slag welding–Gas metal arc welding–TIG and MIG welding–Principle and application of special welding processes-Thermit welding–Electron beam welding- LASER beam welding-Plasma arc welding–Friction welding–Diffusion welding–Weld defects–Brazing and soldering process–Methods and process capabilities–Filler materials and fluxes–Types of Adhesive bonding.

UNIT III

Bulk Deforming Processes: Hot working and cold working of metals–Forging processes–Open, impression and closed die forging–Characteristics of the process–Types of Forging Machines –Typical forging operations–Rolling of metals–Types of Rolling mills-Flat strip rolling– Shape rolling operations–Defects in rolled parts - Principle of rod and wire drawing-Tube drawing–Principles of Extrusion–Types of Extrusion–Hot and Cold extrusion–Equipments used.

UNIT IV

Sheet Metal Processes: Sheet metal characteristics - Typical shearing operations, bending and drawing operations – Stretch forming operations — Formability of sheet metal – Test methods– Working principle and application of special forming processes - Hydro forming – Rubber pad forming – Metal spinning – Introduction to Explosive forming, Magnetic pulse forming, Peen forming, Super plastic forming.

UNIT V

Manufacturing of Plastic Components: Types of plastics-Characteristics of the forming and shaping processes–Moulding of Thermoplastics–Working principles and typical applications of-Injection moulding–Plunger and screw machines–Compression moulding, Transfer moulding–Typical industrial applications–Introduction to Blow moulding–Rotational moulding–Film blowing–Extrusion-Thermoforming-Bonding of Thermoplastics.

Text books:

1. Hajra Choudhury, "Elements of Workshop Technology, Vol. I and II", Media Promotors Pvt Ltd., Mumbai, 2001
2. S.Gowri, P.Hariharan, and A.SureshBabu, "Manufacturing Technology 1", Pearson Education , 2008.

Reference books:

1. P.N. Rao,"ManufacturingTechnology",Tata McGraw-Hill Publishing Limited, II Edition, 2002.
2. B.S. Magendran Parashar& R.K. Mittal,"Elements of Manufacturing Processes",Prentice Hall of India, 2003.
3. P.C. Sharma, "A text book of production technology",S. Chand and Company, IV Edition, 2003.
4. Begman, 'Manufacturing Process", John Wilely& Sons, VIII Edition, 2005.
5. Serope Kalpajian, Steven R.Schmid, Manufacturing Engineering and Technology, Pearson Education, Inc. 2002(Second Indian Reprint).
6. Beddoes.J and Bibby M.J, 'Principles of Metal Manufacturing Processes', Elsevier, 2006.
7. Rajput R.K, 'A text book of Manufacturing Technology', Lakshmi Publications, 2007.

Teaching Methodology:

- Power point Presentations
- Working models
- White board & marker

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

THERMAL ENGINEERING LAB

Course Code: GR22A2049 **L/T/P/C: 0/0/4/2**
II Year II Semester

Course Objectives

1. Understand the working principles of each component of internal combustion engines, refrigeration system, Boilers etc.
2. Explore to measuring devices functioning for air, fuel, temperature, pressure, loading, speed, Calorific value, viscosity etc.
3. Recollect the basic conservation of energy principles, laws of thermodynamics for real time applications.
4. Explain the process involved in the thermal systems for assessing the performance and its enhancement using graphs, balance sheets etc.
5. Summarize the differences between internal and external combustion engines, reciprocating and rotary type with merits and limitations.

Course Outcomes

1. Explain the functioning of measuring devices such as manometer, thermocouples, loading devices, fuel measurements etc. by applying the conservation laws and demonstrate the function of parts of 4 stroke diesel/petrol engines by assembling and dismantling.
2. Evaluate the properties of fuels such as flash & fire points, calorific value, Viscosity using basic concepts by conducting experimentation.
3. Assess the performance parameters of different thermal systems such as diesel/Petrol engines, refrigeration system, air compressors, Boilers etc.,
4. Enumerate and calculate the amount of dissipation of heat/energy in different ways by drawing balance sheets for an IC Engine.
5. Represent the processes, performance of the system in the form of graphs, period of suction, compression, expansion, exhaust and injection/ignition in the form of diagrams.

LIST OF EXPERIMENTS:

Task-1: Disassemble and Assemble of 4 stroke single cylinder diesel and petrol engine.
Task-2: Valve timing diagram for 4 stroke single cylinder diesel and petrol engine.
Task-3: Performance test on 4-stroke single cylinder diesel engine with Electrical loading.
Task-4: Heat balance test on 4 stroke single cylinder diesel engine with Electrical loading.
Task-5: Performance test on 4- stroke single cylinder diesel engine with Mechanical loading.
Task-6: Heat balance test on 4-stroke single cylinder diesel engine with Mechanical loading.
Task-7: Determination of the calorific value of a given fuel.
Task-8: Determination of the flash & fire points of a given fuel.
Task-9: Determination of the density and viscosity of a given oil.
Task-10: Performance test on two stage reciprocating Air Compressor

Task-11: Study of Babcock and Wilcox boiler.

Task-12: Determination of COP of a Vapour compression refrigeration system.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

MANUFACTURING ENGINEERING LAB

Course Code: GR22A2050 **L/T/P/C: 0/0/3/1.5**
II Year II Semester

Prerequisites: Fundamentals of Production Technology

Course Objectives

1. Provide practical experience on various manufacturing processes used in industry for converting raw materials into finished products.
2. Provide knowledge and practical exposure on how to create plastic components using plastic moulding machine.
3. Emphasize the importance of casting process and tools used in it.
4. To analyze and understand the welding techniques.
5. Understand various conventional manufacturing processes in manufacturing a product.

Course Outcomes

1. Recommend appropriate Design and manufacture simple patterns for castings.
2. Know the principles and gain knowledge on different kinds of joining processes.
3. Acquire knowledge on Manufacturing of plastic components.
4. Acquire knowledge on different kinds of production processes available for shaping or moulding products.
5. Recognize the importance of safety devices and gain practical experience on various manufacturing processes.

Task-1: CASTING

1. Pattern Design and making-2 Exercises.
2. Moulding, Melting and Casting-1Exercise

Task-2: WELDING

1. ARC Welding Lap Joint-1 Exercise
2. ARC Welding Butt Joint-1 Exercise
3. Spot Welding-1Exercise
4. TIGWelding-1Exercise
5. Plasma welding and Brazing - 2 Exercises (Water Plasma Device)

Task-3: MECHANICAL PRESS WORKING

1. Blanking & Piercing operation and study of simple, compound and progressive press tool.
2. Hydraulic Press: Deep drawing.
3. Bending and other operation

Task-4: PROCESSING OF PLASTICS

1. Injection Moulding
2. Blow Moulding

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

FLUID MECHANICS AND FLUID MACHINES LAB

Course Code: GR22A2051 **L/T/P/C: 0/0/3/1.5**
II Year II Semester

Prerequisites: Fundamentals of Fluid Mechanics and Fluid Machinery

Course Objectives

1. Provide practical knowledge in verification of principles of fluid flow.
2. Impart knowledge in measuring pressure, discharge and velocity of fluid flow.
3. Understand Major and Minor Losses.
4. Gain knowledge in performance testing of Hydraulic Turbines and Hydraulic Pumps at constant speed and Head.
5. Familiarize laminar and turbulent flows in pipes.

Course Outcomes

1. Demonstrate practical knowledge in fluid flow principles.
2. Demonstrate the knowledge in calculating performance analysis in turbines and pumps understand to analyse practical problems in all power plants and chemical industries.
3. Conduct experiments in pipe flows and interpreting data from model studies to prototype cases, as well as documenting them in engineering reports.
4. Analyse a variety of fluid-flow devices and utilize fluid mechanics principles in design.
5. Analyze flow rate and pressure rise, select the proper pump to optimize the pumping efficiency.

LIST OF EXPERIMENTS:

Task-1: Verification of Bernoulli's theorem and draw the HGL, TEL
Task-2: Determination of Coefficient discharge of Venturi meter and Orificemeter.
Task-3: Determination of Darcy's Friction factor in various diameters of pipes
Task-4: Determination of Minor Losses (Different Valve connections, SuddenExpansion, Sudden Contraction, Bends, joints) in various pipe fittings
Task-5: Determination of coefficient of impact of Jet on given Vanes
Task-6: Determination of overall efficiency of Pelton wheel Turbine at ConstantSpeed and Constant Head
Task-7: Determination of overall efficiency of Francis Turbine at Constant Speed and Constant Head
Task-8: Determination of overall efficiency of Kaplan Turbine at Constant Speed and Constant Head
Task-9: Determination of the overall efficiency of Single Stage Centrifugal pump
Task-10: Determination of the overall efficiency of Multistage Centrifugal pump
Task-11: Determination of the overall efficiency of Reciprocating pump
Task-12: Determination of the laminar and turbulent flow using Reynold's apparatus.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

CONSTITUTION OF INDIA

Course Code: GR22A2003 **L/T/P/C: 2/0/0/0**
II Year II Semester

Course objectives:

1. Create an awareness about the Constitution of India, Fundamental Rights and Duties, Directive Principles
2. Learn the role of Prime Minister, President and the Council of Ministers and the State Legislature
3. Learn the divisions of executive, legislative and judiciary and so on.
4. Know how a municipal office, panchayat office etc. works
5. Understand the importance and role of Election Commission Functions.

Course Outcomes

1. Know the importance of Constitution and Government
2. Become Good Citizens and know their fundamental rights, duties and principles.
3. Learn about the role of PM, President, Council of Ministers etc and it will help students learn about Local Administration.
4. Understand the importance of Election Commission and the Students will become aware of how a Country and State are run in Democracy.
5. Know about Secularism, Federalism, Democracy, Liberty, Freedom of Expression, Special Status of States etc.,

UNIT I

Introduction: Constitution' meaning of the term, Indian Constitution: Sources and constitutional history, Features: Citizenship, Preamble, Fundamental Rights and Duties, Directive Principles of State Policy

UNIT II

Union Government and its Administration: Structure of the Indian Union: Federalism, Centre - State relationship, President: Role, power and position, PM and Council of ministers, Cabinet and Central Secretariat, Lok Sabha, Rajya Sabha

UNIT III

State Government and its Administration: Governor: Role and Position, CM and Council of ministers, State Secretariat: Organization, Structure and Functions

UNIT IV

Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation, Pachayati raj: Introduction, PRI: Zila Pachayat, Elected officials and their roles, CEO Zila Pachayat: Position and role, Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials.

UNIT V

Composition of Judiciary and Election Commission: Composition of Indian Judiciary, Election Commission: Role and Functioning, Chief Election Commissioner and Election Commissioners, State Election Commission: Role and Functioning, Institute and Bodies for the welfare of SC/ST/OBC.

Books Recommended:

1. 'Indian Polity' by Laxmikanth 5th Edition, McGraw Hill Edition.
2. Indian Constitution by Subhash C. Kashyap, Vision Books Publisher
3. 'Introduction to Indian Constitution' by D.D. Basu, 21st Edition, LexisNexis Publisher
4. '*Indian Administration by Avasthi* and Avasthi-by lakshminarainagarwal publication