Academic Regulations Programme Structure and Detailed Syllabus

Bachelor of Technology (B.Tech) in Civil Engineering

(Four Year Regular Programme) (Applicable for Batches admitted from 2024-25)

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 GR24

(Applicable for Batches Admitted from 2024-25)

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	Computer Science and Business System	32	B.Tech Computer Science & Business System
7	Computer Science and Engineering (AIML)	66	B.Tech Computer Science and Engineering (Artificial Intelligence & Machine Learning)
8	Computer Science and Engineering (Data Science)	67	B.Tech Computer Science and Engineering (Data Science)

GR24 Regulations shall govern the above programmes offered by the Departments with effect from the students admitted to the programmes in 2024-25 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) All courses are to be registered by the student in a semester to earn credits which shall be assigned to each subject/ course in an L: T: P: C (lecture periods: tutorial periods: practical periods: credits) structure based on the following general pattern.

- One credit for one hour/week/semester for Theory/Lecture (L) courses and Tutorials (T).
- One credit for two hours/week/semester for Laboratory/Practical (P) courses.
- Mandatory Courses will not carry any credits.

i) 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. Courses to be offered

a) Open Electives: Students are to register an Open Elective (OE-I) during III year I semester, an Open Elective (OE-II) during III-year II semester, and a Open Elective (OE–III) in IV year I semester from the list of Open Electives given. OE- I and OE-II are to be selected from SWAYAM courses (MOOCs platform).

b) Professional Electives: The students have to choose six Professional Electives from the list of Professional Electives given in the course structure.

c) A course may be offered to the students, only if a minimum of 15 students opts for it.

d) More than one faculty member may offer the same subject.

e) A lab/practical may be included with the corresponding theory subject in the same semester) in any semester.

f) If more students opt for a particular course, then the priority shall be given to students firstly on 'first come first serve' basis and secondly based on CGPA (student who has higher CGPA is given more preference).

g) If more students opt for a particular course, then the concerned Head of the Department shall decide whether or not to offer such a course for two or more sections.

h) In case of options coming from students of other departments, priority shall be given to the student of the 'parent department'.

6. 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.

7. 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	Componentof 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 isfor 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 examinati on	The semester-end examination isfor 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.

- A student is deemed to have satisfied the academic requirements and earned the credits allotted to **Project Stage-I** if the student secures not less than 40% of marks (40 marks out of 100 marks) in the evaluation of the same.
- A student is deemed to have failed if the student does not submit a report on work carried out during Project Stage-I or does not make a presentation of the same before the evaluation committee as per schedule or secures less than minimum marks in the evaluation.
- A student who has failed may reappear once for evaluation when it is scheduled again; if the student fails in the evaluation of 'one such reappearance', the student has to reappear for the same in the subsequent semester, as and when it is offered.
- A student is deemed to have satisfied the academic requirements and earned the credits allotted to **Project Stage-II** if the student secures not less than 35% (14 marks out of 40 marks) in the Continuous Internal Evaluation (CIE), not less than 35% (21 marks out of 60 marks) in the Semester End Examinations (SEE), 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; in terms of letter grades, this implies securing **'C'** grade or above in that subject/ course.

- The student is deemed to have failed if the student does not submit a report on work carried out during Project Stage-II or does not make a presentation of the same before the evaluation committee as per schedule or secures less than minimum marks in either CIE or SEE or CIE+SEE taken together.
- A student who has failed may reappear once for the evaluation when it is scheduled again; if the student fails again in the evaluation of "once such reappearance", the student has to reappear for the same in the subsequent semester as and when the evaluation is scheduled.

g) The evaluation of courses having ONLY **CIE** is as follows:

- **Elements of CE/EEE/ME/ECE/CSE as a Theory Course,** in I year I semester is evaluated for **50 marks**. The CIE for 50 marks shall be done through first and second mid-term examinations. The average marks of two mid-term examinations are taken as final marks in CIE. Student shall have to earn 40% i.e. 20 marks out of 50 marks in the average of two mid- term examinations. **There shall be no external evaluation.** The student is deemed to have failed, if he (i) is absent as per schedule, or (ii) secures less than 40% marks in this course.

CIE is done for 50 marks as follows:

- There shall be two mid-term examinations during the semester conducted for 40 marks consisting of two parts with a total duration of 2 hours: Part A for 20 marks and Part B for 20 marks.
- Part A is an objective paper or a quiz and shall consist of multiple-choice questions, fill- in- the blanks, match the following, etc. for a total of 20 marks.
- Part B is a descriptive paper and shall contain 6 questions out of which, the student needs to answer 4 questions each carrying 5 marks.
- While the first mid-term examination shall be conducted for the first 50% syllabus, the second mid-term examination shall be conducted for the remaining 50% of the syllabus. The average of the two mid-term examinations shall be taken as final marks.
- Two assignments are evaluated for 5 marks each. The first assignment should be submitted before the conduct of the first mid-term examination, and the second assignment should be submitted before the conduct of the second mid-term examination. The assignments shall be given by the subject teachers. The average of the two assignments shall be taken as the final marks.
- The remaining 5 marks may be evaluated by conducting viva-voce in the subject or by evaluating the performance of the student in PPT/Poster/Case-Study presentation on a topic in the concerned subject before second mid-term examination**.**

- **Elements of CE/EEE/ME/ECE/CSE as a Lab Course,** in I year I semester is evaluated for **50 marks**.

CIE is done for 50 marks as follows:

- A write-up on day-to-day experiments in the laboratory (in terms of aim, components/procedure, expected outcome) shall be evaluated for 10 marks

- 10 marks are awarded either for the performance in viva-voce (or) case study presentation (or) application development (or) poster presentation.
- Internal practical examination shall be conducted by the concerned laboratory teacher for 15 marks.
- The remaining 15 marks are awarded for laboratory project, which consists of the design (or) model presentation (or) prototype presentation at the end of the completion of laboratory course and before semester end practical examination.

- **Real-Time/Field-based Research Project C**ourse in II-year II Semester is evaluated for **50 marks.** The internal evaluation is for 50 marks 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**.

A student is deemed to have satisfied the academic requirements and earned the credits allotted to "Real-Time/Field-Based Research Project" if the student secures not less than 40% marks (i.e. 20 marks out of 50 marks) in the evaluation of the same.

A student is deemed to have failed in Real-Time/Field-Based Research Project, if he (i) does not submit a report on the same or (ii) does not make a presentation of the same before the evaluation committee as per schedule, or (iii) secures less than 40% marks in evaluation of the same.

A student who is failed in either Real-Time/Field-Based Research Project may reappear once for the evaluation when they are scheduled again; if the student fails again in the evaluation of 'one such reappearance', the student has to reappear for the same in the subsequent semester, as and when it is offered.

- **Mandatory Courses** are evaluated for **50 marks.** The CIE for 50 marks shall be done through first and second mid-term examinations. The average marks of two mid-term examinations are taken as final marks in CIE. Student shall have to earn 40% i.e. 20 marks out of 50 marks in the average of two mid-term examinations. There shall be **NO external evaluation**. The student is deemed to have failed, if he (i) is absent as per schedule, or (ii) secures less than 40% marks in this course.

A mandatory course is not graded and does not carry credits. Only Pass/Fail shall be indicated in Grade Card

The evaluation pattern for mandatory courses shall be done similar to **Elements of CE/EEE/ME/ECE/CSE as a Theory Course.**

8. 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.

9. 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.

10. 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.

11. 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.

12. 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.

13. 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	Promoti on	Conditions to be fulfilled
1	First year first semester toFirst year	Regular course of study of First year firstsemester.

	second 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 second semester from all the relevant regular and supplementary examinations, whether the student takes those examinations or not.
3	Second year first semester toSecond 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.

14. 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 $\mathbf{k^{th}}$ 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 **ith** course and **Gi** is the grade point scored by the student in the
ith 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.

15. 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 ≥ 7.00 and CGPA < 8.00
4	Second Class	CGPA ≥ 6.00 and CGPA < 7.00
5	Pass Class	CGPA ≥ 5.00 and CGPA < 6.00

Equivalence of grade to marks
Marks % = (CGPA -0.5)*10

16. 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).

17. 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.

18. Transitory Regulations

A. For students detained due to shortage of attendance:
1. A Student who has been detained in I year of GR22 Regulations due to lack of attendance, shall be permitted to join I year I Semester of GR24 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 GR22 regulations for want of attendance, shall be permitted to join the corresponding semester of GR24 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 GR24 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 GR22 Regulations who has been detained due to lack of credits, shall be promoted to the next semester of GR24 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 GR22 & GR24 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 GR24 Academic Regulations are applicable to a student from the year of readmission. See rule (C) for further Transitory Regulations.
C. For readmitted students in GR24 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 GR24 Regulations. **There is NO exemption of credits in any case**.

6. If a student is readmitted to GR24 Regulations and has any subject with 80% of syllabus common with his/her previous regulations, that particular subject in GR24 Regulations will be substituted by another subject to be suggested by the college academic administration.

Note:

If a student readmitted to GR24 Regulations and has not studied any courses/topics in his/her earlier regulations of study which is prerequisite for further subjects in GR24 Regulations, then the college shall conduct remedial classes to cover those courses/topics for the benefit of the students.

19. 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.

20. 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 andthe 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 GR24

(Applicable for Batches Admitted from 2025-26)

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 semester from all therelevant regular and supplementary examinations, whether the student takes those examinations or not.
3	Third year first semester toThird 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 Third year 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 ≥ 7.00 and CGPA < 8.00
4	Second Class	CGPA ≥ 6.00 and CGPA < 7.00
5	Pass Class	CGPA ≥ 5.00 and CGPA < 6.00

Academic Regulations for B.Tech with Minors Programme under GR24

(Applicable for Batches Admitted from 2024-25)

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

	Minor Programme	**Eligible programme of students**	**@Offering Department**	**Award of Degree**
	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"

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

(Autonomous)

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

B. Tech Civil Engineering GR24 Course Structure

I B. Tech (CE)-I Semester

S.No	BOS	Group	Course Code	Course Name	L	T	P	Credits	Int.	Ext.	Total Marks
1	Maths	BS	GR24A1001	Linear Algebra and Function Approximation	3	1	0	4	40	60	100
2	Chemistry	BS	GR24A1004	Engineering Chemistry	3	1	0	4	40	60	100
3	CSE	ES	GR24A1006	Programming for Problem Solving	2	0	0	2	40	60	100
4	CE	ES	GR24A1008	Elements of Civil Engineering Lab	0	0	2	1	50	-	50
5	Chemistry	BS	GR24A1019	Engineering Chemistry lab	0	0	3	1.5	40	60	100
6	CSE	ES	GR24A1021	Programming for Problem Solving Lab	0	0	3	1.5	40	60	100
7	ME	ES	GR24A1025	Engineering Workshop	1	0	3	2.5	40	60	100
8	ME	ES	GR24A1016	Graphics for Engineers	1	0	4	3	40	60	100
Total					**10**	**2**	**15**	**19.5**	**330**	**420**	**750**
9	Mgmt	MC	GR24A1028	Design Thinking	2	0	0	0	50	--	50

I B. Tech (CE)- II Semester

S. No	BOS	Group	Course Code	Course Name	L	T	P	Credits	Int.	Ext.	Total Marks
1	Maths	BS	GR24A1002	Differential Equations and Vector Calculus	3	1	0	4	40	60	100
2	Physics	BS	GR24A1003	Applied Physics	3	1	0	4	40	60	100
3	English	HS	GR24A1005	English	2	0	0	2	40	60	100
4	CSE	ES	GR24A1017	Data Structures	2	0	0	2	40	60	100
5	ME	ES	GR24A1015	Engineering Mechanics	3	1	0	4	40	60	100
6	CSE	ES	GR24A1024	Data Structures Lab	0	0	2	1	40	60	100
7	English	HS	GR24A1020	English Language and Communication Skills Lab	0	0	2	1	40	60	100
8	Physics	BS	GR24A1018	Applied Physics Lab	0	0	3	1.5	40	60	100
9	CSE	ES	GR24A1027	Python Programming	0	0	2	1	50	--	50
TOTAL					**13**	**3**	**9**	**20.5**	**370**	**480**	**850**

II B. Tech (CE)- I Semester

S.No	BOS	Group	Course Code	Course Name	L	T	P	Credits	Int.	Ext.	Total Marks
1	CE	PC	GR24A2009	Building Materials and Construction Planning	2	0	0	2	40	60	100
2	CE	PC	GR24A2017	Surveying and Geomatics	2	0	0	2	40	60	100
3	CE	PC	GR24A2011	Solid Mechanics –I	2	1	0	3	40	60	100
4	Maths	BS	GR24A2008	Computational Mathematics for Engineers	3	0	0	3	40	60	100
5	CE	PC	GR24A2012	Introduction to Fluid Mechanics	3	0	0	3	40	60	100
6	EEE	PC	GR24A2013	Basic Electrical and Electronics Engineering	3	0	0	3	40	60	100
7	CE	PC	GR24A2020	Surveying Lab	0	0	4	2	40	60	100
8	CE	PC	GR24A2015	Solid Mechanics Lab	0	0	4	2	40	60	100
TOTAL					**15**	**1**	**8**	**20**	**320**	**480**	**800**
9	Mgmt	MC	GR24A2002	Value Ethics and Gender Culture	2	0	0	0	50	--	50

II B. Tech (CE)- II Semester

S.No	BOS	Group	Course Code	Course Name	L	T	P	Credits	Int.	Ext.	Total Marks
1	CE	PC	GR24A2016	Solid Mechanics–II	2	0	0	2	40	60	100
2	CE	PC	GR24A2010	Engineering Geology	2	0	0	2	40	60	100
3	CE	PC	GR24A2018	Structural Analysis– I	3	0	0	3	40	60	100
4	Mgmt	HS	GR24A2004	Economics and Accounting for Engineers	3	0	0	3	40	60	100
5	CE	PC	GR24A2019	Hydraulic Engineering	2	0	0	2	40	60	100
6	CE	PC	GR24A2014	Engineering Geology Lab	0	0	4	2	40	60	100
7	CE	PC	GR24A2021	Computer Aided Design Lab	0	0	4	2	40	60	100
8	CE	PC	GR24A2022	Fluid Mechanics and Hydraulic Machinery Lab	0	0	4	2	40	60	100
9	CE	PW	GR24A2106	Real-time Research Project/ Societal Related Project	0	0	4	2	50	--	50
TOTAL					**12**	**0**	**16**	**20**	**370**	**480**	**850**
10	Chemistry	MC	GR24A2001	Environmental Science	2	0	0	0	50	--	50

III B. Tech (CE)-I Semester

S.No	BOS	Group	Course Code	Course Name	L	T	P	Credits	Int	Ext	Total Mark
1	CE	PC	GR24A3001	Geotechnical Engineering	2	0	0	2	40	60	100
2	CE	PC	GR24A3002	Concrete Technology	2	0	0	2	40	60	100
3	CE	PC	GR24A3003	Hydrology and Water Resources Engineering	3	0	0	3	40	60	100
4	CE	PC	GR24A3004	Design of Reinforced Concrete Structures	2	1	0	3	40	60	100
5	CE	PE		Professional Elective-I	3	0	0	3	40	60	100
6	CE	OE		Open Elective-I	3	0	0	3	40	60	100
7	CE	PC	GR24A3011	Geotechnical Engineering Lab	0	0	3	1.5	40	60	100
8	CE	PC	GR24A3012	Concrete Technology Lab	0	0	3	1.5	40	60	100
9	English	HS	GR24A3013	Advanced English Communication Skills Lab	0	0	2	1	40	60	100
TOTAL					**16**	**1**	**6**	**20**	**360**	**540**	**900**
10	Mgmt	MC	GR24A2003	Constitution of India	2	0	0	0	50	--	50

Professional Elective-I			
S.No.	**BOS**	**Course Code**	**COURSE**
1	CE	GR24A3005	Structural Analysis - II
2	CE	GR24A3006	Traffic Engineering and Management
3	CE	GR24A3007	Surface Hydrology
4	CE	GR24A3008	Pavement Materials

Open Elective-I			
S.No.	**BOS**	**Course Code**	**COURSE**
1	CE	GR24A3009	Engineering Materials for Sustainability

III B. Tech (CE)-II Semester

S.No	BOS	Group	Course Code	Course Name	L	T	P	Credits	Int	Ext	Total Marks
1	CE	PC	GR24A3015	Design of Steel Structures	2	1	0	3	40	60	100
2	CE	PC	GR24A3016	Foundation Engineering	3	0	0	3	40	60	100
3	CE	PC	GR24A3017	Environmental Engineering	2	0	0	2	40	60	100
4	CE	PE		Professional Elective-II	3	0	0	3	40	60	100
5	CE	OE		Open Elective-II	3	0	0	3	40	60	100
6	CE	PC	GR24A3025	Environmental Engineering Lab	0	0	4	2	40	60	100
7	CE	PC	GR24A3026	GIS Lab	0	0	4	2	40	60	100
8	CE	PW	GR24A3027	Mini Project with Seminar	0	0	4	2	40	60	100
TOTAL					**13**	**1**	**12**	**20**	**320**	**480**	**800**

Professional Elective II			
S.No	**BOS**	**Course Code**	**COURSE**
1	CE	GR24A3018	Masonry Structures
2	CE	GR24A3019	Rock Mechanics
3	CE	GR24A3020	Open Channel Flow
4	CE	GR24A3021	Green Building Technology

Open Elective II			
S.No	**BOS**	**Course Code**	**COURSE**
1	CE	GR24A3022	Geographic Information Systems and Science

IV B. Tech (CE)-I Semester

S. No	BOS	Group	Course Code	Course Name	L	T	P	Credits	Int	Ext	Total Marks
1	CE	PC	GR24A4001	Estimation and Costing	2	1	0	3	40	60	100
2	CE	PC	GR24A4002	Transportation Engineering	3	0	0	3	40	60	100
3	CE	PE		Professional Elective-III	3	0	0	3	40	60	100
4	CE	PE		Professional Elective-IV	3	0	0	3	40	60	100
5	CE	OE		Open Elective-III	3	0	0	3	40	60	100
6	CE	PC	GR24A4014	Transportation Engineering Lab	0	0	4	2	40	60	100
7	CE	PC	GR24A4015	Computer Applications in Structural Engineering Lab	0	0	4	2	40	60	100
8	CE	PW	GR24A4016	Project Work-Phase I	0	0	12	6	40	60	100
TOTAL					**14**	**1**	**20**	**25**	**320**	**480**	**800**

Professional Elective III			
S.No.	**BOS**	**Course Code**	**COURSE**
1	CE	GR24A4003	Bridge Engineering
2	CE	GR24A4004	Ground Improvement Techniques
3	CE	GR24A4005	Groundwater
4	CE	GR24A4006	Tall Buildings

Professional Elective IV			
S.No.	**BOS**	**Course Code**	**COURSE**
1	CE	GR24A4007	Finite Element Methods
2	CE	GR24A4008	Port and Harbour Engineering
3	CE	GR24A4009	Physico-Chemical Processes for Water and Wastewater Treatment
4	CE	GR24A4010	Rehabilitation and Retrofitting of Structures

Open Elective III			
S.No.	**BOS**	**Course Code**	**COURSE**
1	CE	GR24A4011	Plumbing -Water and Sanitation

IV B. Tech (CE)-II Semester

S.No	BOS	Group	Course Code	Course Name	L	T	P	Credits	Int	Ext	Total Marks
1	CE	PE		Professional Elective-V	3	0	0	3	40	60	100
2	CE	PE		Professional Elective-VI	3	0	0	3	40	60	100
3	CE	HS	GR24A4025	Entrepreneurship and Project Management	2	1	0	3	40	60	100
4	CE	PW	GR24A4026	Project Work-Phase II	0	0	12	6	40	60	100
		TOTAL			**8**	**1**	**12**	**15**	**160**	**240**	**400**

Professional Elective V			
S. No.	**BOS**	**Course Code**	**COURSE**
1	CE	GR24A4017	Design of Prestressed Concrete Structures
2	CE	GR24A4018	Urban Transportation and Planning
3	CE	GR24A4019	Design of Hydraulic Structures
4	CE	GR24A4020	Construction Project Planning and Systems

Professional Elective VI			
S.No.	**BOS**	**Course Code**	**COURSE**
1	CE	GR24A4021	Earthquake Engineering
2	CE	GR24A4022	Pavement Design
3	CE	GR24A4023	Irrigation Management
4	CE	GR24A4024	Construction Equipment and Automation

PROFESSIONAL ELECTIVES - 4THREADS

S. No.	Structural Engineering	Geotechnical and Transportation Engineering	Environmental and Hydrology Engineering	Construction Technology &Management
1	Structural Analysis-II	Traffic Engineering and Management	Surface Hydrology	Pavement Materials
2	Masonry Structures	Rock Mechanics	Open Channel flow	Green Building Technology
3	Bridge Engineering	Ground Improvement Techniques	Groundwater	Tall Buildings
4	Finite Element Methods	Port and Harbour Engineering	Physico-Chemical Processes for Water and Wastewater Treatment	Rehabilitation and Retrofitting of Structures
5	Design of Prestressed Concrete Structures	Urban Transportation and Planning	Design of Hydraulic Structures	Construction Project Planning and Systems
6	Earthquake Engineering	Pavement Design	Irrigation Management	Construction Equipment and Automation

OPEN ELECTIVES FOR GR24 REGULATIONS:

THREAD 1	THREAD 2	OFFERED BY
1. Human Resource Development and Organizational Behavior (GR24A3010) 2. Cyber Lawand Ethics (GR24A3024) 3. Economic Policies in India (GR24A4013) 4. Indian knowledge system (GR24A3023) 5. Personality Development through Life Enlightenment skills (GR24A4012)	1. Engineering Materials for Sustainability (GR24A3009)	**CE**
	2. Geographic Information Systems and Science (GR24A3022)	
	3. Plumbing (Water and Sanitation) (GR24A4011)	
	1. Non-Conventional Energy Sources (GR24A3035)	**EEE**
	2. Concepts of Control Systems (GR24A3046)	
	3. Artificial Neural Networks and Fuzzy Logic (GR24A4037)	
	1. Industrial Automation and Control (GR24A3056)	**ME**
	2. Operations Research (GR24A3034)	
	3. Composite Materials (GR24A3066)	
	1. Digital Electronics For Engineering (GR24A3076)	**ECE**
	2. Sensor Technology (GR24A3085)	
	3. Communication Technologies (GR24A4078)	
	1. Data Science for Engineers (GR24A3092)	**CSE**
	2. Data Analytics using open source tools (GR24A3103)	
	3. Augmented Reality and Virtual Reality (GR24A4096)	
	1.Services Science and Service Operational Management (GR24A4115)	**CSBS**
	2. IT Project Management (GR24A4116)	
	3. Marketing Research and Marketing Management (GR24A4117)	
	1.Basics for java programming (GR24A3133)	**CSE(AIML)**
	2. Introduction to DBMS (GR24A3141)	
	3. Introduction to Data Mining (GR24A4124)	
	1. Introduction to Operating System (GR24A3143)	**CSE (DS)**
	2. Internet of Things (GR24A3145)	
	3. Scripting Languages (GR24A4134)	

I YEAR
I SEMESTER

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
LINEAR ALGEBRA AND FUNCTION APPROXIMATION

Course Code: GR24A1001 **L/T/P/C: 3/1/0/4**

I Year I Semester

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

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. Illustrate the concepts of function approximation with measurement of error
5. Develop the skill of finding multivariable function optima

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
Function approximation tools in engineering
Mean value theorems- Lagrange's mean value theorem, Taylor's theorem (without proof), Approximation off a function by Taylor's series

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

UNIT V

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

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

Reference Books

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, R.K.Jain- 3rd edition- New Age publishers
3. 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: GR24A1004 **L/T/P/C: 3/1/0/4**
I Year I Semester

Course Outcomes:
1. Assess the specification of water regarding its usage in domestic & Industrial scenarios
2. Learn the working principles of various energy storage devices, and electrochemical reactions involved in corrosion.
3. Analyse the efficacy of polymers in diverse applications
4. Distinguish various energy sources to prioritize eco-friendly fuels for environmentally sustainable development.
5. Interpret the role of engineering materials in various sectors

UNIT I
Water and its Treatment-Introduction to the hardness of water – Estimation of hardness of water by complexometric method and related numerical problems. Potable water and its specifications - Steps involved in the treatment of potable water - Disinfection of potable water by chlorination and break- point chlorination. Boiler troubles: Sludges, Scales, and Caustic embrittlement. Internal treatment of Boiler feed water - Calgon conditioning - Phosphate conditioning, External treatment methods - Softening of water by ion-exchange processes. Desalination of water – Reverse osmosis

UNIT II
Battery Chemistry and Corrosion- Introduction - Classification of Batteries- primary, and secondary batteries with examples. Basic requirements for commercial batteries. Construction, working and applications of Zn-air and Lithium-ion battery, Applications of Li-ion battery to electric vehicles.
Fuel Cells - Definition, Construction, working principle and applications of Hydrogen-Oxygen fuel cell and Solid oxide fuel cell, Differences between battery and a fuel cell.
Corrosion: Causes and effects of corrosion – theories of chemical and electrochemical corrosion – mechanism of electrochemical corrosion, Types of corrosion: Galvanic, water-line and pitting corrosion. Factors affecting rate of corrosion, Corrosion control methods- Cathodic protection – Sacrificial anode and impressed current methods.

UNIT III
Polymers- Definition – Classification of polymers with examples – Types of polymerization – addition (free radical addition) and condensation polymerization with examples – Nylon 6:6
Plastics: Plastics: Definition and characteristics- thermoplastic and thermosetting plastics, Preparation, Properties and engineering applications of PVC and Bakelite, Compounding and fabrication of plastics
- compression moulding and injection moulding. Fiber-reinforced plastics (FRP).
Conducting Polymers: Characteristics and Classification with examples-mechanism of conduction in trans-polyacetylene and applications of conducting polymers.
Biodegradable Polymers: Concept and advantages - Polylactic acid and poly vinyl alcohol and their applications.

Unit IV

Energy Resources - Introduction, Calorific value of fuel – HCV, LCV- Dulong's formula. Classification- solid fuels: -

Coal – analysis of coal – proximate and ultimate analysis and their significance. Liquid fuels – **Petroleum** and its refining, cracking types – moving bed catalytic cracking. Knocking – octane and cetane rating, synthetic petrol - Fischer-Tropsch's process; Gaseous fuels – composition and uses of natural gas, LPG and CNG, Biodiesel – Transesterification, advantages.

UNIT V

Engineering Materials

Smart materials and their engineering applications: Shape memory materials- Poly L-Lactic acid. Thermoresponse materials- Polyacryl amides, Poly vinyl amides.

Biosensors: Definition, characteristics, classification-, construction & working, applications and advantages of biosensors. Biochips -Definition, advantages, and applications.

Semiconductors: Si and Ge - Preparation, Ultra-purification and Crystal Growth by Zone Refining and Czochralski Crystal Pulling methods, Doping – Epitaxy, Diffusion and Ion-implantation.

Text Books

1. Engineering Chemistry by P.C. Jain and M. Jain; Dhanpat Rai Publishing Company (P) Ltd., New Delhi.
2. Engineering Chemistry, Rama Devi, Venkata Ramana Reddy and Rath, Cengage Learning, 2016

Reference Books

1. A Textbook of Engineering Chemistry by Shashi Chawla, Dhanpat Rai Publishing Company (P) Ltd., New Delhi.
2. Engineering Chemistry by O.G.Palanna, Tata McGraw Hills Private Ltd.
3. Engineering Chemistry, Shikha Agarwal, Cambridge University Press, 2015

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
PROGRAMMING FOR PROBLEM SOLVING

Course Code: GR24A1006 **L/T/P/C: 2/0/0/2**
I Year I Semester

Course Outcomes:
1. Design algorithms and flowcharts for problem solving and illustrate the fundamentals of C language.
2. 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. Demonstrate file handling mechanism, 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 ofarrays.
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 tofiles, error handling in files.
Preprocessor: Commonly used preprocessor commands like include, define, undef, if, ifdef,ifndef, elif, command line arguments, enumeration data type.

Teaching methodologies

- Power Point Presentations
- Tutorial Sheets
- Assignments

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 Hallof 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
ELEMENTS OF CIVIL ENGINEERING LAB

Course Code: GR24A1008 **L/T/P/C: 0/0/2/1**
I Year I Semester

Course Outcomes:
1. Identify various minerals and their properties.
2. Identify various rocks depending on geological classifications.
3. Prepare and interpret various sections of geological maps showing structures like faults, folds and Unconformities
4. Evaluate the properties of cement, fine and coarse aggregates and determine its suitability for construction.
5. Apply the method and ways of investigations required for Civil Engineering projects

List of Experiments:
1. Identification of Minerals – Silica Group, Feldspar Group, Crystalline Group, Carbonate Group, Pyroxene Group, Mica Group, Amphibole Group.
2. Identification of Rocks – Igneous Petrology, Sedimentary Petrology, Metamorphic Petrology.
3. a. Study of topographical features from Geological maps. Identification of symbols in maps.
b. Simple structural Geology Problems (Folds, Faults & Unconformities)
4. Tests on Cement
a. Fineness test & Normal Consistency test.
b. Specific gravity test, Initial and Final setting time of cement.
5. Tests on Fine Aggregates
a. Specific Gravity test.
b. Bulking of sand & Fineness modulus of Fine aggregate.
6. Tests on Coarse Aggregate
a. Specific Gravity test.
b. Fineness modulus of Coarse aggregate.

Reference Books
1. N. Chennkesavulu, Mc-Millan, Text book of Engineering Geology, India Ltd., 2nd edition, 2013.
2. IS 269:2013 – Ordinary Portland cement, 33 grade- Specification (Fifth Revision).
3. 1. IS 383:2016 – coarse and fine aggregates for concrete- Specification (Third Revision).

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
ENGINEERING CHEMISTRY LABORATORY

Course Code:GR24A1019 **L/T/P/C: 0/0/3/1.5**

I Year I Semester Course Outcomes

1. Determination of parameters like hardness of water chloride content in water
2. Able to handle instruments like conductometer and potentiometer to find out the concentrations of acids and bases.
3. Estimate the amount of metal ion present in a given sample.
4. Prepare polymers like bakelite, nylon-6, and aspirin in the laboratory.
5. Find out the physical properties of fluids like adsorption, surface tension, and viscosity.

List of Experiments

1. Determination of Total Hardness of water by a complexometric method using EDTA.
2. Determination of Chloride content of water by Argentometry.
3. Redox titration: Estimation of Ferrous ion using standard $KMnO_4$ by Permanganometry.
4. Estimation of HCl by Conductometric titrations.
5. Estimation of Ferrous ion by Potentiometry using dichromate.
6. Determination of rate of corrosion of mild steel in the presence and absence of inhibitor.
7. Determination of molecular weight of polyvinyl alcohol using Ostwald viscometer.
8. Determination of Viscosity of liquid by using Ostwald's Viscometer.
9. Determination of Surface tension of liquid by using Stalagmometer.
10. Determination of Partition Coefficient of Acetic acid between n-butanol and water.
11. Preparation of phenol-formaldehyde resin (Bakelite).
12. Synthesis of Aspirin.

Reference Books

1. Vogel's textbook of Practical Organic Chemistry, 5^{th} Edition.
2. A Textbook on Experiments and Calculations in Engineering Chemistry-S. S. Dara, S Chand & Company; 9^{th} edition.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
PROGRAMMING FOR PROBLEM SOLVING LAB

Course Code: GR24A1021 **L/T/P/C: 0/0/3/1.5**

I Year I Semester

Course Outcomes:
1. Translate algorithms into a working program and analyze and debug the codes usingbasics 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
a. Write a C program to convert days into years, weeks and days.(Assume a year has 365days).
b. Write a C program to find greatest and smallest among three numbers using conditionaloperator.
c. Write a C program to enter P, T, R and calculate Compound Interest.

TASK 2
a. Write a C program to swap two numbers using the following:
(i) Using third variable
(ii) Without using third variable
(iii) Using bitwise operators
b. 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
a. Write a C program to add two numbers without using arithmetic operators in C.
b. Write a C program to determine whether a number is a power of 2 or not using bitwiseoperator and ternary operator.
c. Write a C program to check whether a number is even or odd using bitwise operator andternary operator.

TASK 4
a. Write a C program to find the roots of a quadratic equation using if-else.
b. 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/unitFor next 100 units Rs. 1.20/unitFor unit above 250 Rs. 1.50/unit
An additional surcharge of 20% is added to the bill
c. Write a menu driven C program to implement a simple arithmetic calculator.
d. Write a C program to display number of days in month using switch case (The input is month number 1 -12).

TASK 5

a. Write a C program check whether a given number is Perfect number or not.
b. Write a C program check whether a given number is Palindrome number or not.
c. Write a C program check whether a given number is Armstrong number or not.
d. Write a C program check whether a given number is Strong number or not.

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TASK 6

a. 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
```

b. Write a C program to generate the prime numbers between x and y where x and y arestarting and ending values to be supplied by the user.

c. 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

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

TASK 8

a. Write a C program to implement matrix addition.
b. Write a C program to implement matrix multiplication.

TASK 9

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

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

ENGINEERING WORKSHOP

Course Code: GR24A1025 **L/T/P/C: 1/0/ 3/2.5**

I Year I Semester

Course Outcomes

1. Identify workshop tools and their operational capabilities
2. Practice on manufacturing of components using workshop trades including Carpentry, Fitting, Tin Smithy, Welding, Foundry and Black Smithy
3. Apply basic electrical engineering knowledge for House Wiring Practice
4. Develop various trades applicable to industries
5. Create hands on experience for common trades with taking safety precautions

TRADES FOR EXERCISES: At least two tasks from each trade

1. Carpentry: Demonstration and practice of carpentry tools
Task 1: Preparation of T- Lap Joint
Task 2: Preparation of Dove Tail Joint.

2. Fitting - Demonstration and practice of fitting tools
Task 3: Preparation of Straight Fit
Task 4: Preparation of V-Fit

3. Tin-Smithy - Demonstration and practice of Tin Smithy tools
Task 5: Preparation of Rectangular Tray
Task 6: Preparation of Open Scoop

4. Welding : Demonstration and practice on Arc Welding tools
Task 7: Preparation of Lap joint,
Task 8: Preparation of Butt Joint

5. House-wiring: Demonstration and practice on House Wiring tools
Task 9: Exercise on One way switch controlled two bulbs in series one bulb in Parallel.
Task 10: Exercise on Stair Case connection.

6. Foundry: Demonstration and practice on Foundry tools
Task 11: Preparation of Mould using Single Piece Pattern.
Task 12: Preparation of Mould using Split Piece Pattern.

7. Black Smithy: Demonstration and practice on Black Smithy tools
Task 13: Preparation of U-Hook

Task 14: Preparation of S-Hook

8. Preparation of a prototype model of any trade under G-LOBE activity Text Books

1. Basic Workshop Technology: Manufacturing Process, Felix W.; Independently Published,2019.
2. Workshop Processes, Practices and Materials; Bruce J. Black, Routledge publishers, 5thEdn. 2015.
3. A Course in Workshop Technology Vol I. & II, B.S. Raghuwanshi, Dhanpath Rai & Co., 2015 & 2017.

Reference Books

1. Elements of Workshop Technology, Vol. I by S. K. Hajra Choudhury & Others, Media Promoters and Publishers, Mumbai. 2007, 14th edition
2. Elements of Workshop Technology, Vol. II by S. K. Hajra Choudhury & Others, Media Promoters and Publishers, Mumbai. 2007, 12th edition
3. Workshop Practice by H. S. Bawa, Tata-McGraw Hill, 2004.
4. Technology of machine tools, Steve F. Krar, Arthur R. Gill and Peter Smid, McGraw Hill Education (India) Pt. Ltd., 2013.
5. Engineering Practices Laboratory Manual, Ramesh Babu.V., VRB Publishers Private Limited, Chennai, Revised edition, 2013 – 2014.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

GRAPHICS FOR ENGINEERS

Course Code: GR24A1016 **L/T/P/C: 1/0/4/3**

I Year I Semester Course Outcomes

1. Generate two dimensional drawings and apply AutoCAD commands.
2. Interpret projection methods and draw projections of line or point objects.
3. Imagine and generate multi-view projections of planes and solid objects in different positions
4. Construct and interpret sectional views and develop solid surfaces.
5. Create isometric drawings from given orthographic views and familiar with isometric to orthographic transformations.

UNIT I

Introduction to AutoCAD software: user interface, tool bar -draw, modify, dimension, layers, setting drawing area, status bar, print setup, generation of two-dimensional drawings.

Construction of Engineering Curves- Ellipse, Parabola and Hyperbola -general method only.

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 regular plane figures like triangle, square, pentagon, hexagon, and circle; projections of planes -inclined to one reference plane only.

Projections of solids - definition and types of right regular solids objects like prism, cylinder, pyramid, and cone; projections of solids -axis inclined to one reference plane only.

UNIT IV

Sections of solids- Section and sectional views of right regular solids like Prism, Cylinder, Pyramid and Cone – Auxiliary Views.

Development of surfaces- Development of surfaces of Right Regular Solids like Prism, Pyramid, Cylinder and Cone.

UNIT V

Isometric views– isomeric views of lines, planes (polygons) and solids (prism, cylinder, pyramid, and cone); generation of Isometric line diagrams. World Coordinate System, User Coordinate System.

Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions.

Text Books

1. Engineering Drawing by N. D. Bhatt, Fiftieth Revised and Enlarged Edition:2011, Charotar Publishing House Pvt. Ltd.
2. Engineering Graphics by Basant Agrawal and C M Agrawal, fifth re-print 2011, Tata McGraw Hill Education Private Limited, New Delhi.

Reference Books

1. Engineering Graphics with AutoCAD 2020 by James D. Bethune, Copyright © 2020 by Pearson Education, Inc. All rights reserved.
2 Engineering Graphics by M. B. Shah, B. C. Rana, S. N. Varma, Copyright © 2011 Dorling Kindersley (India) Pvt. Ltd, Licensees of Pearson Education in South Asia.
3. Engineering Drawing and Graphics by K Venu Gopal /New Age International Pvt. Ltd, Publishers, fifth edition, 2002.
4. Engineering Graphics by Koushik Kumar, Apurba Kumar Roy, Chikesh Ranjan, S Chand and Company limited, first edition 2019.
5. Engineering Drawing with Auto Cad by B. V. R. Gupta, M. Raja Roy, IK International Pub., 2009.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
DESIGN THINKING

Course Code: GR24A1028 **L/T/P/C: 2/0/0/0**
I Year I Semester

Course Outcomes

1. Use design thinking and hypothesis-driven innovation processes to develop viable solutions to user challenges
2. Use multiple brainstorming techniques to find innovative solutions
3. Develop and test a business model or business case to support the viability of the solution
4. Prototype a solution to a user challenge
5. Investigate the cultural, emotional, technological, and business factors relevant to developing a new product or service design concept

UNIT I

Revisiting Design Thinking: Creative thinking as basis of innovation; Empathy process for deep understanding of challenge with practical ingenuity; Making sense of observations and insights; Defining a point of view and context Design thinking skills for Problem Discovery, Definition, and Ideation – Identifying problems in daily lives and in the world at large, Understanding user and customer perspectives.

UNIT II

Ideation Process: Clear Articulation of problem statement with focus on latent needs; Brainstorming potential solutions; Ideation methods with case-study based approach to using Systematic Inventive Thinking (SIT) Methods such as Addition, Subtraction, Multiplication, Division and Task Unification Strategic Innovation for competition in future: Linear Innovation vs. non-linear innovation, Understanding and identifying weak signals, 3-box thinking, 3-Box framework and Box- 3 ideation.

UNIT III

Designing Customer Experience: Understanding Innovation through Design Thinking; Enhancing Customer Experience; Service Design and Development Process and Case Studies; Service Experience Cycle and Case Studies .

UNIT IV

Sustainable Design Approaches: Concern for Environment and Sustainability in Design, Case Studies to understand good Design For Environment (DFE) Decisions; Design Considerations in the five stages of the Product Life Cycle.

UNIT V

Integrative Engineering Design Solutions: Identifying and resolving issues with working in diverse teams, Modularising, prototype building by different engineering disciplines within the team, validated learning with accessible metrics, Capstone Project (Interdisciplinary)

Applying Design

Thinking Principles and Methods for Ideation and Prototyping, Testing Solution, Refining Solution, and Taking the Solution to the Users.

Text Books

1. 101 Design Methods: A Structured Approach for Driving Innovation in Your Organization, Vijay Kumar, John Wiley & Sons, ISBN: 978-1118083468, 2012
2. Living with Complexity, Donald A Norman, MIT Press, ISBN: 978-0262528948, 2016
3. Design Thinking for Entrepreneurs and Small Businesses: Putting the Power of Design to Work, Beverly Rudkin Ingle, A Press, ISBN: 978-1430261810, 2013

Reference Books

1. Emotionally Durable Design: Objects, Experiences and Empathy, Jonathan Chapman, 2nd Edition, Routledge, ISBN: 978-0415732161, 2015
2. Innovation Design: How Any Organization Can Leverage Design Thinking to Produce Change, Drive New Ideas, and Deliver Meaningful Solutions, Thomas Lockwood, Edgar Papke, New Page Books, ISBN: 978-1632651167, 2017
3. Design Thinking Business Analysis: Business Concept Mapping Applied, Thomas Frisendal, Springer, ISBN: 978-3642434822, 2012
4. Chapter 1: A Simple Framework for Leading Innovation, The Three Box Solution, HBR Press, 2016
5. Design a Better Business: New Tools, Skills and Mindset for Strategy and Innovation, Patrick Van Der Pijl, Justin Lokitz, Lisa Kay Solomon, Erik van der Pluijm, Maarten van Lieshout, Wiley, ISBN: 978-8126565085, 2016

I YEAR
II SEMESTER

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
DIFFERENTIAL EQUATIONS AND VECTOR CALCULUS

Course Code: GR24A1002 **L/T/P/C: 3/1/0/4**

I Year II Semester

Course Outcomes

1. Classify the differential equations of first order and solve them analytically by suggested methods
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 and mechanics
4. Apply vector differential operators on scalar and vector fields and apply them to solve 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
LDE of the first order: Solution of Exact, Linear and Bernoulli equations, modeling Newton's law of cooling, growth and decay models.

UNIT II
Ordinary Differential Equations Of Higher Order
LDE with constant coefficients: Complementary function, Particular integrals for *f(x)* of the form e^{ax}, x^n, $cosax$, $sinax$, $e^{ax}V(x)$ and $x\ V(x)$where $V(x)=cosax\ and\ sinax$, the method of variation of parameters, LDE with variable coefficients: Cauchy's homogeneous equation.

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)
Applications: Area using the double integral –Volume of a solid using the double and triple integral-

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.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
APPLIED PHYSICS

Course Code: GR24A1003 **L/T/P/C: 3/1/0/4**

I Year II Semester Course Outcomes:

1. Solve engineering problems involving quantum nature of radiation and matter waves.
2. Understand the characteristics of semiconductor devices and operation of optoelectronic devices.
3. Identify magnetic and superconducting materials based on their properties for various applications.
4. Analyze the properties of Laser and its propagation in different types of optical fibers.
5. Explore the features of nanomaterials.

UNIT I: Quantum Physics and Solids

Quantum Mechanics: Introduction, Black body radiation, Planck's law, Photoelectric effect-Einstein's Photoelectric equation(quantitative), Wave-Particle duality: de Broglie hypothesis, Davisson and Germer experiment, Heisenberg's uncertainty principle, Born's interpretation of the wave function, Schrodinger's time independent wave equation, Particle in one dimensional infinite potential box.

Solids: Classification of solids into metals, semiconductors, and insulators.

UNIT II: Semiconductors and devices

Intrinsic and extrinsic semiconductors(qualitative) - Hall Effect and its applications, direct and indirect band gap semiconductors, Construction and principle of operation of p-n junction diode, I-V characteristics of p-n junction diode and Zener diode.

Radiative transition: Absorption, Spontaneous and Stimulated emissions, Principle, Construction, Working, Characteristics and Applications: LED and Solar cell.

UNIT III: Magnetic materials and Superconductivity

Magnetic Materials: Introduction, permeability, field intensity, magnetic field induction, magnetisation, magnetic susceptibility, origin of magnetic moment: Bohr magneton, classification of magnetic materials: Ferro, Para, Dia, Antiferro and Ferri, Hysteresis curve based on domain theory of ferromagnetism, Soft and hard magnetic materials, Applications of magnetic materials.

Superconductivity: Superconductivity phenomenon, Meissner effect, Type I and Type II superconductors, applications of superconductors.

UNIT IV: Lasers and Fiber Optics

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, Advantages of optical fibers over conventional cables, Types of optical fibers, Acceptance angle-Numerical aperture, Losses associated with optical fibers, Applications of optical fibers.

UNIT V: Nanotechnology

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.

Text Books

1. Engineering Physics, B.K. Pandey, S. Chaturvedi – Cengage Learing.
2. Applied Physics, T. Bhīma Sankaram, BSP Publishers.
3. Engineering Physics, P.K Palanisamy, Scitech Publishers.
4. A textbook of Engineering Physics, Dr. M. N. Avadhanulu, Dr. P.G. Kshirsagar - S. Chand.

Reference Books

1. Fundamentals of Semiconductor Devices, Second Edition, Anderson and Anderson, McGraw Hill.
2. J. Singh, Semiconductor Optoelectronics: Physics and Technology, McGraw- Hill Inc. (1995)
3. Semiconductor Physics and Devices, 4e, Neamen and Biswas, McGraw Hill.
4. Online Course: “Optoelectronic Materials and Devices” by Monica Katiyar and Deepak Guptha on NPTEL.
5. Halliday and Resnick, Physics – Wiley.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
ENGLISH

Course Code:GR24A1005 **L/T/P/C: 3/1/0/4**

I Year II Semester

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. Convey complex ideas clearly and accurately in academic and professional settings

UNIT I

Chapter entitled '***Toasted English*' by R.K.Narayan** from ***"English: Language, Context and Culture"*** published by Orient BlackSwan, Hyderabad.

Vocabulary: The Concept of Word Formation -The Use of Prefixes and Suffixes - Acquaintance with Prefixes and Suffixes from Foreign Languages to form Derivatives - Synonyms and Antonyms **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 – Types, Structuresand Features of a Paragraph - Creating Coherence-Organizing Principles of Paragraphs in Documents.

UNIT II

Chapter entitled **'Appro JRD' by Sudha Murthy** from ***"English: Language, Context and Culture" published*** by Orient BlackSwan, Hyderabad.

Vocabulary: Words Often Misspelt - Homophones, Homonyms and Homographs

Grammar: Identifying Common Errors in Writing with Reference to Noun-pronoun Agreement andSubject-verb Agreement.

Reading: Sub-Skills of Reading – Skimming and Scanning – Exercises for Practice

Writing: Nature and Style of Writing- Defining /Describing People, Objects, Places and Events – Classifying- Providing Examples or Evidence.

UNIT III

Chapter entitled **'Lessons from Online Learning' by F.Haider Alvi, Deborah Hurst et al** from ***"English: Language, Context and Culture"*** published by Orient BlackSwan, Hyderabad.

Vocabulary: Words Often Confused - Words from Foreign Languages and their Use in English.

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

Tenses.

Reading: Sub-Skills of Reading – Intensive Reading and Extensive Reading – Exercises for Practice.

Writing: Format of a Formal Letter-Writing Formal Letters E.g.., Letter of Complaint, Letter of Requisition, Email Etiquette, Job Application with CV/Resume.

UNIT IV

Chapter entitled **'Art and Literature' by Abdul Kalam** from ***"English: Language, Context and Culture"*** published by Orient BlackSwan, Hyderabad.

Vocabulary: Standard Abbreviations in English

Grammar: Redundancies and Clichés in Oral and Written Communication.

Reading: Survey, Question, Read, Recite and Review (SQ3R Method) - Exercises for Practice

Writing: Writing Practices- Essay Writing-Writing Introduction and Conclusion -Précis Writing.

UNIT V

Chapter entitled **'Go, Kiss the World' by Subroto Bagchi** from ***"English: Language, Context and Culture"*** published by Orient BlackSwan, Hyderabad.

Vocabulary: Technical Vocabulary and their Usage

Grammar: Common Errors in English (*Covering all the other aspects of grammar which were notcovered in the previous units*)

Reading: Reading Comprehension-Exercises for Practice

Writing: Technical Reports- Introduction – Characteristics of a Report – Categories of Reports Formats- Structure of Reports (Manuscript Format) -Types of Reports - Writing a Report.

Note: ***Listening and Speaking Skills which are given under Unit-6 in AICTE Model Curriculum are coveredin the syllabus of ELCS Lab Course.***

- **Note: 1**. As the syllabus of English given in AICTE *Model Curriculum-2018 for B.Tech First Year is* ***Open-ended***, besides following the prescribed textbook, it is required to prepare teaching/learning materials **by the teachers collectively** in the form of handouts based on theneeds of the students in their respective colleges for effective teaching/learning in the class.

- **Note**: **2**.Based on the recommendations of NEP2020, teachers are requested to be flexible to adopt Blended Learning in dealing with the course contents .They are advised to teach 40 percent of each topic from the syllabus in blended mode.

Text Book

1. "English: Language, Context and Culture" by Orient BlackSwan Pvt. Ltd, Hyderabad. 2022. Print.

Reference Books

1. Effective Academic Writing by Liss and Davis (OUP)
2. Richards, Jack C. (2022) Interchange Series. Introduction, 1,2,3. Cambridge University Press
3. Wood, F.T. (2007). Remedial English Grammar. Macmillan.
4. Chaudhuri, Santanu Sinha. (2018). Learn English: A Fun Book of Functional Language, Grammar and Vocabulary. (2nd ed.,). Sage Publications India Pvt. Ltd.
5. (2019). Technical Communication. Wiley India Pvt. Ltd.
6. Vishwamohan, Aysha. (2013). English for Technical Communication for Engineering Students.Mc Graw-Hill Education India Pvt. Ltd.
7. Swan, Michael. (2016). Practical English Usage. Oxford University Press. Fourth Edition.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
DATA STRUCTURES

Course Code: GR24A1017 **L/T/P/C:2/0/0/2**
I Year II Semester

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 ofqueue 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 ofa linked list in memory, operations-insertion, deletion, display, search.
Types and applications: Circular linked list, double linked list, implementation of stack, queueusing 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).

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

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 MECHANICS

Course Code:GR24A1015 **L/T/P/C: 3/1/0/4**

I Year II Semester Course Outcomes:

1. Determine resultant of forces acting on a body and analyze equilibrium of a body subjectedto a system of forces.
2. Solve problem of bodies subjected to friction, Determine the forces in the members of the trusses
3. Find the location of centroid and calculate moment of inertia of a given section and bodies
4. Solve Kinematic Problems of uniform motion and uniform accelerated motion
5. Solve Dynamic problems using Newton's Second Law, work energy and Impulse Momentum Equations.

UNIT I

Introduction to Engineering Mechanics - Force Systems: Basic concepts, Particle equilibrium in 2- D ; Rigid Body equilibrium; System of Forces, Coplanar Concurrent Forces, – 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.

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.

UNIT III

Centroid and Center of gravity- Centroid of Areas and Volumes from first principle, centroid of composite sections; Centre of Gravity and its implications.

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; 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 Rectangular box, Cylinder, Cone and Sphere.

UNIT IV

Kinematics of Particles: Rectilinear motion (Uniform motion and uniform accelerated motion), Plane curvilinear motion (rectangular, path, and polar coordinates), Projectile motion, Relative and constrained motion.

UNIT V

Dynamics of Particles; Newton's 2nd law of motion to solve particle kinetics (rectangular,

path, and polar coordinates). energy, power Work-energy method, potential energy, kinetic energy. Impulse-momentum method (linear, angular), Impact (Direct and oblique).

Text Books

1. Singer's Engineering Mechanics: Statics and Dynamics, 2011 Edition by K. Vijay Kumar Reddy,
J. Suresh Kumar , B.S. Publications.
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.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
DATA STRUCTURES LAB

Course Code: GR24A1024 **L/T/P/C: 0/0/2/1**

I Year II Semester

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, deleteand display.

TASK 8

a. Write a C program to implement Double Linked List operations – create, insert, deleteand 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 Treeusing 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

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
ENGLISH LANGUAGE AND COMMUNICATION SKILLS LAB

Course Code: GR24A1020 **L/T/P/C: 0/0/2/1**

I Year II Semester 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:

a. Computer Assisted Language Learning (CALL) Lab
b. 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– Weak Forms and Strong Forms in Context– Word Stress and Rhythm.
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: Role-Play- Expressions in Various Situations –Making Requests and Seeking Permissions- Telephone Etiquette, Rapid Round –Memory Games.

Exercise III CALL Lab:
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: Public Speaking – Exposure to Structured Talks.

Practice: 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
APPLIED PHYSICS LAB

Course Code: GR24A1018 **L/T/P/C: 0/0/3/1.5**
I Year II Semester Course Outcomes:

1. Compare the behavior of Solar cells and LED.
2. Analyze the behavior of magnetic fields and their applications.
3. Infer the work function of a material through photoelectric effect.
4. Discuss the characteristics of Lasers and infer the losses in optical fibers.
5. Estimate the frequency of tuning fork through the phenomena of resonance.

List of Experiments:

1. Energy gap of P-N junction diode: To determine the energy gap of a semiconductor diode.

2. Solar Cell: To study the V-I Characteristics of solar cell.

3. Light emitting diode: To study V-I characteristics of light emitting diode.

4. Stewart – Gee's experiment: Determination of magnetic field along the axis of a current carrying coil.

5. Hall effect: To determine Hall co-efficient of a given semiconductor.

6. Photoelectric effect: To determine work function of a given material and Planck's constant.

7. LASER: To study the V-I characteristics of LASER sources.

8. Optical fiber: To determine the bending losses of Optical fibers.

9. Optical fiber: To determine the Numerical Aperture of Optical fibers.

10. Melde's experiment: To determine the frequency of a tuning fork using Melde's arrangement.

Note: Any 8 experiments are to be performed.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

PYTHON PROGRAMMING

Course Code: GR24A1027 **L/T/P/C: 0/0/2/1**

I Year II Semester

Course Outcomes:

1. Demonstrate the fundamental concepts and flow control in Python
2. Implement different sequence types and file handling operations.
3. Design python programs using functions and exception handling mechanisms.
4. Develop programs with object oriented programming features and modules.
5. Design GUI based applications using Tkinter.

UNIT I

Introduction: features of Python-Interactive execution, comments, types, variables, operators, expressions, Statements-assignment, input, print.

Control flow: if, if-else, if-elif-else Statements, Nested Decision Structures, Loops- while loop, for loop, Nested Loops, break, continue, pass statement.

UNIT II

Sequences: Strings, Lists and Tuples-basic operations and functions, iterating over sequences, Sets and Dictionaries- operations and functions, Python program examples.

Files-operations-opening, reading, writing, closing, file positions.

UNIT III

Exceptions: raising and handling exceptions, try/except statements, finally clause, standard exceptions, custom exceptions.

Functions: definition, call, scope and lifetime of variables, keyword arguments, default parameter values, variable length arguments, recursive functions, Lambda function.

UNIT IV

Modules: Modules, Standard Modules, Importing Modules, Namespaces and Packages.

Object Oriented Programming: Classes, constructors, objects, class variables, class methods, static methods, operator overloading. Inheritance-is-a relationship, composition, polymorphism, overriding, multiple inheritance, abstract classes, multithreaded programming, Python program examples.

UNIT V

GUI Programming: Introduction, Tkinter, Widgets (Buttons, Canvas, Frame, Label, Menu, Entry, Text, Scrollbar, Combobox, Listbox), event driven programming-events, callbacks, binding, layout management- geometry managers: pack and grid, creating GUI based applications in Python.

Teaching methodologies:

- Power Point Presentations
- Tutorial Sheets
- Assignments

Text Books

1. Exploring Python, Timothy A. Budd, McGraw Hill Publications.
2. Introduction to Programming using Python, Y.Daniel Liang, Pearson.
3. Python Programming, Sheetal Taneja and Naveen Kumar, Pearson.

Reference Books

1. Introduction to Computer Science using Python, Charles Dierbach, Wiley India Edition.
2. Internet of Things - A hands on approach, Arshdeep Bahga and Vijay Madisetti, Universities Press, 2015.
3. Fundamentals of Python, K. A. Lambert, B.L. Juneja, Cengage Learning.
4. Think Python, how to think like a computer scientist, Allen B. Downey,SPD, O'Reilly. Core Python Programming, Wesley J.Chun, second edition, pearson.

II YEAR
I SEMSTER

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
BUILDING MATERIALS AND CONSTRUCTION PLANNING

Course Code: GR24A2009 **L/T/P/C: 2/0/0/2**
II Year I Semester

Course Outcomes:

1. Distinguish between various types of building stones, bricks and tiles and their structural requirements.
2. Recognize the need and process of manufacture of cement and lime.
3. Identify function of various materials like wood, glass, paints and building components.
4. Find the importance of masonry, finishing and form works.
5. Assess various building services and principles of building planning.

UNIT I

Building Stones, Bricks and Tiles

Stone- Ancient Building stones, classification of building stones, quarrying procedures, characteristics ofgood building stone, dressing and tools for dressing of stones.
Bricks -Composition of brick earth, manufacturing of brick, characteristics of good brick, field and labtest.
Tiles - Types of tiles, manufacturing of tiles, structural requirements of tiles.

UNIT II

Cement, Lime, Admixtures

Ingredients of cement, manufacturing of cement.
Lime -Various ingredients of lime, constituents of limestone, classification of lime, manufacturing oflime.
Admixtures - physical admixtures, chemical admixtures.

UNIT III

Wood, Glass, Paints

Wood- structure, types of wood, properties of wood, seasoning, defects, alternative material for wood.
Glass-types of glasses, manufacturing of glass. Paints -Constituents of paints, types of paints. Introduction to Building Components -Lintel, arches, staircase, floors, roofs, foundation, Doors, windows.

UNIT IV

Masonry and Finishing, Form Works

Brick Masonry- Types and bonds. Stone Masonry- Types.
Finishing- plastering, pointing and cladding- Types of ACP (Aluminium composite panel). FormWorks - requirements, standards, Scaffolding, shoring, under pinning.

UNIT V

Building Services and Building Planning

Building Services- Water distribution, Sanitary lines and fittings, Plumbing services, ventilators, air conditioning. Characteristics- Absorption, fire safety, fire resistance materials.

Building Planning - Principles of building planning, classification of building and building by laws as per National Building code.

Text Books:

1. SK Duggal, Building Materials, New Age Publications 5th Edition, April, 2019.
2. B C Punmia, Ashok Kumar Jain and Arun Kumar Jain, Building Construction, Laxmi Publications (P) Ltd., New Delhi, 12th Edition, 2023.
3. P C Varghese, Building Construction, Prentice Hall of India Private Ltd., New Delhi, 2nd Edition, 2017.

Reference Books:

1. Rangwala, Building Construction, Charotar Publishing House Pvt. Ltd.; 34th Edition, 2022.
2. Roy Chudley "Construction Technology" Vol. – 1 & 2,2nd Edition, Longman, UK, 2014.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
SURVEYING AND GEOMATICS

Course Code: GR24A2017 **L/T/P/C: 2/0/0/2**
II Year I Semester

Course Outcomes:
1. Apply the knowledge, techniques, skills, and applicable tools of the discipline to Engineering and surveying activities.
2. Apply the knowledge of levelling, area, and volume calculations in construction industry.
3. Apply the knowledge on theodolite and traversing methods in surveying requirements.
4. Apply the tacheometry principles, curves, and knowledge of advanced instruments in surveying requirements
5. Implement the photogrammetry principles, methods and product generation strategies in both Analytical and digital Photogrammetry system

UNIT I
Surveying and Basic Concepts: Introduction - Objectives, classification and principles of surveying, Scales, Shrinkage of Map, Conventional symbols and Code of Signals, Surveying accessories, phases of surveying.
Measurement of Distances and Directions
Linear distances- Approximate methods, Direct Methods-Chains- Tapes, ranging, Tape corrections.
Prismatic Compass - Bearings, included angles, Local Attraction, Magnetic Declination, and dip

UNIT II
Simple Levelling: Basic definitions; Types of levels and levelling staves – Temporary adjustments, methods of levelling- HI Method-Rise and Fall method Sources of errors in levelling - Curvature and Refraction − Contour: contour interval; Characteristics of contours; Methods of plotting of contours; Uses of contour maps (Surveyor of India toposheets).
Areas and Volumes: Introduction – Determination of areas by Trapezoidal rule, Simpsons rule, Coordinate system, MDM and DMD methods. Computation of volumes by trapezoidal and prismoidal rule - capacity of a reservoir.

UNIT - III
Theodolite Surveying: Types of Theodolites, Fundamental Lines, temporary adjustments, measurement of horizontal angle by repetition method and reiteration method, measurement of vertical Angle, Trigonometrical levelling when base is accessible and inaccessible.
Traversing: Methods of traversing, traverse computations, and adjustments, Omitted measurements.

UNIT - IV
Curves: Types of curves and their necessity, elements of simple curve, setting out of simple Curves.

Tacheometric Surveying: Principles of Tacheometry, stadia, and tangential methods of Tacheometry.

Modern Surveying Methods: Principle and types of E.D.M. Instruments, Total station advantages and Applications. Field Procedure for total station survey, Errors in Total Station Survey, Global Positioning System- Principle and Applications.

UNIT - V

Photogrammetry Surveying: Introduction, Basic concepts, perspective geometry of aerial photograph, relief and tilt displacements, terrestrial photogrammetry, flight planning; Stereoscopy, ground control extension for photographic mapping- aerial triangulation, radial triangulation, methods; photographic mapping-mapping using paper prints, mapping using stereo plotting instruments, mosaics, map substitutes. Digital Photogrammetry − Introduction- List of softwares related to Digital photogrammetry

Text Books:

1. Surveying (Vol – 1, 2 & 3), by B. C. Punmia, Ashok Kumar Jain and Arun Kumar Jain – Laxmi Publications (P) ltd., New Delhi 2016
2. Arora K R "Surveying Vol 1, 2 & 3), Standard Book House, Delhi, 2004.
3. Duggal S K, "Surveying (Vol – 1 & 2), Tata McGraw Hill Publishing Co. Ltd. New Delhi, 2004.
4. Hoffman. B, H. Lichtenegga and J. Collins, Global Positioning System - Theory and Practice, Springer -Verlag Publishers, 2001

Reference Books:

1. Surveying and levelling by R. Subramanian, Oxford university press, New Delhi.2012
2. Chandra A M, "Plane Surveying", New Age International Pvt. Ltd., New Delhi, 2002.
3. Chandra A M, "Higher Surveying", New age International Pvt. Ltd., Publishers, New Delhi, 2002.
4. Arthur R Benton and Philip J Taety, Elements of Plane Surveying, McGraw Hill – 2000.
5. Surveying and leveling by R. Agor Khanna Publishers 2015.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
SOLID MECHANICS – I

Course Code: GR24A2011 **L/T/P/C: 2/1/0/3**

II Year I Semester

Prerequisite: Mathematics, Engineering Mechanics.

Course Outcomes:

1. Summarize the stresses, strains, elastic constants and also to determine the strain energy for various types of loading.
2. Analyze the shear force, bending moment diagrams and identify the point of contraflexure for different types of beams such as cantilever, simple supports under different loading conditions.
3. Examine the bending equation and shear equation to calculate the bending stresses and shear stresses for different sections of the structural members.
4. Solve the principal stresses and strains in different planes by using analytical and graphical methods
5. Analyze the slope and deflection of different beams for different end conditions and loads by using double integration, Macaulay's and Moment area methods.

UNIT I

Simple Stresses and Strains: Concept of stress and strain, St.Venant's principle, elasticity and plasticity - types of stresses and strains, Hooke's law - stress - strain diagram for mild steel - Working stress - Factor of safety- Elastic constants (E, K, G, μ) and the relationship between them - Bars of varying section - composite bars - Temperature stresses. Strain Energy - Resilience- gradual, sudden, impact and shock loadings - simple applications.

UNIT II

Shear Force and Bending Moment Diagrams: Shear force and Bending moment diagrams for cantilevers, simply supported and overhanging beams. Calculation of maximum SF, BM and the point of contra flexure under point loads, uniformly distributed load, uniformly varying load, moment couple and combination of these loads. Relationship between SF, BM and rate of loadingat a section of beam.

UNIT III

Flexural Stresses: Theory of simple bending - assumptions - derivation of bending equation: M/I
= f/y = E/R – neutral axis - determination of bending stresses -section modulus of rectangular and circular sections (Solid and Hollow), I, T, angle and channel sections - design of simple beam sections. **Shear Stresses** - Derivation of formula - Shear stress distribution across various beam sections like rectangular, circular, triangular and angle sections**.**

UNIT IV

Compound Stresses and Strains: Two- dimensional system, stress at a point on an inclined plane under axial loading-Normal and Tangential stresses on an inclined plane for biaxial stresses-two perpendicular normal stresses accompanied by a state of simple shear.

Principal Stresses and Strains

Analytical and graphical solutions- Mohr's circle of stresses - various theories of failures- maximum principal stress theory-maximum shear stress theory- maximum strain energy theory- maximum shear strain energy theory.

UNIT V

Slope and Deflection: Relationship between moment, slope and deflection, Double integration method, Moment area method, Macaulay's method. Use of these methods to calculate slope and deflection for static determinate beams- Cantilever and simply supported beams.

Text Books:

1. Dr. R.K. Bansal, Strength of material, Laxmi Publications, New Delhi, 6_{th} edition, 2018.
2. S. Ramamrutham, Strength of material- Dhanpat Rai Publishing Company, New Delhi,20th edition, 2020.
3. R K Rajput, Strength of materials, S Chand Publications,6^{th} edition, 2015.

Reference Books:

1. Dr. B.C. Punmia, Mechanics of Materials, Laxmi publications, 11^{th} edition, 2017.
2. B. S. Basavarajaiah, Strength of Materials, University Press, Hyderabad, 3rd Edition, 2010.
3. Ferdinand Beer and others, Mechanics of Solid, Tata Mc. Graw Hill publications, 7^{th}Edition, 2014.
4. A.R.Basu, Strength of materials, Dhanpat Rai &Co, Nai Sarah, New Delhi, 2^{nd} dition,2012.
5. S S Bhavikatti, Strength of materials, New Age Publications, 4^{th} edition, 2021.
6. R. Subramanian, Strength of materials, Oxford UniversityPress, New Delhi, 3^{rd} edition,2016.
7. R.S. Khurmi, Strength of material-S. Chand & Company Ltd., New Delhi, 2010 Re-print.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

INTRODUCTION TO FLUID MECHANICS

Course Code:GR24A2012 **L/T/P/C: 3/0/0/3**
II Year I Semester

Prerequisite: Mathematics, Physics.

Course Outcomes:

1. Evaluate the various fluid properties and fluid statics in engineering problems.
2. Comprehend the broad principles of hydrostatic forces on submerged planes
3. Analyzing fluid dynamics and kinematics.
4. Classify concept of boundary layer and predict the laminar and turbulent flows
5. Predict the losses in pipes flows and able to calculate discharge measurement.

UNIT I

Basic Concepts and Definitions Distinction between a fluid and a solid; Density, Specific weight, Specific gravity, Kinematic and dynamic viscosity; variation of viscosity with temperature, Newton law of viscosity; vapor pressure, boiling point, cavitation; surface tension, capillarity, Bulk modulus of elasticity, compressibility. Fluid Statics - Fluid Pressure: Pressure at a point, Pascal law, pressure variation with temperature, density and altitude. Piezometer, U-Tube Manometer, Single Column Manometer, U-Tube Differential Manometer, Micro manometers. pressure gauges

UNIT II

Hydrostatic Law, Hydrostatic pressure and force: horizontal, vertical and inclined curved surfaces. Introduction and explanatory to Buoyancy, Metacenter.

Fluid Kinematics- Classification of fluid flow: steady and unsteady flow; uniform and non-uniform flow; laminar and turbulent flow; rotational and irrotational flow; compressible and incompressible flow; ideal and real fluid flow; one-, two- and three-dimensional flows, Stream line, path line, streak line and stream tube; stream function, velocity potential function. One-, two- and three - Dimensional continuity equations in 3D-Cartesiancoordinates

UNIT III

Fluid Dynamics- Surface and body forces; Equations of motion - Euler's equation; Bernoulli's equation – derivation; Energy Principle; Practical applications of Bernoulli's equation: venturimeter, Momentum principle; Forces exerted by fluid flow on pipe bend;

Measurement of Discharge and Velocity: Flow over rectangular, triangular and trapezoidal and Stepped notches. Venturimeter, orifice meter and pitot tube.

UNIT IV

Flow through Pipes: Reynolds experiment- laminar, Transition and Turbulent flows, Loss of head through pipes, Darcy-Wiesbatch equation, minor losses (explanatory), total energy equation, hydraulic gradient line, Pipes in series, equivalent pipes, pipes in parallel. Laminar flow through straight circular pipes- Haigen- Poisuelle equation derivation.

UNIT V

Boundary Layer Analysis – Assumption and concept of boundary layer theory. Boundary-layer thickness, displacement, momentum & energy thickness, laminar and turbulent boundary layers on a flat plate; Laminar sub-layer, smooth and rough boundaries. Local and average friction coefficients. Separation and control of boundary layer. Navier- Stokes equation explanatory.

Text Books

1. Modi and Seth, Fluid Mechanics, Standard book house, 22nd Edition 2019
2. Dr. R.K. Bansal, A text of Fluid mechanics and hydraulic machines, Laxmi Publications (P) ltd., New Delhi, 10th Edition, 2022.
3. S.K.Som & G.Biswas, Introduction to Fluid Machines, Tata Mc.Graw Hill publishers, Pvt. Ltd.,3rd Edition, 2017.

References Books

1. J.F.Douglas, J.M. Gaserek and J.A.Swaffirld, Fluid Mechanics, 5th Edition,2005.
2. Frank.M. White, Fluid Mechanics, Tata Mc. Graw Hill Pvt. Ltd, 8th Edition, 2016.
3. A.K. Mohanty, Fluid Mehanics, Prentice Hall of India Pvt. Ltd., New Delhi, 2nd Edition,1994.
4. Edward J. Shaughnessy, M. Katz and James P. Schaffer, Introduction to Fluid Machines, Oxford University Press, New Delhi, 1st Edition, 2005

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

Course Code: GR24A2013 **L/T/P/C:3/0/0/3**
II Year I Semester

Course Outcomes:
1. Analyze and solve DC and AC Circuits.
2. Choose appropriate LT switchgear used for electrical installations.
3. Summarize the working principles of Electrical Machines and Transformers.
4. Categorize various types of diodes.
5. Interpret the different modes of Operations of a transistor.

UNIT I
D.C. Circuits: Electrical circuit elements (R, L and C), voltage and current sources, KVL&KCL, analysis of simple circuits with dc excitation.
A.C. Circuits: Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor, Analysis of single-phase ac circuits, Three- phase balanced circuits, voltage and current relations in star and delta connections.

UNIT II
Electrical Installations: Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery backup.

UNIT III
Electrical Machines: Working principle of Single-phase transformer, equivalent circuit, losses in transformers, efficiency, Three-phase transformer connections. Construction and working principle of DC generators, EMF equation, working principle of DC motors, Torque equations and Speed control of DC motors, Construction and working principle of Three-phase Induction motor, Torques equations and Speed control of Three-phase induction motor. Construction and working principle of synchronous generators.

UNIT IV
P-N Junction and Zener Diode: Principle of Operation Diode equation, Volt-Ampere characteristics, Temperature dependence, Ideal versus practical, Static and dynamic resistances, Equivalent circuit, Zener diode characteristics and applications.
Rectifiers and Filters: P-N junction as a rectifier - Half Wave Rectifier, Ripple Factor - Full Wave Rectifier, Bridge Rectifier, Harmonic components in Rectifier Circuits, Filters – Inductor Filters, Capacitor Filters, L- section Filters, π- section Filters.

UNIT V
Bipolar Junction Transistor (BJT): Construction, Principle of Operation, Amplifying Action, Common Emitter, Common Base and Common Collector configurations, Comparison of CE,

CB and CC configurations.**Field Effect Transistor (FET)**: Construction, Principle of Operation, Comparison of BJT and FET, Biasing FET.

Text Books

1. "Basic Electrical and electronics Engineering", –M S Sukija TK Nagasarkar Oxford University
2. "Basic Electrical and electronics Engineering",-D P Kothari. I J Nagarath, McGraw Hill Education

Reference Books

1. "Electronic Devices and Circuits", – R. L. Boylestad and Louis Nashelsky, PEI/PHI, 9th Ed, 2006.
2. "Electronic Devices and Circuits", – J. Millman and C. C. Halkias, Satyabrata Jit, TMH, 2/e, 1998.
3. "Network Theory", by Sudhakar, Shyam Mohan Palli, TMH.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
SURVEYING LAB

Course Code: GR24A2020
L/T/P/C:0/0/4/2
II Year I Semester Prerequisite: Surveying

Course Outcomes:
1. Define the characteristics and applications of basic survey instruments.
2. Apply knowledge of mathematics, science and engineering in land measurement techniques.
3. Calculate distances, inclinations, elevations, areas and volumes.
4. Generate maps of earth surfaces.
5. Analyzing the data and transfer relevant points onto ground.

List of Experiments

TASK-1: (i) Measurement of an area by Chain Survey (Open and Closed Traverse).
(ii) Study of Topo sheets
TASK-2: Chaining across obstacles
TASK-3: Simple, fly, Differential Levelling.
TASK-4: Study of Theodolite- Measurement of horizontal and vertical angles- (Repetition and Reiteration method).
TASK-5: Trigonometric Levelling- Heights and distances problems.
TASK-6: Calculation of R.L and distance using tachometric survey.
TASK-7: Setting out of simple Curve**.**
TASK-8: Determine the area of the field by using Total Station.
TASK-9: Column and foundation marking using Total Station.
TASK-10: (i) Distance, gradient, differential height between two inaccessible points using Total Station.
(ii) Measurement of Area using hand held GPS

Reference Books:
1. B C Punmia, Surveying, Vol- III, Higher surveying, Laxmi Publications,2016.
2. S K Duggal- Vol- I & II, McGraw-Hill publications, 5th edition, 2019.
3. T P Kanetkar and S V Kulkarni, Surveying and Levelling, PVGP publications,2006.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
SOLID MECHANICS LAB

Course Code: GR24A2015
L/T/P/C:0/0/4/2
II Year I Semester

Prerequisites: Engineering Mechanics, Mathematics and Physics.

Course Outcomes:
1. Determine the important mechanical properties of materials.
2. Identifythe stiffness of an elastic isotropic material.
3. Evaluate the Reciprocal theorem.
4. Measure anysubstance's resistance to uniform compression.
5. Resistance of various materials against abrasion and impact.

TASK- 1: Tension test on metals **TASK- 2**: Torsion test on metals **TASK- 3**: Hardness test on metals **TASK- 4**: Spring test on metals

TASK-5: Compression test on wood or concrete or brick or block.

TASK-6: Impact test on metals.

TASK-7: Deflection test on cantilever beam. **TASK-8:** Deflection test on simply supported beam.

TASK-9: Deflection test on continuous beam.

TASK-10: Verification of Maxwell's Reciprocal theorem

Reference Books:

1. Dr. R.K. Bansal, Strength of material, Laxmi Publications, New Delhi, 6th edition, 2018.
2. S. Ramamrutham, Strength of material- Dhanpat Rai Publishing Company, New Delhi, 18th Edition,2014.
3. R K Rajput, Strength of materials, S Chand Publications, 6th edition,2015.
4. Dr. B.C. Punmia, Mechanics of Materials, Laxmi publications, 11th edition, 2017.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
VALUE ETHICS AND GENDER CULTURE

Course Code:GR24A2002
L/T/P/C: 2/0/0/0
II Year I Semester

Course Outcomes:

1. To enable the student to understand the core values that shapes the ethical behaviour. And Student will be able to realize the significance of ethical human conduct and self-development
2. Students will be able to inculcate positive thinking, dignity of labour and religious tolerance.
3. The students will learn the rights and responsibilities as an employee and a team member.
4. Students will attain a finger grasp of how gender discrimination works in our society and how to counter it.
5. Students will develop a better understanding on issues related to gender and Empowering students to understand and respond to gender violence.

UNIT I

Values and Self-Development –social values and individual attitudes, Importance of cultivation of values, Sense of duty, Devotion, Self-reliance, Confidence, Concentration, Truthfulness, Cleanliness, Honesty, Humanity, Power of faith, National unity, Patriotism, Love for nature, Discipline.

A Case study on values and self-development

UNIT II

Personality and Behaviour Development-positive thinking, punctuality, avoiding fault finding, Free from anger, Dignity of labour, religious tolerance, Aware of self-destructive habits.

A Case study on Personality

UNIT III

Introduction to Professional Ethics: Basic Concepts, Governing Ethics, Personal & Professional Ethics, Ethical Dilemmas, Life Skills, Emotional Intelligence, Thoughts of Ethics, Value Education, Dimensions of Ethics, Profession and professionalism, Professional Associations, Professional Risks, Professional Accountabilities, Professional Success, Ethics and Profession.

A Case study on professional ethics

UNIT IV

Introduction to Gender - Definition of Gender, Basic Gender Concepts and Terminology, Attitudes towards Gender, Social Construction of Gender.

A Case study/ video discussion on attitudes towards gender

UNIT V

Gender-based Violence -The concept of violence, Types of Gender-based violence, the relationship between gender, development and violence, Gender-based violence from a human rights perspective.

A Case study/ video discussion on gender-based violence in view of human rights

Text Books

1. Professional Ethics Includes Human Values (2nd Edition) By R Subramanian, Oxford University Press, 2017.
2. Ethics in Engineering Practice & Research, Caroline Whit beck, 2e, Cambridge University Press 2015.
3. A Bilingual Textbook on Gender" written by A. Suneetha, Uma Bhrugubanda, Duggirala Vasanta, Rama Melkote, Vasudha Nagaraj, Asma Rasheed, Gogu Shyamala, Deepa Sreenivas and Susie Tharu and published by Telugu Akademi, Hyderabad,Telangana State in the year 2015.

Reference Books

1. Menon, Nivedita. Seeing like a Feminist. New Delhi: Zubaan-Penguin Books, 2012
2. Abdulali Sohaila. "I Fought For My Life…and Won."Available online at: http://www.thealternative.in/lifestyle/i-fought-for-my-lifeand-won-sohaila-abdulal/
3. Engineering Ethics, Concepts Cases: Charles E Harris Jr., Michael S Pritchard, Michael J Rabins, 4e, Cengage learning, 2015.
4. Business Ethics concepts & Cases: Manuel G Velasquez, 6e, PHI, 2008.

II YEAR
II SEMESTER

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
SOLID MECHANICS- II
Course Code:GR24A2016
L/T/P/C: 2/0/0/2
II Year II Semester

Prerequisites: Mathematics, Physics, Engineering Mechanics and Solid Mechanics I

Course Outcomes:
1. Compute various stresses in thin and thick cylinders under fluid pressure.
2. Calculate the torsional strength of structural members and differentiate between closed and open coiled helical springs.
3. Determine the buckling failure load for axially loaded and eccentrically loaded columns.
4. Evaluate stresses in columns, dams, retaining walls and chimneys and also check the stability of dams.
5. Evaluate the behaviour of members under unsymmetrical bending and find the stresses in circular and semi-circular beams.

UNIT I
Thin Cylinders
Derivation of formula for longitudinal and hoop stress, calculation of longitudinal stress and hoop stress, longitudinal and volumetric strains, changes in diameter and volume of thin cylinders and sphere subjected to internal pressures.
Thick Cylinders
Introduction -Lame's theory for thick cylinders- derivationof Lame's formulae, distribution of hoop, radial stresses across thickness due to internal pressure,design of thick cylinders and thick spherical shells.

UNIT II
Torsion of Circular Shafts
Assumptions and derivation of torsion equation**,** Torsional moment of resistance, polar section modulus, power transmitted by shafts, torsional rigidity, combined bending, torsion and end thrust of circular shafts, principal stress and maximum shear stresses under combined loading of bendingand torsion.
Springs
Introduction, types of spring, analysis of elliptical, closely and open coiled helical spring.

UNIT III
Columns and Struts
Introduction –Types of columns–Short, medium, and long columns**.** Axially loaded compression members, crushing load. Euler's theorem for long columns, assumptions, derivation of Euler's critical load formulae for various end conditions. Effective length of a column, slenderness ratio, Euler's critical stress, limitations of Euler's theory, Rankine's formula, Gordon formula, Long columns subjected to eccentric loading, Secant formula, Empirical formulae, Johnsons straight line and parabolic formula.
Beam Columns:
Laterally loaded struts subjected to uniformly distributed and concentrated loads, Maximum B.M

and stress due to transverse and lateral loading.

UNIT IV

Direct and Bending Stresses of Dams, Retaining walls and Chimneys

Stresses under the action of direct loading and bending moment, core of a section**.** Determination of stresses in the case of chimneys, retaining walls and dams. Conditions for stability of dams. Stresses due to direct loading and bending moment about its axis.

UNIT V

Unsymmetrical Bending of Beams

Introduction–Centroid principal axes of section–Graphical Stresses in beams subjected to unsymmetrical bending. Principal axes- Resolution of bending moment into two rectangular axes through the centroid - Location of neutral axis. Deflection of beams under unsymmetrical bending. **Curved Beams:** Introduction – circular beams loaded uniformly and supported on symmetrically placed columns and Semi-circular beams simply supported on three equally spaced supports.

Text Books:

1. R.K Bansal, A textbook of Strength of materials, Laxmi Publications(P)Ltd., New Delhi, 6th Edition,2018.
2. Mechanics of Materials by Dr. B. C Punmia, Dr. Ashok Kumar Jain and Dr. Arun Kumar Jain. Laxmi Publications (P) Limited, 2001.
3. S.S. Bhavikatti, Strength of materials, Vikas Publications, 4thEdition,2010.

Reference Books:

1. Strength of Materials by R.K Rajput, S. Chand & Company Ltd. 2018.
2. Ferdinand Beer and others, Mechanics of solid, Tata Mc. Graw Hill Publications, 6thEdition.
3. S.Rama Krishna and R.Narayan, Strength of materials, Dhanpat Rai Publications.
4. A.R.Basu, Strength of materials, Dhanpat Rai& Co, NaiSarah, NewDelhi,first revised on 2005, Re-print 2009.
5. L.S.Srinath, Strength of materials, Macmillian India Ltd.
6. B.S. Basavrajaiah and P. Mahadevappa, Strength of materials, University Press, Hyderabad, 3rd Edition,2010.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
ENGINEERING GEOLOGY
Course Code: GR24A2010
L/T/P/C: 2/0/0/2
II Year II Semester

Course Outcomes:
1. Identify the weathering effects and various deposits.
2. Recognize the minerals and its importance from civil engineering point of view.
3. Distinguish features of igneous, sedimentary and metamorphic rocks.
4. Recognize various geological structures and the failures of dams, reservoirs and tunnels due to geological reasons.
5. Relate water table and the failures of earthquake and landslides

UNIT I
Physical Geology: Branches of geology useful to civil engineering, Scope of geological studies in various Civil Engineering projects. Weathering, Erosion and Denudation. Factors affecting weathering and product of weathering. Engineering consideration. Development of river, River meandering, Alluvial cones and fans, Placer Deposits, Delta deposits and natural levees.

UNIT II
Mineralogy: Mineral, origin and composition. Physical properties of minerals, Role of study of physical properties of following common rock forming minerals: Feldspar, Quartz, Flint, Jasper, Olivine, Augite, Hornblende, Muscovite, Biotite, Asbestos, Chlorite, Kyanite, Garnet, Talc, Calcite. Megascopic identification of common primary & secondary minerals.

UNIT III
Petrology: Rock forming processes. Igneous rocks - Various forms of rocks, Structures and Classification of Igneous rocks on the basis of Chemical composition. Texture and its types. Detailed study of Igneous rocks like Granite, Pegmatite, Dolerite and Basalt. Sedimentary rocks - mode of formation, Structures and Textures. Detailed study of Conglomerate, Sandstone, Shale and Limestone. Metamorphic rocks - structures and textures in metamorphic rocks. Detailed study of Gneiss, Schist, Slate.

UNIT IV
Structural Geology: Outcrop and width of outcrop. Fold - Types and nomenclature, classification and recognition of Faults. Types of joints & unconformities. Geological structures - required geological consideration for selecting dam, reservoir and tunnel site.

UNIT V
Earthquake and Landslides: Pervious & impervious rocks and ground water. Earthquake - Magnitude and intensity of earthquake. Seismic zone in India. Consequences of failure due to Land sliding and Earthquake.

Text Books:

1. N. Chennakesavulu, Text book of Engineering Geology, Trinity India Ltd., 3rd edition, 2018
2. K.V.G.K. Gokhale, Principles of Engineering Geology, B.S publications, kindle edition, 2019
3. P. C. Varghes, Engineering Geology for Civil Engineers, PHI learning, New Delhi,2012

Reference Books:

1. F.G. Bell, Fundamental of Engineering Geology, Butter worth Heinemann Publications London, New Delhi, 2016.
2. Krynine & Judd, Principles of Engineering Geology & Geotechnics, McGraw Hill New York, CBS publications,2005

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
STRUCTURAL ANALYSIS - I

Course Code: GR24A2018
L/T/P/C: 3/0/0/3
II Year II Semester

Prerequisites: Engineering Mechanics, Solid mechanics.

Course Outcomes:
1. Solve the deflections of beams and trusses using energy methods.
2. Analyze three and two hinged circular and parabolic arches.
3. Analyze indeterminate beams using force method for propped cantilever and Fixed beams.
4. Apply Clapeyron's three moment theorem and Slope deflection methods to analyze statically indeterminate structures.
5. Analyze statically determinate structures using rolling load and influence line methods.

UNIT I
Energy Theorems: Introduction – strain energy in linear elastic system, expression of strain energy due to axial load, bending moment and shear forces – Castiglione's first theorem – Deflections of simple beams and pin jointed trusses (Use Unit load method)

UNIT II
Arches: Classification of arches, advantage of arch, three and two hinged arches – Circular and parabolic arches yielding of supports, Effect of rib shortening, Effect of temperature changes, Tied and linear arch, Eddy's theorem.

UNIT III
Propped Cantilever and Fixed Beams: Determination of static and kinematic indeterminacies for beams- Analysis of Propped cantilever and fixed beams, including the beams with different moments of inertia - subjected to uniformly distributed load - point loads
- uniformly varying load, couple and combination of loads - Shear force, Bending moment diagrams and elastic curve for Propped Cantilever and Fixed Beams-Deflection of Propped cantilever and fixed beams - effect of sinking of support, effect of rotation of a support.

UNIT IV
Continuous Beams: Introduction-Continuous beams - Clapeyron's theorem of three moments-Analysis of continuous beams with constant and variable moments of inertia with one or both ends fixed-continuous beams with overhang - effect of sinking of supports.
Slope Deflection Method: Derivation of slope-deflection equation, application to continuous beams with and without sinking of supports -Determination of static and kinematic indeterminacies for frames- Analysis of Single Bay, Single storey Portal Frames by Slope Deflection Method including Side Sway- Shear force and bending moment diagrams and Elastic curve.

UNIT V

Moving Loads and Influence Line Diagrams: Introduction, maximum SF and BM at a given section and absolute maximum SF and BM due to single concentrated load, UDL shorter than the span and longer than the span, two-point loads with fixed distance between them and several point loads – Equivalent uniformly distributed load – focal length.

Definition of influence line for SF, Influence line for BM- load position for maximum SF at a section –Load positions for maximum BM at a section – Point loads, UDL shorter than the span and longer than the span - Influence lines for forces in members of Pratt and Warren trusses.

Text Books:

1. K U Muthu, Azmi Ibrahim, M Vijayanand, Maganti Janardhana, Basic Structural analysis, I K International Publishing House Pvt.Ltd,2017.
2. S Ramamrutham, Theory of structures, Dhanpat Rai publications,9th edition 2014.
3. V. N. Vazirani & M. M. Ratwani, Analysis of structures –Vol. & Vol. II, Khanna Publications, New Delhi,1994.

Reference Books:

1. T.S. Thandavamoorthy, Analysis of structures, Oxford University Press, New Delhi,2005.
2. S.S Bhavikatti, Structural Analysis I, Vikas Publishing House, 4th edition,2010.
3. S.B. Junnakar, Mechanics of structures Vol II, Charotar Publishing House, Anand, Gujarat, 24th edition 2017.
4. Pandit& Gupta, Theory of structures, Vol I, Tata Mc. Graw Hill Publishing Co. Ltd., New Delhi,1st edition, 2017.
5. R. S. Khurmi, Theory of structures, S. Chand Publishers, 12th edition, 2020.
6. Dr. B.C. Punmia, Mechanics of Materials, Laxmi publications, 11th edition, 2017.
7. B.D. Nautical, Introduction to structural analysis, new age international publishers, New Delhi,2001.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

ECONOMICS AND ACCOUNTING FOR ENGINEERS

Course Code:GR24A2004

L/T/P/C: 3/0/0/3

II Year II Semester Course Outcomes:

1. The students will be able to understand the managerial economics, analyze demand behavior and interpret the concepts of national income indicators.

2. The student will be able to plan the production levels in tune with maximum utilization of organizational resources to determine optimal input combinations for production processes.

3. To recognize the type of markets based on competition levels, the characteristics and determine pricing strategies for products and services.

4. Understand the importance of capital budgeting in the context of strategic financial management and identify, evaluate investment opportunities using appropriate capital budgeting techniques.

5. Learners understand the fundamental principles, concepts & conventions of accounting, including the recording of business transactions using journals, ledgers, preparation of trail balance and more emphasis on preparation of final accounts.

UNIT I

Introduction & Demand Analysis: Definition and Scope: Introduction to micro, macroeconomics, Nature, and Scope of Managerial Economics. National Income and its Components - GNP, NNP, GDP, NDP, Introduction to demand: Demand Determinants, Law of Demand, and its exceptions. Elasticity of Demand: Definition, Types, Measurement and Significance of Elasticity of Demand. Demand Forecasting, Factors governing demand forecasting, methods of demand forecasting, Law of supply.

UNIT II

Production & Cost Analysis: Production Function – Law of variable proportions, Isoquants and Isocosts, MRTS, Least Cost Combination of Inputs, Laws of Returns, Internal and External Economies of Scale. Cost Analysis: Cost concepts. Break-even Analysis (BEA)-Determination of Break-Even Point (simple problems) - Managerial Significance.

UNIT III

Markets and Forms of Business organizations: Types of competition and Markets, Features of Perfect competition, Monopoly and Monopolistic Competition. Pricing: Objectives of Pricing, Methods of Pricing. Business: Features and evaluation of different forms of Business Organisation: Sole Proprietorship, Partnership, Joint Stock Company, Public Enterprises.

UNIT IV

Introduction to Financial Accounting: Accounting Concepts and Conventions - Double-Entry Bookkeeping. Accounting Cycle: Journal, Ledger, Trial Balance, Final Accounts (Trading Account, Profit and Loss Account and Balance Sheet with simple adjustments).

UNIT V

Capital Budgeting: Capital and its significance, Types of Capital, Methods of Capital Budgeting: Payback Method, Accounting Rate of Return (ARR) and Net Present Value (NPV) Method and Internal Rate of Return (IRR) (simple problems) and Profitability Index (PI)

Text Books:

1. Managerial Economics – International Edition, 2019, by Christopher Thomas (Author), S. Charles Maurice (Author), McGraw-Hill Education

2. Managerial Economics & Business Strategy, Michael R. Baye, Jeffrey T. Princ, McGraw-Hill Education, 2021 (10th Edition)

3. Managerial Economics, Mark Hirschey, Cengage Learning, 2016 (13th Edition)

4. Managerial Economics: Analysis, Problems and Cases - P. L. Mehta, Edition, 13. Publisher, Sultan Chand, 2016.

5. Managerial Accounting, Carl S. Warren, James M. Reeve, Jonathan Ducha, Cengage Learning, 2021

6. Managerial Accounting: Tools for Business Decision Making (9th Edition), Jerry J. Weygandt, Paul D. Kimmel, Donald E. Kieso, Wiley, 2021

7. Managerial Economics Aryasri: Managerial Economics and Financial Analysis, TMH, 2009.

Reference Books:

1. Managerial Economics 4th Edition, W. Cris Lewis, Sudhir K. Jain, H. Craig Petersen, Pearson, 2009

2. Ambrish Gupta, Financial Accounting for Management, Pearson Education, New Delhi.2009

3. Financial Accounting, 6/e, Dr S N Maheshwari, CA Sharad K Maheshwari & Dr Suneel K Maheshwari, Vikas Publishing, 2018

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
HYDRAULIC ENGINEERING

Course Code: GR24A2019
L/T/P/C: 2/0/0/2
II Year II Semester

Prerequisite: Introduction to Fluid Mechanics

Course Outcomes:

1. Analyse the most economical Rectangular, Trapezoidal and Circular channel sections and Critical flow in rectangular channels.
2. Apply dynamic equation in steady and nonuniform gradually varied and visualize surface profiles of channel flow & analyse hydraulic jump of rapidly varied flow.
3. Apply dimensional analysis and analyse the model and prototype simulation for practical problems & evaluate the hydrodynamic force of jets on vanes and flat plates
4. Evaluate the work done and efficiency of Pelton turbine, Francis turbine and Kaplan turbine & Performance Characteristic Curves
5. Evaluate the work done and efficiency of centrifugal pumps & evaluate the load factor, utilization factor, capacity factor and hydropower potential of Hydropower plants.

UNIT I

Open Channel Flow – I (Uniform Flow): Flow Comparison between open channel flow and pipe flow, geometrical parameters of a channel, classification of open channels, classification of open channel flow, Velocity Distribution of channel section. Characteristics of uniform flow, Computation of Uniform flow, Chezy's formula, Manning's and Bazin's formula. Factors affecting Manning's Roughness Coefficient 'n'. Most economical Rectangular, Trapezoidal and Circular Channel sections. Computation of Uniform flow, Normal depth.

Critical Flow: Specific energy, Specific energy curve; Critical, Subcritical and Supercritical Flows; Critical flow in rectangular channel, Specific force curve.

UNIT II

Open Channel Flow -II (Gradually Varied and Rapidly Varied Flow): Channel Transitions. Measurement of Discharge and Velocity – Venturi Flume, Parshall Flume, Measurement of Velocity- Current meter, Floats, Hot wire. Gradually Varied Flow-Dynamic Equation of Gradually Varied Flow, Classification of channel bottom slopes, Classification of surface profile, Characteristics of surface profile, Computation of water surface profile, Direct Step method.

Rapidly Varied Flow: Theory of hydraulic jump, Elements and characteristics of hydraulic jump in a rectangular Channel, length and height of jump, location of jump, jump types, applications of hydraulic jump. Energy dissipation and other uses, Positive and Negative Surges (Theory only).

UNIT III

Dimensional Analysis and Hydraulic Similitude: Dimensional homogeneity, Rayleigh method, Buckingham's π Method. Application of dimensional analysis and model studies to fluid flow problems, Dimensionless groups, Similitude-Three types of similarities: Geometric similarity, Kinematic similarity and Dynamic similarity – Force Ratios – Dimensionless Numbers

– Definitions of Reynolds Number, Froude Number, Mach Number, Weber Number and Euler Number – Model laws -Undistorted and Distorted models.

Basics of Turbo Machinery: Hydrodynamic force of jets on stationary and moving flat, inclined

and curved vanes, jet striking centrally and at tip of the vane, Velocity triangles at inlet and outlet, expressions for work done and efficiency.

UNIT IV

Hydraulic Turbines-I: Layout of a typical Hydropower installation Heads and Efficiencies classification of turbines-Pelton wheel, Francis turbine, Kaplan turbine-working, working proportions, velocity diagram, work done and efficiency, hydraulic design, Draft Tube Theory – different types - functions and efficiency. Angular momentum principle, Applications to radial flow turbines.

Hydraulic Turbines - II: Governing of Turbines, Surge Tanks, Unit Speed, Unit Discharge, Unit Power, Specific Speed, Performance Characteristic Curves, Model testing of turbines, Cavitation and Selection of Turbines.

UNIT V

Centrifugal Pumps: Pump installation details-classification-work done- Manometric head minimum starting speed- Losses and efficiencies-specific speed- Multistage pumps-pumps in parallel- Performance of pumps- Performance characteristic curves- NPSH-Cavitations - Reciprocating pumps- Single Acting and Double Acting -Working- Discharge- Slip- Indicator Diagrams.

Hydropower Engineering: Classification of Hydropower plants Definition of terms Load factor, utilization factor, capacity factor, estimation of hydropower potential.

Text Books:

1. Fluid Mechanics and Hydraulic Machines, K. Subramanya, Tata McGraw Hill,2nd edition, 2018.
2. K. Subramanya, Flow in Open Channel, Tata McGraw Hill, 5th edition, 2019
3. Modi & Seth, Hydraulics and Fluid Mechanics including Hydraulics Machines, Standard Book House, 22nd edition, 2018.

Reference Books:

1. Dr. R.K. Bansal, A text of Fluid mechanics and Hydraulic Machines, Laxmi Publications (P) ltd., New Delhi, 10th Edition, 2019.
2. J.F.Douglas, J.M.Gaserek and J.A.Swaffirld, FluidMechanics, Prentice Hall, 5th edition, 2005.
2. Frank.M. White, Fluid Mechanics, Tata Mc. Graw Hill Pvt. Ltd, 4th Edition, 2013.
3. A.K. Mohanty, Fluid Mehanics, Prentice Hall ofIndia Pvt. Ltd., New Delhi, 2nd edition,1994.
4. Open Channel Hydraulics, VenTe Chow, Tata McGraw Hill,2009.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
ENGINEERING GEOLOGY LAB

Course Code:GR24A2014
L/T/P/C: 0/0/4/2
II Year II Semester
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Course Outcomes:
1. Identify various minerals and their properties.
2. Identify various rocks and their properties.
3. Recognize various rocks and minerals used in the industries.
4. Interpret various sections of geological maps showing structures like faults, folds and Unconformities etc.
5. Resolve simple structural Geology problems.

Exercises:
1. Study of physical properties and identification of minerals referred under theory.
2. Megascopic description and identification of rocks referred under theory.
3. Study of Geological map of India.
4. Interpretation and drawing of sections for geological maps showing tilted beds, folds, faults and unconformities
5. Simple Structural Geology problems.

Lab Examination Pattern:
1. Description and identification of six minerals.
2. Description and identification of six rocks (including Igneous, Sedimentary and Metamorphic Rocks).
3. Interpretation of a Geological map along with a geological section.
4. Simple strike and Dip problems.

Reference Books:
1. N. Chennkesavulu, Mc-Millan, Text book of Engineering Geology, India Ltd.,2nd edition, 2013.
2. P. C. Varghes, Engineering Geology for Civil Engineers, PHI learning, New Delhi,2012.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
COMPUTER AIDED DESIGN LAB
Course Code: GR24A2021
L/T/P/C:0/0/4/2
II Year II Semester

Prerequisite: Engineering Graphics

Course Outcomes:
1. Comprehend the fundamentals of building drawings and understand CAD software for drafting.
2. Draw conventional symbols in constructions and brick bonds by CAD.
3. Draft the building components detailing and sectional view of doors, windows, and trusses.
4. Develop geometric plan, section and elevation for single and multi- storeyed buildings with suitable scale and dimensions.
5. Create drawings for developing the layout of electrical and plumbing connections in building.

LIST OF EXPERIMENTS
1. Basic principles of Vastu in building planning.
2. Planning Aspects of Building systems as per National Building Code (NBC).
3. Materials, Plumbing and Electrical Symbols used in Building Construction.
4. Bonds in brick masonry
5. Detailing of Building Components
a. Doors
b. Windows
c. Ventilator
d. Stairs
e. Lintel Cum Sunshade
6. Drawing of different industrial trusses.
7. Drawing Plan, Section and Elevation of Building.
a. Single room with R.C.C flat roof.
b. A Residential building with single bedroom.
c. R.C.C framed structure with R.C.C roof slab.
d. Library building with R.C.C flat roof.
e. Planning of fully tiled gabled house (Pitched Roof).
f. Workshop building with north light roof truss.
8. Drawing Plan, Section and Elevation of Multi-Storeyed Building
9. Development of working drawing of building –Electrical Layout.
10. Development of working drawing of building – Plumbing Layout.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
FLUID MECHANICS AND HYDRAULIC MACHINERY LAB

Course Code: GR24A2022
L/T/P/C:0/0/4/2
II Year II Semester

Prerequisite: Fluid Mechanics and Hydraulic Engineering

Course Outcomes:

1. Predict the discharge through venturi meter and orifice meter.
2. Estimatethe coefficients of impact of jets.
3. Predict the velocitydistribution in pipe flows.
4. Computethe major and minor losses in pipe flow.
5. Evaluate the efficiency of Hydraulic machines.

List of Experiments

1. Calibration of Venturi meter
2. Calibration of Orifice meter
3. Calibration of Rectangular notch
4. Calibration of Triangular Notch
5. Major losses in pipe flows
6. Minor losses in pipe (Hydraulic losses due to sudden enlargement of pipe)
7. Minor losses in pipe (Hydraulic losses due to sudden contraction of pipe)
8. Verification of Bernoulli's Theorem
9. Reynolds's experiment on Laminar Flow and Turbulent flow through pipes
10. Impacts of jets on vanes
11. Pelton wheel turbine
12. Multi stage centrifugal pump
13. Hydraulic Jump

Text Books

1. Modi & Seth, Hydraulic and Fluid mechanics, Standard Book House, 22nd edition, 2018.
2. S.K.Som & G.Biswas, Introduction to Fluid Machines, Tata Mc.Graw Hill publishers, Pvt. Ltd.,3rd Edition, 2017.
3. Edward J. Shaughnessy, M. Katz and James P. Schaffer, Introduction to Fluid Machines, Oxford University Press, New Delhi, 1st Edition, 2005.

Reference Books

1. Frank.M. White, Fluid Mechanics, Tata Mc. Graw Hill Pvt. Ltd, 4th Edition, 2013.
2. Dr. R.K. Bansal, A text of Fluid mechanics and hydraulic machines, Laxmi Publications (P) ltd., New Delhi, 10th Edition, 2019.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

ENVIRONMENTAL SCIENCE

Course Code:GR24A2001
L/T/P/C: 2/0/0/0

II Year II Semester

Pre-Requisites: Basic knowledge of environmental issues

Course Outcomes:

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

III YEAR
I SEMESTER

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
GEOTECHNICAL ENGINEERING

Course Code: GR24A3001 **L/T/P/C: 2/0/0/2**
III Year I Semester

Prerequisites: Engineering Geology

Course Outcomes:

1. Identify basic Engineering properties of soil and classify the soil.
2. Evaluate coefficient of permeability and effective stresses of soil.
3. Assess the mechanism of stress distribution and compaction in soils.
4. Analyse the behaviour of soil during consolidation process.
5. Evaluate the performance of shear strength of soil mass.

UNIT I

Introduction - Types of soils and their formation, Scope of soil mechanics, Basic definitions and relationships, Soil mass as two and three-phase system, Relative Density, Consistency limits, Consistency indices, Grain size analysis, Indian standard soil classification system and Plasticity chart.

UNIT II

Permeability of Soil – Capillary rise, Darcy's law, Determination of coefficient of permeability by constant-head method and falling-head method. Field methods by pumping-out test. Permeability of stratified soils and factors affecting permeability of soil.

Seepage Analysis – Characteristics and uses of flow nets, Total stress, neutral stress and effective stress, effect of water table in effective stress, quicksand condition.

UNIT III

Stresses in Soils – Introduction, Pressure bulb and Isobars, Boussinesq's equation for the vertical stress due to point load, line load, strip load, uniformly loaded circular area. Representation of stress along the vertical plane and horizontal plane. Westergaard's equation, Theory of Newmark's Influence Chart. Appropriate stress distribution methods - equivalent point load method and two to one method.

Compaction of Soil – Mechanism of compaction, laboratory tests, factors affecting compaction, effects of compaction on soil properties, Field compaction and quality control.

UNIT IV

Consolidation of Soil – Stress history of clay, primary consolidation and secondary consolidation settlement, Terzaghi's theory of consolidation, interpretation of consolidation test results, determination of pre-consolidation pressure.

UNIT V

Shear Strength - Mohr circle and its characteristics, Mohr-Coulomb theory. Types of laboratory shear tests – direct shear test, tri-axial compression test, unconfined compression test and vane shear test. Shear strength of clays and sands.

Text Books

1. Gopal Ranjan and ASR Rao, Basic and Applied Soil Mechanics, New Age International Pvt. Ltd, New Delhi, 3rd edition (2016).

2. K.R. Arora, Soil Mechanics and Foundation Engineering, Standard Publishers Distributors, Delhi, 5th edition (2000), Reprint (2020).

3. C. Venkataramiah, Geotechnical Engineering, New age international publishers (2002),5th edition (2017).

Reference Books

1. B.C. Punmia, Ashok Kumar Jain and Arun Kumar Jain, Soil Mechanics and Foundations, Laxmi publications Pvt. Ltd., New Delhi, 16th edition, Reprint (2017).
2. Dr. P. Purushotham Raj, Soil Mechanics and Foundation Engineering, Pearson Education India (2008).
3. S. K. Gulhati & Manoj Datta, Geotechnical Engineering, Mc. Graw Hill Education Pvt Ltd., New Delhi (2005), Reprint (2017).
4. Braja M. Das, Advanced Soil Mechanics, Taylor and Francis, 4 th edition (2013).
5. Soil Mechanics by Craig R.F., Chapman & Hall, 8th edition 2012, CRC Press.
6. Soil Mechanics in Engineering Practice by Karl Terzaghi, Ralph B. Peck, and Gholamreza Mesri- Wiley Inter science, 3rd edition- 1996.
7. Geotechnical Engineering: Principles and Practices of Soil Mechanics and Foundation Engineering (Civil and Environmental Engineering) by V. N. S. Murthy, Publishers: Marcel Dekker, 2010.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
CONCRETE TECHNOLOGY

Course Code: GR24A3002 **L/T/P/C: 2/0/0/2**

III Year I Semester
Prerequisites: Building Materials and Construction Planning

Course Outcomes:

1. Evaluate the physical and chemical properties of concrete ingredients and able to conduct tests on cement.
2. Identify the physical and chemical properties of aggregates and able to conduct tests on aggregates.
3. Assess the behaviour of fresh & hardened concrete.
4. Demonstrate different tests on hardened concrete and estimate the creep and shrinkage of concrete.
5. Evaluate the mix proportions for the specific work for required strength and workability with available materials at workplace and discuss the applications of the special concretes.

UNIT I

Cements & Admixtures: Portland cement – Chemical composition – Hydration, setting of cement – Structure of hydrated cement – Tests on physical properties – Different grades of cement – Admixtures – Mineral and chemical admixtures.

UNIT II

Aggregates: Classification of aggregate – Particle shape & texture – Bond, strength & other mechanical properties of aggregate – Specific gravity, bulk density, porosity, adsorption & moisture content of aggregate – Bulking of sand – Deleterious substance in aggregate – Soundness of aggregate – Alkali aggregate reaction – Thermal properties – Sieve analysis – Fineness modulus – Grading curves – Grading of fine & coarse Aggregates – Gap graded aggregate – Maximum size of aggregate.

UNIT III

Fresh Concrete: Manufacturing of concrete, mixing, compaction curing, Properties of fresh concrete. Workability – Factors affecting workability – Measurement of workability–Setting times of concrete – Effect of time and temperature on workability – Segregation & bleeding. Hardened Concrete: Water / Cement ratio – Abram's Law – Gel Space ratio – Nature of strength of concrete – Maturity concept – Strength in tension & compression – Factors affecting strength – Relation between compression & tensile strength -Durability of Concrete.

UNIT IV

Testing of Hardened Concrete: Compression tests – Tension tests – Factors affecting strength – Flexure tests – Splitting tests – Non-destructive testing methods – Codal provisions for NDT – Quality control of Concrete. Elasticity, Creep & Shrinkage: Modulus of elasticity – Dynamic modulus of elasticity – Poisson's ratio – Creep of concrete – Factors influencing creep – Relation between creep & time – Nature of creep – Effects of creep – Shrinkage – Types of shrinkage.

UNIT V

Concrete Mix Design: Factors in the choice of mix proportions – Acceptance criteria – Proportioning of concrete mixes by BIS method of mix design. Special concretes: Lightweight aggregate concrete – Cellular concrete– No-fines concrete – High density concrete – Fibre Reinforced concrete – Different types of fibres– Factors affecting properties & Applications of F.R.C – Polymer concrete – Types of Polymer concrete – Properties of polymer concrete & Applications – High performance concrete – Self-consolidating concrete – SIFCON – Geopolymer Concrete.

Text Books:

1. Concrete Technology: Theory and Practice, M. S. Shetty and A. K. Jain, S Chand Co., Publishers 2018.

2. Concrete Technology by M.L. Gambhir – Tata Mc. Graw Hill Publishers, 5th edition 2017 New Delhi.

3. Concrete: Microstructure, Properties, and Materials, P. Kumar Mehta, Paulo J. M. Monteiro, McGraw Hill Professional, 2013.

Reference Books:

1. Properties of Concrete, AM Nevelli, Prentice Hall Publishers, 2012, 5th edition.
2. Concrete Technology and Good Construction Practices by Y P Gupta, New Age International Private Ltd. 1st edition 2013.
3. Concrete Technology by A.R. Santha Kumar, Oxford University Press, NewDelhi-2006.
4. Concrete: Microstructure, Properties and materials by P Kumar Mehta, P J M Monteiro, MC Graw Hill Education Publisher, New Delhi- 4th edition-2017.
5. Concrete Mix Design by A. P. Remideos, Himalaya Publishing House 2015. Concrete Technology by S.S Bhavikatti, I K International Publishing House 2015. IS CODES: 1. 2. 3. IS 10262: 2019,
6. Concrete Mix Proportioning- Guidelines (Second Revision). IS 383: 2016 Coarse and Fine Aggregate for Concrete – Specification IS 516: Method of Tests for Strength of Concrete.

List of Codes:

1. IS 10262: 2019, Concrete Mix Proportioning- Guidelines (Second Revision).
2. IS 383: 2016 Coarse and Fine Aggregate for Concrete – Specification
3. IS 516: Method of Tests for Strength of Concrete.

HYDROLOGY AND WATER RESOURCES ENGINEERING

Course **Code:GR24A3003**
L/T/P/C:3/0/0/3
III Year I Semester

Pre-Requisites: Introduction to Fluid Mechanics

Course Outcomes:

1. Analyze runoff processes, identify factors influencing runoff in catchments, and apply empirical and rational formulae for runoff estimation.

2. Design a model in a region for direct run off hydrograph, unit hydrograph, S-Curve hydrograph, and Synthetic unit hydrograph.

3. Compute the discharge of radial flow to wells in a region of confined and unconfined aquifers by determining the aquifer parameters.

4. Identify a suitable irrigation method depending on soil, water and plant conditions on the field.

5. Design irrigation canals and evaluate the forces acting on gravity dam.

UNIT I

Introduction to Engineering Hydrology and its applications: Hydrologic Cycle, types and forms of precipitation, rainfall measurement, types of Rain gauges, computation of average rainfall over a basin, processing of rainfall data- adjustment of record-Rainfall Double Mass Curve. Runoff-Factors affecting Runoff over a Catchment-Empirical and Rational Formulae. Abstraction from rainfall: Evaporation, factors effecting Evaporation, Measurement of evaporation– Evapotranspiration-Penman and Blaney & Criddle Methods -Infiltration, factors affecting infiltration, measurement of infiltration, infiltration indices.

UNIT II

Distribution of Runoff: Hydrograph Analysis; Flood Hydrograph – Effective Rainfall - Base Flow- Base Flow Separation - Direct Runoff Hydrograph– Unit Hydrograph, definition and limitations of application of Unit hydrograph, Derivation of Unit Hydrograph from Direct Runoff Hydrograph and vice versa S- Curve hydrograph, Synthetic Unit Hydrograph

UNIT III

Ground water Occurrence: Types of aquifers, aquifer parameters,' porosity' Specific yield, permeability, transmissivity and storage coefficient, Darcy's law, radial flow to wells in confined and unconfined aquifers, Types of wells, Well Construction - Well Development.

UNIT IV

Necessity and importance of irrigation: Advantages and ill-effects of irrigation, Types of irrigation, Methods of application of irrigation water, Indian Agriculture soils, Methods of improving soil fertility-Crop rotation, preparation land for irrigation, Standards of quality for irrigation water.

Soil-water-plant relationship: Vertical distribution of soil moisture, soil moisture constants, soil moisture tension, consumptive use, Duty and delta, factors Affecting duty- design discharge for a water course. The depth and frequency of Irrigation, Irrigation efficiencies- Water Logging.

UNIT V

Classification of canals: Design of Irrigation canals by Kennedy's and Lacey's theories, balancing depth of cutting, IS standards for canal design canal lining.

Design discharge over a catchment: computation of design discharge–Rational formula, SCS curve number method, flood frequency analysis introductory part only. Stream gauging-measurement and estimation of stream flow.

Dams: Types of Reservoirs, Dams and Spillways. Stability Analysis on Gravity Dams and Earthen Dams.

Text Books

1. A Text book of Hydrology by P. Jaya Rami Reddy,3rd Edition, Laxmi publications,2016.

2. Engineering Hydrology by K. Subramanya, Fourth Edition, McGraw HillEducation,2017.

3. Irrigation and Water Power Engineering- B.C. Punmia, Pande B.B. Lal, Ashok Kumar Jain, Arun Kumar Jain-Laxmi Publications, 17th edition- 2021.

Reference Books

1. Irrigation Engineering & Hydraulic Structures- Santosh Kumar Garg first edition 2006.

2. Elementary Hydrology by V.P. Singh, PHI publications, Fascimile edition-1991

3. Irrigation and Water Resources &Water Power by P. N. Modi, Standard Book House, 11th edition 2019.

4. Irrigation Water Management by D.K. Majumdar, Prentice Hall of India., 2nd edition-2013.

5. Applied Hydrology by Ven Te Chow, David R Maidment, Larry W Mays, Tata Mc Graw Hill Education, first edition 2017.

6. Introduction to Hydrology by Warren Viessman, Jr. Garyl Lewis- Pearson, 5th edition2003.

Groundwater Hydrology– David K. Todd and Larry W. Mays Wiley.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
DESIGN OF REINFORCED CONCRETE STRUCTURES

Course Code: GR24A3004 **L/T/P/C: 2/1/0/3**
III Year I Semester

Prerequisite: Solid Mechanics, Structural Analysis, Building Materials and Construction Planning.

Course Outcomes:

1. Design singly and doubly reinforced concrete beams applying limit state approaches using IS-456-2000.
2. Design and detail flanged beams for bending, shear, torsion, and bond failures, calculate development lengths, and provide proper detailing for simply supported and continuous beams following IS standards.
3. Design one-way, two-way slabs and flat slabs, staircases, and canopies with appropriate reinforcement layouts following IS code guidelines.
4. Design short and long columns under various bending conditions accurately, utilizing IS design charts and code guidelines.
5. Design footings for walls and columns that satisfy serviceability criteria in accordance with IS standards.

UNIT I

Concepts of R.C Design: Study of the strength and behavior of indeterminate reinforced concrete structures. Loads, stresses, and load combinations. Working stress method and limit state approach as per IS-456-2000. Analysis and design of singly and doubly reinforced rectangular beams.

UNIT II

Analysis and Design of Beams: Analysis and design of singly and doubly reinforced Flanged sections using limit state method. Design for shear, torsion and bond using limit state concept. Mechanism of shear and bond failure. Development length of bars; I.S. code provisions design examples in simply supported and continuous beams with detailing.

UNIT III

Design of Slabs: Design of one-way slab and two-way slab using I S coefficients. Placement of reinforcement in slabs. Design of flat slab (direct method). Design of Staircase and Canopy (Portico) with detailing.

UNIT IV

Design of Columns: Design of Short columns, columns with uni-axial and bi-axial bending. Design of long columns with detailing, use of design charts - IS code provisions.

UNIT V

Design of Foundation: Design of wall footing, isolated and combined footing for columns with detailing. Limit state design of serviceability for deflection, cracking and codal provisions.

Text Books

1. Limit State design of Reinforced Concrete by B.C.Punmia, Ashok Kumar Jain and Arun Kumar Jai, Laxmi publication Pvt. Ltd., New Delhi, 2016. Revised edition

2. Limit State Design of Reinforced Concrete by P.C. Varghese, 2nd Edition, PHI, New Delhi, 2011

3. Fundamentals of reinforced concrete design by M.L.Gambhir, Prentice Hall of India Private Ltd.,2010, New Delhi. 1st Edition,

Reference Books

1. Reinforced concrete structural elements-behavior, analysis and design by Purushotam, Tata Mc. Graw Hill, New Delhi, 1984.

2. Design of Reinforced Concrete Structures by N.Subramaniyan. Oxford University Press.

3. Reinforced Concrete Design by S. Unnikrishna Pillai & Devdas Menon, 3rd Edition, TMH, New Delhi, 2009.

4. Reinforced Concrete Design by N. Krishna Raju and R.N. Pranesh, 8th Edition, New Age International, New Delhi, 2004.

5. Design of Reinforced Concrete Structures by I. C. Syal and A. K. Goel, S. Chand & company.

6. Reinforced Concrete by H J Shah. Charotar Publishing House Pvt. Limited. 12th Edition.

7. Design of concrete structures by J.N. Bandhyopadhyay PHI Learning Private Limited.

List of Codes

1. IS 456-2000; Indian Standard Code of Practice for Plain and Reinforced Concrete.

2. SP 16: Design Aids for Reinforced Concrete

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
STRUCTURAL ANALYSIS-II
(PROFESSIONAL ELECTIVE - I)

Course Code:GR24A3005 **L/T/P/C: 3/0/0/3**
III Year I Semester

Pre-requisites: Solid Mechanics I, Solid Mechanics II, Structural Analysis -I

Course Outcomes:
1. Analyze various types of continuous beams, frames with and without sway using Moment distribution methods.

2. Analyze various types of continuous beams and building frames using Kani's methods of Analysis.

3. Evaluate the shear forces, bending moments and axial forces in beams, columns and at joints of multistorey frames using approximate methods of analysis.

4. Analyze the simple beams and frames using stiffness matrix and flexibility matrix methods of analysis.

5. Apply the principles of virtual work to estimate the collapse load and plastic moment carrying capacity of simple beams and frames.

UNIT I

Moment Distribution Method of analysis- application to continuous beams with and without sinking of supports-Determination of static and kinematic indeterminacies for frames- Analysis of Single Bay, Single storey Portal Frames without and with sway- frames with inclined legs - Shear force and bending moment diagrams and Elastic curve.

UNIT II

Kani's Method of analysis- application to continuous beams with and without sinking of supports- Analysis of Single Bay, Single storey Portal Frames without and with sway - Analysis of Single Bay, two storey Portal Frames without and with sway - Shear force and bending moment diagrams and Elastic curve.

UNIT III

Approximate method of Analysis: Frames with vertical loads using Substitute frame method - Frames with horizontal loads using Portal and Cantilever methods.

UNIT IV

Matrix method of analysis: Static and Kinematic indeterminacies- different approaches to matrix methods- analysis using stiffness matrix methods for beams and frames (3 DOF) and flexibility matrix methods for beams and frames (2 DOF).

UNIT V

Plastic analysis: Concepts - Plastic hinges- mechanism- Shape factors- upper and lower bound theorems- Plastic analysis for simple beam and simple portal frames (without and with sway).

Text Books

1. Theory of structures - B.C. Punmia, Jain, Ashok Kumar Jain &Arun Kumar Jain, Laxmi publications, 13th edition-2017.

2. Indeterminate Structural Analysis - K.U. Muthu, H. Narendra, Maganti Janardhana, M. Vijayanand – I K International Publishing House Pvt. Ltd., 2014.

3. Structural Analysis 1 and II by S S Bhavikatti, Vikas Publishing House,5th edition, 2021.

Reference Books

1. Advanced Structural Analysis - Devdas Menon, Narosa Publishing House Pvt Ltd, Edition 2019.

2. Analysis of structures-T.S.Thandava Moorthy, Oxford University Press, 2005.

3. Structural Analysis –Devdas Menon -Alpha Science International Ltd., 2nd edition, 2017.

4. Advanced Structural Analysis - Devdas Menon - Narosa Publishers, 2009.

5. Wang C.K., “Indeterminate Structural Analysis”, Tata McGraw Hill Education Pvt. Ltd., NewDelhi, 2010.

6. William Weaver Jr. & James M. Gere, "Matrix Analysis of Framed Structures", CBS Publishers and Distributors, Delhi, 2004.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
TRAFFIC ENGINEERING AND MANAGEMENT
(PROFESSIONAL ELECTIVE - I)

Course Code:GR24A3006 **L/T/P/C: 3/0/0/3**

III Year I Semester

Pre-Requisites: Surveying & Geomatics

Course Outcomes: On completion of the course, the students will be able to:

1. Solve traffic problems and evaluate its characteristics
2. Plan various traffic surveys and demonstrate the solutions
3. Show traffic regulation and control measures at intersection
4. Illustrate basic traffic signal phasing and timing plan
5. Demonstrate Traffic management Systems

UNIT I

Traffic Planning and Characteristics- Road Characteristics – Road user characteristics – PIEV theory – Vehicle – Performance characteristics – Fundamentals of Traffic Flow. Characteristics of Vehicles and Road Users, Skid Resistance and Braking Efficiency (Problems), Components of Traffic Engineering- Road, Traffic and Land Use Characteristics.

UNIT II

Traffic Surveys and Analysis - Traffic Surveys - Speed, journey time and delay surveys - Vehicles Volume Survey-Methods and interpretation- Origin Destination Survey-Methods and presentation -Parking Survey- Accident analyses- Methods, interpretation and presentation - Statistical applications in traffic studies and traffic forecasting- Level of service-Concept, applications and significance.

UNIT III

Intersections - Conflicts at Intersections, Classification of Intersections at Grade, - Channelised and Unchanellised Intersection - Grade Separated Intersections-Concept and layout, Principles of Intersection Design, Elements of Intersection Design, Rotary Intersection, and elements.

UNIT IV

Traffic Control

Traffic signs- Road markings - Traffic signal design using Websters method and IRC method - Traffic control aids and Street furniture, Street Lighting, Computer applications in Signal design

UNIT V

Traffic Management

Traffic Management- Traffic System Management (TSM) and Travel Demand Management (TDM), Traffic Forecasting techniques, Restrictions on turning movements, One-way Streets, Traffic Segregation, Traffic Calming, Tidal flow operations, Exclusive Bus Lanes - Introduction to Intelligence Transport System (ITS)

Text Books

1. Khanna, S.K, Justo, A and Veeraragavan, A, 'Highway Engineering', Nem Chand & Bros. Revised 11th Edition, 2020

2. Kadiyali L.R. and Lal N B, Principles and Practices of Highway Engineering; Seventh Edition, First Reprint; Khanna Publishers, New Delhi, 7th edition 2023

3. Kadiyali L R, Traffic Engineering and Transport Planning, Khanna Technical Publications, Delhi, 9th edition, 2024.

Reference Books

1. Subhash C. Saxena, A Course in Traffic Planning and Design, Dhanpat Rai Publications, New Delhi, 6th edition 2011.

2. Papacoastas, C. S. and Prevedouros, Transportation Engineering and Planning, Third Edition, Third Impression; Pearson Education, 2018.

3. Khisty C J and Lall B Kent; Transportation Engineering: An Introduction, Third Edition, 1st Indian Adaptation; Pearson India Education Service Pvt. Ltd, New Delhi 2016.

List of Codes

1. Indian Roads Congress (IRC) specifications: Guidelines and special publications on Traffic Planning and Management 2023.

2. Guidelines of Ministry of Road Transport and Highways, Government of India. 2020.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

SURFACE HYDROLOGY

(PROFESSIONAL ELECTIVE - I)

Course Code:GR24A3007 **L/T/P/C: 3/0/0/3**

III Year I Semester

Pre-Requisites: Hydrology and Water Resource Engineering

Course Outcomes:

1. Examine the different types of hydrology definitions.
2. Evaluate the consumptive use, infiltration, and evaporation.
3. Compute the runoff discharges in streams and rivers.
4. Illustrate the application of hydrographs by computing rainfall and run off.
5. Examine the flood estimation by various methods.

UNIT I

Introduction: Hydrology- definition, Surface and ground water hydrology, Hydrologic cycle- Precipitation, Evaporation, Infiltration, Rain-gauges, Mass rainfall curve, characteristics, Mean rainfall on a basin-Arithmetic, Theissen and Isohyetal Methods, Intensity-duration analysis, Intensity-frequency-duration analysis, depth-area- duration curves, estimation of missing rainfall data, consistency of rainfall records- double mass curves, rain-gauge network analysis.

UNIT II

Evaporation & Infiltration: Evaporation process, Factors affecting, estimation, measurement of Evaporation, Evaporation pans, Transpiration, Evapotranspiration, PET, Consumptive use Lysimeter, formulae for estimating PET. Infiltration process, factors affecting, measurement of infiltration, infiltrometers, infiltration capacity curve, Horton's Relation, Infiltration Indices.

UNIT III

Stream flow and Runoff: Measurement of stage, measurement of velocities-surface floats, velocity rods and current meter, measurement of discharge in a river, stage- discharge relation, extension of stage- discharge curves, selection of site for stream- discharge gauging.

Components of Runoff - factors affecting and estimation of runoff - basin yield - flow duration

UNIT IV

Hydrographs: Hydrograph-components, separation of hydrograph into base flow, and DRO methods, Unit Hydrograph-principles, derivation of UH of Isolated unit storms, UH for various durations, S-curve technique. Estimation of runoff from UH, limitations of UH theory, Synthetic UH, IUH.

UNIT V

Design Flood: Maximum flood and design flood, estimation of flood- different methods, flood frequency analysis- probability table, different plotting positions, Gumble's extreme value theory, Log Pearson type-III analysis, selection of design flood. Flood routing: Flood Routing through reservoirs- Puls method and modification plus method. Channel routing- Muskinghum method, derivation of routing equations, Goodrich method.

Flood Control: Flood control measures, flood control through reservoirs, channel improvements, Bank protection measures, Flood fighting, flood proofing, flood forecasting and flood warning.

Text Books

1. A Textbook of Hydrology, P. Jayaram Reddy,3rd edition,2011, Laxmi Publications, New Delhi 2021.
2. Engineering Hydrology, K Subramanya, 6th edition, Tata-Mc Graw Hill Publishing, New Delhi, 2024.
3. Hydrology, Madan Mohan Das, Mim Mohan Das, PHI Learning Private Ltd., New Delhi,2022.

Reference Books

1. Engineering Hydrology, EM Wilson, The Mac million press limited. 4th edition 2021.
2. Hydrology (Principles, Analysis, Design) | H. M. Raghunath | New Age; ISBN 13, 9789393159045; Publisher, New Age; Edition 4th; 2022
3. Introduction to Hydrology, W. Viessman Jr. & G L Lewis, Harper & Row Publications, 2nd edition 2021
4. Handbook of Applied Hydrology, Second Edition by VP Singh 2017.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
PAVEMENT MATERIALS
(PROFESSIONAL ELECTIVE - I)

Course Code:GR24A3008 **L/T/P/C: 3/0/0/3**
III Year I Semester

Prerequisites: Building Materials and Construction Planning, Concrete Technology

Course Outcomes:

1. Characterize the soil based on the geotechnical properties and justify the applicability.
2. Analyze the engineering properties of aggregates and customizing for application under various field situations
3. Characterize the binder based on the properties and justify the applicability.
4. Apply appropriate mix design in flexible pavement construction depending upon the traffic and climatic conditions.
5. Demonstrate the utility of Advanced and alternative pavement materials.

Unit I

Subgrade Soil Characterization: Different types of soils, Mechanical response of soil; Properties of subgrade layers; Suitable lab and field tests-, CBR, Sieve analysis, Field Density; Suitability of different type of soil for the construction of highway embankments and pavement layers Field compaction and control.

Unit II

Aggregate Characterization: Origin, Classification, Types of aggregates; Sampling of aggregates; Mechanical and shape properties of aggregates, Aggregate texture and skid resistance, polishing of aggregates; Proportioning and Blending of aggregates: Super pave gradation; Use of locally available materials in lieu of aggregates.

Unit III

Binder Characterization: Bitumen- Origin, preparation, properties and tests, constitution of bituminous road binders; requirements; Criterion for selection of different binders. Cement - Production of cement; Types of cements and basic cement; Physical and chemical properties of cement, Special cements; Quality tests on cement.

Unit IV

Bituminous Mixes: Mechanical properties: Resilient modulus, dynamic modulus and fatigue characteristics of bituminous mixes. Weathering and Durability of Bituminous Materials and Mixes, bituminous mix design methods and Specifications. Performance based Bitumen Specifications; Introduction to Superpave mix design.

Unit V

Advanced Paving Materials: Recycled aggregates, geosynthetics, industrial waste characterization, recycled and waste materials (green materials), Recycled Asphalt Pavement (RAP) material. Bituminous emulsion and Cutbacks, Crum rubber, and rubber modified bitumen and anti-Stripping agents on pavement performance. Pozzolanic and geopolymer materials as alternate cement.

Text Books

1. Highway Engineering - S.K. Khanna & C.E.G. Justo, Nemchand & Bros.; 10th Editon, 2023

2. Highway Materials testing– S.K. Khanna & C.E.G. Justo. Nem Chand & Brothers;5th Edition, 2022

3. Concrete Technology by M.S.Shetty. – S.Chand & Co. ; 8th Edition, 2021.

Reference Books

1. Principles of Pavement Design – E. J. Yoder, M. W. Witczak; 2nd Edition, 1991.

2. Relevant IRC codes and MoRTH specifications.

3. Atkins, N. Harold, Highway Materials, Soils and Concretes, Fourth Edition, 2002, Prentice-Hall. 4th Edition, 2002

4. Das, A. And Chakroborty, P. Principles of Transportation Engineering, 2nd Edition, PHI Publication, 2017.

5. Soil Mechanics and Foundation Engineering- K.R. Arora, Standard Publishers Distributors, Delhi; 7th Edition, 2022.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

GEOTECHNICAL ENGINEERING LAB

Course Code:GR24A3011 **L/T/P/C: 0/0/3/1.5**

III Year I Semester

Pre- Requisites: Geotechnical Engineering, Foundation Engineering

Course Outcomes:

1. Identify the soil behaviour and its mechanism.
2. Interpret basic properties of soil in simple and complex applications.
3. Develop a proficiency in handling experimental data.
4. Excel in experiment research and to succeed with real time project.
5. Propose the extensive research in experimental methods and geotechnical designs.

List of experiments:

Task1: Liquid limit and plastic limit

Task2: Grain size distribution by sieve analysis

Task3: Field density by core cutter method

Task4: Field density by sand replacement method

Task5: Relative density of sands

Task6: Standard and modified compaction test

Task7: Permeability of soil by constant and variable head test

Task8: California Bearing Ratio Test

Task9: Consolidation test
Task10: Unconfined compression test
Task11: Direct shear test
Task12: Vane shear test
Task13: Tri-axial test (Demonstration)

Reference Books

1. K.R. Arora, Soil Mechanics and Foundation Engineering, Standard Publishers Distributors, Delhi, 5 th edition (2000), Reprint (2009).
2. C. Venkataramiah, Geotechnical Engineering, New age international publishers (2002),6th edition (2018).
3. Punmia B. C., "Soil Mechanics and Foundations" Standard Book House, Delhi.
4. Murthy, V. N.S., "Principles of Soil Mechanics and Foundation Engineering" CBS Publisher distributors Pvt. Ltd. Delhi.
5. Alam Singh, "Soil Engineering in Theory and Practice" Vol 1: Fundamentals & General Principles, Vol 2: Geotechnical Testing & Instrumentation.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
CONCRETE TECHNOLOGY LAB

Course Code: GR24A3012 **L/T/P/C: 0/0/3/1.5**

III Year I Semester
Pre-Requisites: Concrete Technology
Course Outcomes:

1. Identify the suitable materials used for concrete for particular purpose
2. Interpret the quality control of Cement and concrete
3. Identify, describe and carry out the main laboratory tests relevant to the use ofconcrete on site
4. Design normal concrete mixes.
5. Interpret the properties in tern to design or invent the new materials

List of Experiments:

1. Normal Consistency test on cement
2. Initial Setting time and final setting time of cement
3. Fineness test of cement
4. Specific gravity of cement

5. Soundness test on cement

6. Compressive strength of cement

7. Sieve analysis of coarse and fine aggregate

8. Bulking of sand (Field test & Laboratory Test)

9. Workability test on concrete using slump Cone

10. Workability test on concrete by compaction factor test

11. Workability test on concrete by Vee-Bee Test

12. Compressive strength of concrete

13. Split tensile strength test on concrete

14. Non-Destructive Test on concrete (Rebound hammer and Ultrasonic Pulse Velocity Test Demonstration)

Reference Books

1. Concrete Technology Theory and Practice, Shetty M.S, S. CHAND, 8th edition,2019.

2. Concrete Technology: Theory and Practice Gambhir Murari Lal, Mcgraw Hill,fifth edition., 2013.

List of Codes

1. IS 269:2013 – Ordinary Portland cement, 33 grade- Specification (Fifth Revision)

2. IS 383:2016 – coarse and fine aggregates for concrete- Specification (Third Revision)

3. IS 10262 :2019, Concrete Mix Proportioning- Guidelines (Second Revision)

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

ADVANCED ENGLISH COMMUNICATION SKILLS LAB

Course Code: GR24A3013 **L/T/P/C: 0/0/2/1**

III Year I Semester

Course Outcomes:

Students will be able to

1. Demonstrate effective listening and reading strategies to comprehend, analyze, and evaluate texts.
2. Produce well-structured written documents for academic, professional, and digital platforms.
3. Deliver effective oral presentations using appropriate language, structure, and non-verbal cues.
4. Participate confidently in group discussions using logical reasoning, fluency, and teamwork.
5. Apply interview strategies to perform successfully in face-to-face and virtual interviews.

1. Syllabus:

The following course content to conduct the activities is prescribed for the Advanced English Communication Skills (AECS) Lab:

1. **Activities on Listening and Reading Comprehension:** Active Listening – Development of Listening Skills Through Audio clips - Benefits of Reading – Methods and Techniques of Reading – Basic Steps to Effective Reading – Common Obstacles – Discourse Markers or Linkers - Sub- skills of reading - Reading for facts, negative facts and Specific Details- Guessing Meanings from Context, Inferring Meaning - Critical Reading — Reading Comprehension – Exercises for Practice.

2. **Activities on Writing Skills**: Vocabulary for Competitive Examinations - Planning for Writing — Improving Writing Skills - Structure and presentation of different types of writing – Free Writing and Structured Writing - Letter Writing –Writing a Letter of Application –Resume vs. Curriculum Vitae – Writing a Résumé – Styles of Résumé - e-Correspondence – Emails – Blog Writing - (N)etiquette– Report Writing – Importance of Reports – Types and Formats of Reports– Technical Report Writing– Exercises for Practice.

3. **Activities on Presentation Skills -** Starting a conversation – responding appropriately and relevantly – using the right language and body language – Role Play in different situations including Seeking Clarification, Making a Request, Asking for and Refusing Permission, Participating in a Small Talk – Oral presentations (individual and group) through JAM sessions- PPTs – Importance of Presentation Skills – Planning,

Preparing, Rehearsing and Making a Presentation – Dealing with Glossophobia or Stage Fear — Understanding Nuances of Delivery - Presentations through Posters/Projects/Reports – Checklist for Making a Presentation and Rubrics of Evaluation.

4. **Activities on Group Discussion (GD):** Types of GD and GD as a part of a Selection Procedure - Dynamics of Group Discussion- Myths of GD - Intervention, Summarizing - Modulation of Voice, Body Language, Relevance, Fluency and Organization of Ideas – Do's and Don'ts - GD Strategies — Exercises for Practice.

5. **Interview Skills**: Concept and Process - Interview Preparation Techniques - Types of Interview Questions – Pre-interview Planning, Opening Strategies, Answering Strategies - Interview Through Tele-conference & Video-conference - Mock Interviews.

2. Minimum Requirement:

The Advanced English Communication Skills (AECS) Laboratory shall have the following infrastructural facilities to accommodate at least 35 students in the lab:

- Spacious room with appropriate acoustics
- Round Tables with movable chairs
- Audio-visual aids
- LCD Projector
- Public Address system
- One PC with latest configuration for the teacher
- T. V, a digital stereo & Camcorder
- Headphones of High quality

3. Suggested Software: The software consisting of the prescribed topics elaborated above should be procured and used.

- **TOEFL & GRE** (KAPLAN, AARCO & BARRONS, USA, Cracking GRE by CLIFFS)
- **Oxford Advanced Learner's Dictionary**, 10th Edition
- **Cambridge Advanced Learner's Dictionary**
- **DELTA's key to the Next Generation TOEFL Test: Advanced Skill Practice.**
- **Lingua TOEFL CBT Insider**, by Dreamtech

4. Books Recommended:

1. Rizvi, M. Ashraf (2018). *Effective Technical Communication*. (2nd ed.). McGraw Hill Education (India) Pvt. Ltd.
2. Suresh Kumar, E. (2015). *Engineering English.* Orient BlackSwan Pvt. Ltd.
3. Bailey, Stephen. (2018). Academic *Writing: A Handbook for International Students.* (5th Edition). Routledge.
4. Koneru, Aruna. (2016). *Professional Communication*. McGraw Hill Education (India) Pvt. Ltd.
5. Raman, Meenakshi & Sharma, Sangeeta. (2022). *Technical Communication, Principles and Practice.* (4TH Edition) Oxford University Press.
6. Anderson, Paul V. (2007). *Technical Communication***.** Cengage Learning Pvt. Ltd. New Delhi.
7. McCarthy, Michael; O'Dell, Felicity & Redman, Stuart. (2017). *English*

Vocabulary in Use
Series. Cambridge University Press
8. Sen, Leela. (2009). *Communication Skills*. PHI Learning Pvt Ltd., New Delhi.
9. Elbow, Peter. (1998). *Writing with Power*. Oxford University Press.
10. Goleman, Daniel. (2013). *Emotional Intelligence*: *Why it can matter more than IQ*. Bloomsbury Publishing.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
CONSTITUTION OF INDIA

Course Code: GR24A2003 **L/T/P/C: 2/0/0/0**

Course Outcomes

1. Students will be able to know the importance of Constitution and Government
2. Students will be able to become Good Citizens and know their fundamental rights, duties and principles.
3. Students will learn about the role of PM, President, Council of Ministers etc and it will help students learn about Local Administration.
4. The students understand the importance of Election Commission and the Students will become aware of how a Country and State are run in Democracy.
5. They will 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

III YEAR

II

SEMESTER

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
DESIGN OF STEEL STRUCTURES

Course Code:GR24A3015 **L/T/P/C: 2/1/0/3**

III Year II Semester

Prerequisite: Engineering Mechanics, Solid Mechanics, and Graphics for Engineers

Course Outcomes:

1. Evaluate material properties and apply limit state concepts to assess structural steel behavior, ensuring compliance with serviceability and stability requirements as per IS 800:2007.

2. Apply design principles for bolted and welded connections in steel structures, ensuring compliance with IS 800:2007 standards.

3. Design and detail tension and compression members in steel structures following IS code specifications.

4. Analyze and design various steel beams, including built-up beams, lintels, and purlins, ensuring safety against bending, shear, and buckling

5. Evaluate and apply suitable eccentric and moment-resistant connections—both bolted and welded—in beam-column junctions.

UNIT I

Materials: Properties of materials. Concepts of limit state method, loads, stresses and load combinations. Types of structural steel- making of iron and steel. Deflection limits, serviceability and stability check as per IS 800-2007.

UNIT II

Bolted Connections: IS – 800 – 2007 specifications, strength, efficiency and design of bolted joint.

Welded connections: Types of welded joints, specifications, strength and design of welded

joints.

UNIT III

Design of tension member: Design of tension members subjected to axial tension and bending, splicing of tension member and lug angle.

Design of compression members: Design of columns, laced and battened columns, column-splice, column slab base and gusset base.

UNIT IV

Design of Beams: Design of flexural members, lateral stability of beams, lateral torsional buckling, shear strength of beams; web buckling, web crippling, built-up beams, lintels and purlins.

UNIT V

Eccentric and Moment connections: Introduction, beam-column connections; connections subjected to eccentric shear, bolted framed connections, bolted seat connections, bolted bracket connections, welded framed connections, welded seat connections, welded bracket connection, moment resistant connection; bolted moment connections and welded moment connections.

Text Books

1. Design of steel structures – N. Subramanian, Oxford University Press – 2018.

2. Limit State Design of steel structures, S.K.Duggal, Tata McGraw Hill Publisher, 3rd edition, 2019

3. Design of Steel Structures Vol. 1 & 2 – Ramchandra, Standard Publications. 2010.

Reference Books

1. Design of steel structures, S. S. Bhavikatti, IK int Publication House, New Delhi, 2019

2. Design of steel structures, BC Punmia A. K. Jain, Ashok Kumar Jain, Laxmi Publications, 2015.

3. Limit State Design of Steel Structures, by S. Kanthimathinathan, Dream tech Press, 2019.

4. Design of steel structures, by Elias G. Abu-Saba, cbspd publisher, 2000.

5. Design of steel structures, by R. R. Gadpal, Nirali Prakashan publisher, 2000.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
FOUNDATION ENGINEERING

Course Code:GR24A3016 **L/T/P/C: 3/0/0/3**
III Year II Semester

Prerequisites: Geotechnical Engineering

Course Outcomes: After completion of this course, students will be able to
1. Identify various soil exploration methods and interpret the results.
2. Assess the stability of slopes.
3. Compute earth pressures and stability of retaining walls.
4. Apply bearing capacity equations for shallow foundations and analyze settlement.
5. Estimate pile and pile group capacity and recognize the shapes and components of well foundations.

UNIT I
Soil Exploration - Introduction, methods of site exploration and soil investigation, methods of boring, soil samplers, penetrometer tests, analysis of borehole logs, preparation of soil investigation report.

UNIIT II
Stability of Slopes - Introduction, types of slopes and their failure mechanisms, factor of safety, analysis of finite and infinite slopes, stability analysis by standard method of slices, Taylor's Stability Number. Stability of earth dam slopes under different conditions.

UNIT III

Earth Pressure and Retaining Walls - Introduction, Rankine's theory of earth pressure, at rest, active and passive earth pressures, Coulomb's earth pressure theory, Culmann's graphical method. Types of retaining walls, stability of cantilever retaining walls.

UNIT IV

Bearing Capacity and Settlement Analysis of Shallow Foundations - Types and choice of foundation, location of depth, modes of soil failure, safe bearing capacity by Terzaghi, Meyerhoff, Skempton and IS methods. Effect of water table on bearing capacity, safe bearing pressure based on N value, contact pressure and settlement analysis, settlement from plate load test.

UNIT V

Deep Foundations - Types of piles, static pile formulae, dynamic pile formulae, pile load tests, load carrying capacity of pile groups in sands and clays, negative skin friction. Types and different shapes of well foundations, components of well foundations.

Text Books

1. Gopal Ranjan and ASR Rao, Basic and Applied Soil Mechanics, New Age International Pvt. Ltd, New Delhi, 3rd edition (2016).
2. Braja M. Das, Principles of Foundation Engineering, Cengage Learning, New Delhi, 8th edition (2017).
3. K.R. Arora, Soil Mechanics and Foundation Engineering, Standard Publishers Distributors, Delhi, 5th edition (2000), Reprint (2020).

Reference Books

1. B.C.Punmia, Ashok Kumar Jain and Arun Kumar Jain, Soil Mechanics and Foundations, Laxmi publications Pvt. Ltd., New Delhi, 16th edition, Reprint (2017).
2. VNS Murthy, Soil Mechanics and Foundation Engineering, CBS Publishers, and Distributors.
3. Bowles, J.E., Foundation Analysis and Design, McGraw-Hill Publishing Company, New York, 5th edition 2001.
4. Singh.A, Modern Geotechnical Engineering, 3 rd Ed., CBS Publishers, New Delhi, 2006.
5. N. Som, Theory and Practice of Foundation Design, Prentice Hall, New Delhi, 2003.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
ENVIRONMENTAL ENGINEERING

Course Code:GR24A3017 **L/T/P/C: 2/0/0/2**

III Year II Semester

Pre-Requisites: Engineering Chemistry, Environmental Science.

Course Outcomes:

1. Analyze characteristics of water and wastewater.
2. Assess water demand and design components of water distribution systems.
3. Design conveyance elements of wastewater collection systems.
4. Assess sources of water and wastewater.
5. Plan and design water treatment units and wastewater treatment systems.

UNIT I

Sources, Quality and Quantity Perspectives of Water: Surface sources, subsurface sources, physical, chemical, and biological characteristics, BIS standards for potable water, Estimation of water demand, water consumption rate, fluctuations in rate of demand, design period, population forecasting methods. Collection and Conveyance of Water, Intakes, types of Intakes.

UNIT II

Water Pollution: Types of pollutants, their sources, and impacts.

Water Treatment: Layout and general outline of water treatment units, screening, plain sedimentation, sedimentation aided with coagulation, filtration, disinfection, water softening, miscellaneous treatments. Design of Clarifiers, working of slow and rapid gravity filters, multimedia filters.

UNIT III

Distribution Systems: Requirements of a good distribution system, methods of distribution, systems of supply of water, Distribution reservoirs, layout of distribution system, design of distribution system, analysis of pipe networks, appurtenances in distribution system- Joints, Valves and Water Meters.

UNIT IV

Quality and Quantity Perspectives of wastewater: Physical, chemical, and biological characteristics of wastewater, analysis of wastewater, Importance of BOD and COD, Effluent standards, BIS for disposal of Industrial Waste water, impacts of disposal, Wastewater Collection, Estimation of dry weather flow and stormwater flow.

UNIT V

Primary Treatment of wastewater: Preliminary & primary treatment of wastewater: screening, grit removal basins, removal of oil and grease, sedimentation, sedimentation aided with coagulation.

Secondary Treatment of wastewater: Principles and classification of secondary treatment, activated sludge process, trickling filters, miscellaneous methods such as oxidation ditch, oxidation ponds, aerated lagoons, rotating biological contractors. Disposal of wastewater, self- purification of streams, sewage irrigation, BIS standards for waste water irrigation, Treatment and disposal of sludge, On-site disposal methods.

Tertiary Treatment of wastewater: Principles and classification of Tertiary treatment

Text Books

1. Water Supply Engineering, Vol. 1, Waste Water Engineering, Vol. II, B.C.Punmia, Ashok Jain & Arun Jain, Laxmi Publications Pvt. Ltd, New Delhi.,2nd edition, 2016.
2. Elements of environmental engineering by K.N. Duggal, S. Chand Publishers, Revised edition, 2018.
3. Sewage treatment & Disposal and waste water Engineering-Environmental Engineering (Vol.II) by P.N. Modi, Standard Book House, 17th edition, 2020.

Reference Books

1. Environmental Engineering Vol. I and II by S.K. Garg, Khanna Publishers, 35th Edition, 2022.
2. P.N. Modi, Standard Book House, 17th edition, 2020.
3. Water and Waste Water Technology by Mark J Hammer and Mark J. Hammer Jr., Pearson 7th Edition, 2011.
4. Water and Waste Water Engineering by Fair, Geyer and Okun- Wiley, 3rd Edition, 2010.
5. Wastewater Engineering by Metcalf and Eddy., 5th Edition-2013.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
MASONRY STRUCTURES
(PROFESSIONAL ELECTIVE-II)

Course Code:GR24A3018 **L/T/P/C: 3/0/0/3**
III Year II Semester

Pre-Requisites: Structural Analysis, Design of Reinforced Concrete Structures.

Course Outcomes:

1. Identify the types of masonry units and Strength and stability of concentrically loaded masonry walls and factors affecting them.
2. Analyze the emerging permissible compressive, tensile and shear stress and factors influencing them for masonry elements.
3. Identify the concept of effective height of walls and columns, effective length, effective thickness of wall and factors affecting them.
4. Analyze how to design load bearing masonry walls for buildings up to three stories using IS:1905 and SP-20.
5. Explain the concept of reinforced masonry and its applications, and analyse flexural and compression elements (beams and columns) of reinforced masonry shear walls.

UNIT I

Introduction: Brick stone, and block masonry units - Strength, modulus of elasticity and water absorption of masonry materials - classification and properties of mortars, selection of mortars. Defects and errors in masonry construction, cracks in masonry, types, reasons for cracking and remedial methods.
Strength and stability of concentrically loaded masonry walls, effect of unit strength, mortar strength, joint thickness, rate of absorption, effect of ageing, workmanship, strength formulae and mechanism of failure of masonry subjected to direct compression.

UNIT II
Load Analysis: Permissible compressive stresses- stress reduction and shape reduction factors, increase in permissible stresses for eccentric vertical and lateral loads, permissible tensile and shear stresses. Load considerations for masonry: walls carrying axial load, eccentric load with different eccentric ratios— walls with openings and free-standing wall.

UNIT III
Design Considerations: Effective height of walls and columns, opening in walls, effective length, effective thickness, slenderness ratio, eccentricity, load dispersion, arching action and Lintels.

UNIT IV
Masonry Design: Design of load bearing masonry walls for building up to 3storeys using IS 1905-1987 and SP20 Procedure.

UNIT V
Masonry Types: Reinforced masonry and its application, flexural and compression elements of reinforced masonry, shear walls. Composite masonry walls, composite wall beam elements, infilled frames.

Text Books
1. Henry, A.W(1990), "Structural masonry", published by Macmillan Education Ltd. 3rd Edition.
2. Dayarathnam.P (1987), "Brick and reinforced brick structures", Oxford & IBH Publication, 2nd Edition-2017.
3.Masonry Structures: Behaviour & Design by Drysdale, R. G. Hamid, A. H. and Baker, L.R, Prentice Hall. 3rd Edition.

Reference Books
1. Reinforced Masonry Design by R.S. Schneider and W.L. Dickey, Prentice Hall
2. Sinha, B.P and Davies, S.R(1997), "Design of Masonry Structures", E &FN spon.
3. Design of Masonry Structures by A.W. Hendry, B.P. Sinha and Davis, S.R, E&FN Spon, UK
4. Design of Reinforced and Prestressed Masonry by Curtin, Thomas Telford
5. Structural Masonry by Sahlin, S, Prentice Hall

List of Codes
1. IS 1905-1987 (3rd revision), "Code of practice for structural use of unreinforced masonry", BIS, New Delhi.
2. SP 20 (S& T) 1991, "Hand book on Masonry Design and Construction (1strevision)", BIS New Delhi.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

ROCK MECHANICS

(PROFESSIONAL ELECTIVE-II)

Course Code: GR24A3019 **L/T/P/C: 3/ 0/0/3**

III Year II Semester

Pre-Requisites: Engineering Geology

Course Outcomes:

1. Identify the objectives of geotechnical data collection and rock mass classification methods, and successfully collect and analyze a range of geotechnical datasets for design purposes.

2. Annotate on impact of geological features on civil engineering projects

3. Analyze the problems associated with different geological features on civil engineering structures and suggest alternatives.

4. Demonstrate various methods to improving the properties of rock masses.

5. Describe the theory and analysis of in situ and induced stresses in a rock mass and structurally controlled failure.

UNIT-I

Importance and application of rock mechanics to engineering problems, Rock mass classification, Lithological classification of rocks, Engineering classification of intact and fissured rocks, Classification of fissures, Physical-mechanical properties of rocks.

UNIT-II

Joints and faults, Engineering properties of rocks, Stability of rock slope, Modes of failure in rock mass, Definition of stress in rock, Simple methods of determining in-situ stresses and stressdistribution around openings.

UNIT-III

Causes and impacts of subsidence, Mechanics of surface subsidence, discontinuous and continuous subsidence. Monitoring, prediction, control and management of subsidence.

UNIT-IV

Analysis by simple field Bishop's method and use of Hoek's chart, Foundations on rocks, Consideration of uplift pressures; Methods of improving the properties of rock masses.

UNIT-V

Mechanics of rock burst and bumps, Stability of slopes. Instrumentation and measurement of in- situ stresses and rock strength, Photoelasticity.

Text Books

1. Jager. J C & Cook NGW Fundamentals of Rock Mechanics, Wiley India Pvt.Ltd,4th edition 2012.

2. Jumikis Alfred's. R, Rock Mechanics, CRC Press, 2nd edition,1988.

3. Goodman, R.E. (1989), 'Introduction to Rock Mechanics', John Wiley, Chichester, 2nd edition.

4. Hudson, J.A. and Harrison, J.P. (2000), 'Engineering Rock Mechanics', Pergamon Press, Amsterdam.

Reference Books

1. Peng. Syd. S. Coal Mining Ground Control West Virginia University.

2. Brady, BHG& Brown.ET, Rock mechanics for underground mining, George Allen & Unwin Ltd, 1992.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

OPEN CHANNEL FLOW

(PROFESSIONAL ELECTIVE-II)

Course Code:GR24A3020 **L/T/P/C: 3/0/0/3**

III Year II Semester

Pre-requisites: Hydraulics Engineering, Hydrology and Water Resource Engineering

Course outcomes:

1. Explain properties and the type of channel flows.
2. Analyse the flow through different shapes of channel section.
3. Familiarize students with the specific energy, hydraulic jump, surges, and spatially varied flow.
4. Apply the dynamic equations and different method for energy loss in the Gradually Varied Flow
5. Apply the dynamic equation in Rapidly Varied Flow.

UNIT I

Introduction: Gradually varied flows Basic Concepts, types of channels, types of flows in open channels Geometric properties of various sections, Velocity, and pressure distribution. Velocity distribution coefficients. Effects of slope on pressure distribution in channel Energy Principles and its Applications.

UNIT II

Channels of compound sections: non uniform flows Basic Principles and assumptions Dynamic equation: Governing equation for wide rectangular channels Computation of water surface profiles by Numerical and Analytical approaches. Direct step method., Factors effecting Manning's roughness coefficient, Equivalent Channels of compound section. Conveyance of a channel section.

Channels of first and second kind - Hydraulic exponent N, Compound sections of roughness.

UNIT III

Rapid varying flow: Specific energy – features, Criterion for critical state of flow - Critical depth in Rectangular and section factor - specific force. Hydraulic jump application of momentum equation Types of jump Energy dissipation and other uses – Positive and Negative Surges (Theory only) - analysis of Jump on sloping floor; Oblique jumps.

UNIT IV

Flow in curved channels: hydraulic jumps, characteristics, and features Characteristics- Control sections- Transitional depth - Length of surface profiles - Standard step method - Direct integration methods - Brasses' method Tolmkit method, Bekhmeteff's method. Chow's method.

UNIT V

Spatially Varied Flow: Flow with increasing and decreasing discharges; Flow in Non-Prismatic Channels: Transitions humps, flumes, gradual and sudden transitions and analysis of flow profiles Surfaces waves.

Text Books

1**.** Flow in open channels by K. Subramanya TMH Publishing Co. Ltd '7th edition, 2022.

2. Flow through open channels by K.G. Ranga Raju. THM Publishing Co. Ltd.8st edition,2021.

3. Elements of Water Resources Engineering by K.N. Duggal and J.P. Soni (New Age International) 1996.

Reference Books

1. Open Channel Hydraulics by French R.H. McGraw Hill book Company, 8th Edition,2021.

2. Open Channel Flow by Hanif Chaudhary. M. Printice — Hall of India Pvt. Ltd., 2022.

3. Open Channel Hydraulics by V.T. Chow, McGraw Hill book company, new edition 2021.

4. Open Channel Flow by Das, Madan Mohan PHI Learning Pvt Ltd.2011 third print.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

GREEN BUILDING TECHNOLOGY

(PROFESSIONAL ELECTIVE II)

Course Code: GR24A3021 **L/T/P/C: 3/0/0/3**

III Year II Semester

Prerequisite: Environmental Science, Building Materials and Construction Planning, Concrete Technology.

Course Outcomes:

1. Correlate the underlying principles, history and the impacts of green building technology and to identify the criteria for rating systems along with the established Indian codes and guidelines.

2. Identify various Renewable and Non-renewable sources of energy along with their carbon foot prints and building modeling and energy analysis, monitoring and metering.

3. Recognize the energy efficient green building materials and the cost-effective Building Technologies and materials with low embodied energy and incorporate them into design.

4. Explain broad perspective in thinking for sustainable practices by utilizing the engineering knowledge and principles gained from this course.

5. Explain the application of design guidelines of Green Building considering the Energy Conservation Measures and to Perform cost/benefit and life-cycle analysis of green buildings.

UNIT-I

Concept of Green Buildings: Definition of Green Buildings, typical features of green buildings, Necessity, Initiatives, environmental benefits economic benefits, health and social benefits, Major energy efficiency areas for building, Contribution of buildings towards Global Warming, Green buildings in India

Green building Assessment: Green Building Rating Systems (BREEAM, USGBC, LEED, IGBC, TERI-GRIHA, GREEN STAR), Criteria for rating, Energy efficient criteria, Codes and Certification Programs.

UNIT-II

Sources of Energy: Renewable and Non-renewable sources of energy; Coal, Petroleum, Nuclear, Wind, Solar, Hydro, Geothermal sources; potential of these sources, hazards, pollution; Global scenario with reference to demand and supply in India, Global efforts to reduce carbon emissions, Building modeling, Energy analysis, Commissioning, Metering, Monitoring.

Carbon emission: Forecasting, Control of carbon emission, Air quality and its monitoring carbon foot print; Environmental issues, Minimizing carbon emission, Energy retrofits

UNIT-III

Green Building Materials: Sustainably managed Materials, renewable and recyclable resources; energy efficient materials; Embodied Energy of Materials, Green cement, Biodegradable materials, Smart materials, Volatile Organic Compounds (VOC's), Natural Non-Petroleum Based Materials, Recycled materials, Renewable and Indigenous Building Materials, Engineering evaluation of these materials.

Green Building Planning and Specifications: Environment friendly and cost-effective Building Technologies, Integrated Life cycle design of Materials and Structures, Green Strategies for Building Systems, Energy Conservation Measures in Buildings, Waste &Water management and Recycling in Sustainable Facilities, Heating, Ventilation and Air Conditioning, Passive Solar & Daylight

UNIT-IV

Design of Green Buildings: Sustainable sites, Impact of building on environment, Life cycle assessment, Principles of sustainable development in Building Design, Design on Bioclimatic and solar passive architecture, Considerations of energy consumption, water use, and system reliability, indoor air quality, noise level, comfort, cost efficiency in building

design, Advanced Green building technologies and innovations.

UNIT-V

Construction of Green Buildings: Energy efficient construction, Practices for thermal efficiency and natural lighting. Eco- friendly water proofing; ECB codes building rating, Maintenance of green buildings, Cost and Performance Comparisons and Benchmarking, Green Project Management Methods and Best Practices, Cost/benefit analysis of green buildings, Life-cycle analysis of green buildings, Case studies of rated buildings (new and existing)

Text Books

1. Alternative Building Materials and Technologies – By K S Jagadeesh, B V Venkata Rama Reddy & K S Nanjunda Rao – 3rdEdition, New Age International Publishers (2023)

2. Non-conventional Energy Resources – By D S Chauhan and S K Sreevasthava – New Age International Publishers, 4th edition 2021.

3. Integrated Life Cycle Design of Structures – By AskoSarja – SPON Press, first edition 2019.

Reference books

1. Sustainable Energy Systems Engineering: The Complete Green Building Design Resource (McGraw hill publication): by Gevorkian-2007

2. Understanding Green Building Guidelines: For Students and Young Professionals, Traci Rose Rider, W. W. Norton & Company Publisher, 2010.

3. Abe Kruger and Carl," Green Building, Principles and practices in Residential Construction", In 2012, Seville Publication

4. Ross Spiegel, Dru Meadows, "Green Building Materials: A Guide to product selection andSpecification",3rd Edition, October 2010

5. IGBC Rating systems Reference guide

6. Free abridged versions of LEED reference guides

7. ECBC latest version

8. US GBC's Reference Material: http://www.ncrec.gov/pdfs/bicar/Greenbuilding.pdf

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

ENVIRONMENTAL ENGINEERING LAB

Course Code:GR24A3025 **L/T/P/C: 0/0/4/2**

III Year II Semester

Pre-Requisites: Engineering Chemistry

1.

Course Outcomes:

1. Study physical, chemical, and biological parameters of water and their importance.

2. Develop the social responsibility to eradicate water borne diseases.
3. Recognize the methods to control environmental pollution.
4. Express water quality parameters in written reports
5. Generalize the various quality control aspects of industrial effluents by performing the different lab tests.

List of Experiments:
1. Determination of pH and Turbidity
2. Determination of Conductivity and Total dissolved solids.
3. Determination of Alkalinity/Acidity.
4. Determination of Chlorides and iron.
5. Determination and Estimation of total solids, organic solids and inorganic solids.
6. Determination of Nitrogen/total Phosphorous.
7. Determination of Dissolved Oxygen (DO) and B.O.D
8. Determination of C.O.D
9. Determination of Optimum coagulant dose.
10. Determination of Chlorine demand.
11. Perform Presumptive coliform test.

Reference Books
1. Standard Methods for Analysis of water and Wastewater – APHA.
2. Sawyer and Mc. Carty, Chemistry for Environmental Engineering, Mc Graw- Hill publications, 2017.
3. IS 10500 (2012): Drinking water; http://cgwb.gov.in/documents/wq-standards.pdf
4. IS 3025 Methods of sampling and test physical and chemical for water and wastewater: by Indian standard burro kindle Edition, 2020.
5. https://ee1-nitk.vlabs.ac.in/
6. https://ee2-nitk.vlabs.ac.in/
7. S.K. Garg, Environmental Engineering (Vol. I) Water Supply Engineering, Khanna Publishers, 35th Edition, 2022.
8. S.K. Garg, Environmental Engineering (Vol. II) Sewage Waste Disposal and Air Pollution Engineering, Khanna Publishers, 41st Edition, 2022.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
GIS LAB

Course Code:GR24A3026
L/T/P/C: 0/0/4/2
III Year II Semester

Pre- Requisites: Surveying and Geomatics

Course Outcomes:

1. Explore the fundamental tools of QGIS.
2. Demonstrate proficiency in the basic functions of geospatial software.
3. Create awareness on raster layer to vector layer conversion
4. Analyze proficiency in the creation and acquisition of spatial data.
5. Recognize conversion of Digital Elevation Model (DEM) to contour map and Contour to DEM map

SOFTWARE: Q GIS (Open Source)

EXCERCISES:

1. Demonstrating the concept of Labeling in GIS using Quantum GIS
2. Demonstrating the concept of Symbolism in GIS using Quantum GIS.
3. Creation of point features Maps using Toposheets (Ex- Trees, Post office, Wells etc.,)
4. Creation of Line features Maps using Toposheets (Ex – Road Networks, Railway Tracks etc.)
5. Creation of polygon features Maps using Toposheets (Ex – Waterbodies, Forest areas, buildings etc.,)
6. Creation of thematic maps for a region of interest.
7. Identify the demographic study using attribute tool.
8. Creation of buffer zones for given maps.
9. Preparation of contour maps, flow accumulation maps from Digital Elevation model maps
10. GIS applications in various civil engineering aspects- Network Analysis, Watershed Analysis.
11. Performing SQL queries on created Thematic maps (Pre-Requisites: 6,8,9 exercises)

Reference Books

1. Introduction to Geographic Information Systems by Kang-tsung Chang, Tata McGraw-Hill Publishing Company Limited- 2008.

2. Concept and Techniques of GIS by C.P.L.O Albert, K.W.Yong, Prentice Hall Publishers (2010).

3. Concept and Techniques of GIS by C.P.L.O. Albert, K.W. Yong, Prentice Hall Publishers (2002).

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

MINI PROJECT WITH SEMINAR

Course Code:GR24A3027 **L/T/P/C: 0/0/4/2**

III Year II Semester

Pre-Requisite: Civil Engineering courses

Course Outcomes:

1. Make use of fundamental knowledge and practical knowledge to implement towards industries.

2. Utilizing software and design, analyze the engineering Knowledge in accordance with applicable standards.

3. Analyze project management skills and scheduling of work in stipulated time.

4. Evaluate and demonstrate the problem finding ability in Engineering Technologies.

5. Develop technical information by means of written and oral reports.

IV YEAR
I SEMESTER

Course Code:GR24A4001 **L/T/P/C: 2/1/0/3**

IV Year I Semester

Pre-Requisite: Building Materials and Construction Planning, Concrete Technology, Engineering Mathematics.

Course Outcomes:

1. Apply appropriate methods such as the centreline method or long wall-short wall method to calculate detailed and abstract estimates for various building works.

2. Analyze and compute the quantities of earthwork and construction materials for hill roads and canals based on given cross-sections and types of roads.

3. Evaluate rate analysis for different civil engineering works and prepare reinforcement bar bending schedules including material and labour cost estimation.

4. Explain the types of contracts, contract documents, tendering processes, and the roles and responsibilities of contracting parties in construction projects.

5. Apply valuation principles and methods including depreciation and rental methods to determine the value of a building or structure.

UNIT I

General items of work in building: Standard Units, Principles of working out quantities for detailed and abstract estimates, approximate methods of Estimating. Detailed Estimates of Buildings – centre line method, longwall short wall method.

UNIT II

Earthwork for roads hill roads (two level sections only) and canals. Quantities of materials for different types of roads.

UNIT III

Rate Analysis –Working out data for various items of work over head and contingent charges. Reinforcement bar bending and bar requirement schedules.

UNIT IV

Contracts: Types of contracts – contract Documents – Conditions of contract, contract procedures, Tendering process, Rights, and responsibilities of parties to contracts

UNIT V

Valuation of buildings: Purpose and principles of valuation, Depreciation, methods of calculating depreciation, methods of valuation, Rental method, development method, profit based method

Text Books

1. Estimating & Costing in Civil Engineering: Theory and Practice including Specifications and Valuations by B.N.Dutta, UBS publishers, 28th Edition, 2020.

2. Estimating & Costing by G.S.Birdie, Dhanpat Raj Publication Company, 6th edition, 2014

3. Valuation of real properties by S.C. Rangawala, Charotar publishing house, 10th edition, 2015.

Reference Books

1. Estimating, Costing & Specifications by M. Chakraborthi, Laxmi publications, 29th Edition, 2006.

2. Standard schedule of rates and standard Data Book by Public works department.

3. SP:27, Handbook of method of measurement of building works, Bureau of Indian Standards, 1987.

4. IS:1200, Methods of measurements National Building code, 2016.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
TRANSPORTATION ENGINEERING

Course Code:GR24A4002 **L/T/P/C: 3/0/0/3**
IV Year I Semester

Prerequisites: Surveying & Geomatics

Course Outcomes:

1. Demonstrate basic principles of highway engineering and project survey requirements
2. Analyse the geometric features of road pertaining to horizontal and vertical alignment
3. Interpret the factors influencing road vehicle performance, characteristics, and design of traffic signal phasing.
4. Illustrate the basic intersection and advanced intersection performance characteristics
5. Demonstrate the geometrics of Railway engineering and Airport engineering in transportation

UNIT I
Highway Development and Planning: Highway development in India – Necessity for Highway Planning- Different Road Development Plans- Classification of Roads- Road Network Patterns – Highway Alignment- Factors affecting Alignment- Engineering Surveys – Drawings and Reports.

UNIT II
Highway Geometric Design: Importance of Geometric Design- Design controls and Criteria-Highway Cross Section Elements -Sight Distances-Stopping sight Distance, Overtaking Sight Distance, Intermediate Sight Distance and Head light sight distance- Design of Horizontal Alignment- Design of Super elevation and Extra widening- Design of Transition Curves- Design of Vertical Alignment-Gradients- Vertical curves-Summit Curves and Valley Curves.

UNITIII
Traffic Engineering: Traffic flow parameters-Volume, Speed, Density and headway- Traffic Volume Studies- Data Collection and Presentation-speed studies- Data Collection and Presentation- Parking Studies, Parking types and Parking characteristics- Road Accidents-Causes and Preventive measures -Presentation of Accident Data–Condition Diagram and Collision Diagrams.

Traffic Regulation and Management: Road Traffic Signs–Types and Specifications–Road Markings-Need for Road Markings-Types of Road Markings- Design of Traffic Signals – Webster Method –IRC Method.

UNIT IV
Intersections: Types of Intersections – Conflicts at Intersections- Types of At-Grade Intersections- Channelization: Objectives –Traffic Islands and Design Criteria-Types of

Grade Separated Intersections- Rotary Intersection – Concept of Rotary and Design Criteria- Advantages and Disadvantages of Rotary Intersection.

UNIT V

Introduction to Railway Engineering and Airport Engineering: Permanent Way and functions of Rail, Sleeper and Ballast-Gradients-Grade Compensation-Cant and Negative Super elevation- Cant Deficiency – Degree of Curve – Crossings and Turnouts.

Factors affecting Selection of site for Airport – Aircraft Characteristics- Geometric Design of Runway- Computation of Runway length – Correction for runway length – Orientation of Runway – Wind Rose Diagram – Runway Lighting system.

Text Books

1. Highway Engineering – S.K. Khanna &C.E.G. Justo, Nemchand & Bros., 10th edition (2023).
2. Airport Planning and Design- S.K.Khanna and Arora, Nem Chand & Bros. 6th edition (2022).
3. Railway engineering- A Textbook of Railway Engineering- Subhash C.Saxena,Satyapal Arora – Dhanpat Rai & Sons – 8th edition (2022).

Reference Books

1. Highway Engineering – S. P. Bindra, Dhanpat Rai & Sons. – 4th Edition (1991)
2. Traffic Engineering & Transportation Planning –Dr.L.R.Kadyali, Khanna Publications – 9th Edition –2024.
3. Railway Engineering – A text book of Transportation Engineering –S.P.Chandola Publisher, S. Chand & Co., 1st Edition, 2011
4. Air Transportation Planning & design – Virendhra Kumar &Statish Chandhra – Gal Gotia Publishers 1st Edition, 1999.
5. Highway Engineering – L.R.Kadiyali & Lal- Khanna Publications 6th edition (2017).

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
BRIDGE ENGINEERING
(PROFESSIONAL ELECTIVE -III)

Course Code:GR24A4003 **L/T/P/C: 3/0/0/3**
IV Year I Semester

Pre-Requisites: Design of Reinforced Concrete Structures, Structural Analysis II

Course Outcomes:
1. Explain the bridge types and IRC loading standards.
2. Analyze and Design the Slab bridges.
3. Analyze and Design the T Beam bridges.
4. Design the Plate girder bridges.
5. Design the Piers caps and Abutments.

UNIT I
Introduction– Bridges- Types- Slab bridges, T Beam, Arch bridges, Cable Stayed bridges, prestressed concrete bridges, Truss Bridges, Culverts, – Nomenclature- Selection of Bridge Site- Economical span- Abutments pier and end connections- types of foundations- Open, Pile, Well Foundations, Bearings – Types- Introduction to Loading standards- Railway and IRC Loading.

UNIT II
Slab bridges-Wheel load on slab- effective width method- slabs supported on two edges- cantilever slabs- dispersion length- Design of interior panel of slab- Guyon's – Massonet Method
–Hendry- Jaegar Methods- Courbon's theory- Pigeaud's method.

UNIT III
T-Beam bridges– Analysis and design of various elements of bridge –Design of deck slab, Longitudinal girders, Secondary beams- Reinforcement detailing.

UNIT IV
Plate Girder Bridges: Elements of plate girder and their design-web- flange- intermediate stiffener- vertical stiffeners- bearing stiffener- Splices, Design problem with detailing.

UNIT V

Design of Piers - Pier caps and Abutments, different types of bearings.

Text Books

1. 'Design of Concrete Bridges' by Aswini, Vazirani, Ratwani, Khanna Publishers, 2nd edition1995.

2. 'Essentials of Bridge Engineering' by Johnson Victor D, Oxford; 6th edition (1 January 2019).

3. 'Design of Bridge Structures' by T. R. Jagadeesh, M.A. Jayaram, PHI, third edition, 2020.

Reference Books

1. 'Design of RC Structures' by B. C. Punmia, Jain & Jain, Lakshmi Publications, 10th Edition2015.

2. 'Design of Steel Structures' by B. C. Punmia, Jain & Jain, Lakshmi Publications, 2nd Edition2015.

3. 'Design of Bridges' by Krishna Raju , Oxford & IBH Publishing Company Private, Limited - 5th edition 2019.

4. 'Bridge Design: Concepts and Analysis', António J. Reis, José J. Oliveira Pedro, John Wiley& Sons, 2019 Edition

5. 'Bridge Engineering Handbook: Fundamentals', Wai-Fah Chen , Lian Duan, CRC Press; 2nd Edition (24 January 2014).

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
GROUND IMPROVEMENT TECHNIQUES
(PROFESSIONAL ELECTIVE -III)

Course Code:GR24A4004 **L/T/P/C: 3/0/0/3**
IV Year I Semester

Pre- Requisites: Geotechnical Engineering, Foundation Engineering
Course Outcomes:

1. Select various techniques along with dewatering technique for the field related problem.
2. Interpret of available field conditions in section of different densification methods.
3. Choose the appropriate grouting technology and different stabilization methods by understanding the mechanics.
4. Analyze the suitability and practicability in the application of reinforced earth walls.
5. Develop the mechanism of identifying and application of suitable geosynthetics in problematic soils.

UNIT I

Introduction: Need for ground improvement, objectives, classification of ground improvement techniques. Dewatering: Methods of dewatering - sumps, single and multistage well points, vacuum well points, electro-osmosis method, horizontal wells and drains.

UNIT II

In-situ densification methods in granular soils: Vibration at the ground surface, impact at the ground surface, vibration at depth, impact at depth. In-situ densification methods in cohesive soils: Preloading, vertical drains, sand drains, stone and lime columns, thermal methods.

UNIT III

Grouting: Characteristics of grouts, grouting methods, grouting technology, ascending, descending and stage grouting. Stabilization: Methods of stabilization, mechanism of cement and lime stabilization, factors effecting stabilization.

UNIT IV

Reinforced Earth: Mechanism, components of reinforced earth, types of reinforcing elements, applications, factors governing design of reinforced earth walls, design principles of reinforced earth walls, soil nailing.

UNIT V

Geosynthetics: Types of geo synthetics, functions and applications of geo synthetic materials geotextiles, geogrids, and geomembranes.

Expansive soils: Problems of expansive soils, tests for identification, swelling pressure tests, improvement of expansive soils, foundation techniques inexpansive soils, under-reamed piles.

Text Books

1. Dr. P. Purushotham Raj, Ground Improvement Techniques, Laxmi Publications, New Delhi, 2nd edition 2021.Rao G. V. "Geosynthetics an Introduction". Sai Master Geo environmental Service Pvt. Ltd., Hyderabad (2020),

2. Mandal J. N. and Divshikar D. G. "A Guide to Geotextile Testing" New Age International Publisher.

3. Moseley M.P. and K. Kirsch, Ground Improvement, Blackie Academic and Professional, Florida,2nd Edition (2007).

Reference Books

1. Hausmann M.R. Engineering Principles of Ground Modification, Mc Graw Hill International Edition (1990).

2. Xanthakos P.P, Abramson, L.W and Brucwe, D.A, Ground Control and Improvement, John Wiley and Sons, New York, USA (1994).

3. Robert M. Koerner, Designing with Geosynthetics, Xlibris Corporation, 6th Edition (2012).

4. F.H.Chen, Foundations on Expansive soils, Elsevier Science, 2nd Edition (1988).

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

GROUNDWATER

(PROFESSIONAL ELECTIVE-III)

Course Code:GR24A4005 **L/T/P/C: 3/0/0/3**

IV Year I Semester

Pre-Requisites: Hydrology and Water Resources Engineering, Surface Hydrology.

Course outcomes:

1. Estimate the porosity and specific yield of aquifers.
2. Apply ground water flow equation.
3. Compute Dupuit's and Theim's equations.
4. Apply the Surface methods and subsurface method of exploration.
5. Construct the Artificial recharge pits.

UNIT I

Ground Water Occurrence: Ground water hydrologic cycle, origin of ground water, rock properties effecting ground water, vertical distribution of ground water, zone of aeration and zone of saturation, geologic formation as Aquifers, types of aquifers, porosity, Specific yield and Specific retention.

UNIT II

Ground Water Movement: Permeability, Darcy's law, storage coefficient. Transmissivity, differential equation governing ground water flow in three dimensions derivation, ground waterflow equation in polar coordinate system. Ground water flow contours their applications.

UNIT III

Steady groundwater flows towards a well in confined and unconfined aquifers – Dupuit's and Theim's equations, Assumptions, Formation constants, yield of an open well interface and well tests – Recuperation Test.

Unsteady flow towards a well – Non equilibrium equations – Theis' solution – Jocob and Chow's simplifications, Leaky aquifers – Well Interference.

UNIT IV

Surface and Subsurface Investigation: Surface methods of exploration – Electrical resistivity and Seismic refraction methods. Subsurface methods Geophysical logging and resistivity logging. Aerial Photogrammetry applications along with Case Studies in Subsurface Investigation.

Artificial Recharge of Ground Water: Concept of artificial recharge – recharge methods, relative merits, Applications of GIS and Remote Sensing in Artificial Recharge of Ground water along with Case studies.

UNIT V

Well Construction – Drilling Equipment used for Well Construction–Bore log – Interpretation of Log Data.

Saline Water Intrusion in aquifer: Occurrence of saline water intrusions, Ghyben-Herzberg relation, Shape of interface, control of seawater intrusion.

Groundwater Basin Management: Concepts of conjunction use, Case studies.

Text Books

1. Ground water Hydrology by David Keith Todd, John Wiley & Son, 3rd · Publisher. John Wiley & Sons Inc · Publication date. 8 November 2005
2. Ground water by H. M. Raghunath, New Age Publishers, 3rd Edition-2021
3. Ground Water Hydrology by D.K. Todd and L.R Mays John Willey, 3rd Edition-2005.

Reference Books

1. Irrigation Water Management: Principles and Practice by Majumdar Dilip Kumar 2001.
2. Ground Water and Well Drilling a Reference Book on Ground Water And Wells (Pb 2018) by Praveen Kumar.
3. Groundwater Hydrology by H.Bower, Mc Graw Hill Inc. US,2000.
4. Groundwater System Planning & Management – R. Willes & W. W. G. Yeh, Prentice Hall.,1987.
5. Groundwater Hydrology of Springs: Engineering, Theory, Management And Sustainability by Neven Kresic (2009).
6. Applied Hydrogeology by C. W. Fetta, Pearson, 4th edition,2000.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
TALL BUILDINGS
(PROFESSIONAL ELECTIVE III)

Course Code: GR24A4006 **L/T/P/C: 3/0/0/3**

IV Year I Semester

Pre-Requisites: Structural analysis II and Design of Reinforced Concrete structures

Course outcomes:
1. Evaluate the components and various types of tall buildings
2. Illustrate concepts and material properties used in tall building constructions.
3. Analyse the behaviour of tall buildings subjected to different types of loads
4. Analyse the tall buildings with and without shear walls.
5. Analyse shear walls with and without openings

UNIT I
Introduction: Evolution of tall buildings-Classification of Buildings – Low-rise, medium-rise, high rise – Ordinary framed buildings & Shear-wall buildings –Behaviour of buildings under lateral loads like Wind loads, Earthquake loads & Blast loads – Basic structural & functional design requirements – Strength, Stiffness & Stability

UNIT II
Design Criteria and Materials-Development of High-Rise Structures – General Planning Considerations – Design philosophies – Materials used for Construction – High Strength Concrete – High Performance Concrete – Self Compacting Concrete – Glass – High Strength Steel

UNIT III
Loading -Gravity Loading – Dead Load – Live Load – Live load reduction technique – Impact Load – Construction Load – Sequential Loading. Lateral Loading – Wind load – Earthquake Load. Combination of loads.

UNIT IV
Behaviour of Various Structural Systems-Factors affecting growth, Height and Structural form. High rise behaviour of Various structural systems – Rigid frames, braced frames, In filled frames, shear walls, coupled shear walls, wall frames, tubular structures, cores, outrigger – braced and hybrid mega systems.
UNIT V

Methods of analysis: Shear walls with and without openings- Estimation of stiffness by simple cantilever theory& Deep Beam theory- Equivalent frame for large frames.

Text Books

1. Design of Tall Buildings by Taranath M. McGraw Hill, first edition, 2010.

2. Tall Building Structures, Analysis and Design, by Bryan Stafford Smith, Alex coull, John Wiley and Sons, Inc., 1991.

3. Structural Analysis and Design of Tall Building, by Taranath B.S., McGraw Hill, first edition, 2011.

Reference Books

1. Structural Concepts and systems for Architectsand Engineers, by Lin.T.Y, Stotes Burry.D, John Wiley, 2022

2. Advances in Tall Buildings, by Lynn S.Beedle, CBS Publishers and Distributors, Delhi, 1986.

3. High Rise Building Structures, by Wolfgang Schueller John Wiley and Sons, New York1977.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
FINITE ELEMENT METHODS
(PROFESSIONAL ELECTIVE - IV)

Course Code:GR24A4007 **L/T/P/C: 3/0/0/3**
IV Year I Semester
Prerequisite: Engineering Mechanics, Strength of materials, structural analysis

Course Outcomes:
1. Illustrate steps involved and minimum potential energy principle in Finite Element Method.
2. Analyse one dimensional elements like bar, beam and truss element using FEM approach.
3. Estimate of stress and strains in planar elements and displacements using appropriate modelling.
4. Determination of stress and strains in 2D CST elements and Iso parametric approach for 4 noded and other higher order elements.
5. Estimate of stress and strains in axisymmetric elements and Numerical methods used in FEM.

UNIT I
Introduction: Concepts of FEM – Steps involved – merits & demerits – energy principles– Discretization – Rayleigh –Ritz method of functional approximation.
Principles of Elasticity: Equilibrium equations – strain displacement relationships in matrix form – Constitutive relationships for plane stress, plane strain and Axi-symmetric bodies of revolution with Axi-symmetric loading.

UNIT II
One Dimensional FEM: Stiffness matrix for bar element - shape functions for one dimensional elements - one dimensional problems.

UNIT III
Two-Dimensional FEM: Different types of elements for plane stress and plane strain analysis – Displacement models – generalized co-ordinates – shape functions – convergent and compatibility requirements – Geometric invariance – Natural coordinate system – area and volume coordinates

UNIT IV
Generation of element stiffness and nodal load matrices for 3-noded triangular element and four noded rectangular elements.
Iso-parametric formulation: Concepts of iso-parametric elements for 2D analysis - formulation of CST element, 4-noded and 8-noded iso-parametric quadrilateral elements-Lagrangian and Serendipity elements.

UNIT V
Axi-symmetric analysis: Basic principles-Formulation of 4-nodediso-parametric axi-symmetric element.
Solution Techniques: Numerical Integration, Static condensation, assembly of elements and solution techniques for static loads.

Text Books
1. Finite Elements Methods in Engineering by Tirupati.R. Chandrepatla and Ashok

D. Belegundu - Pearson Education Publications-2009
2. Finite element analysis by S.S. Bhavikatti-New age International publishers-2015

3. Fundamentals of Finite element analysis by David V Hutton, Tata Mcgraw Hill, New Delhi. 2016

Reference Books

1. Concepts and Applications of Finite Element Analysis by Robert D. Cook, David

S. Malkus and Michael E.Plesha. Jhon Wiley & Sons- 2024
2. Finite Element analysis – Theory & Programming by C.S.Krishna Murthy- Tata Mc. Graw Hill Publishers-2017

3. Text book of Finite Element analysis by P.Seshu – Prentice Hall of India-2003

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
PORT AND HARBOUR ENGINEERING
(PROFESSIONAL ELECTIVE - IV)

Course Code:GR24A4008 **L/T/P/C: 3/0/0/3**
IV Year I Semester
Course Outcome:

1. Demonstrate the role of ports and harbour in water transportation.
2. Assess port features, passenger demand forecasting, cargo handling capacity.
3. Demonstrate the infrastructure facilities of ports and associated utility
4. Demonstrate harbour features, planning and general design
5. To be aware of the infrastructure facilities of harbours and associated utility

UNIT I

Introduction: Water Transportation in India Scope, Merits, Developments, Inland waterways, River, Canal, Inland water transportation, Development of shipping in India, need for Ports and Harbours, General Planning for a Harbour, and Ports.

UNIT II

Ports: Characteristics of good seaport and principles of seaport planning, size of seaport, site selection criteria and layout of seaport, Dry ports, Transshipment ports, Surveys to be carried out for seaport planning, regional and intercontinental transportation development, forecasting cargo & passenger demand, regional connectivity, cargo handling capacity of port.

UNIT III

Port facility: Port building facilities, Transit sheds, Warehouses, Cargo handling facility, Services for shipping terminals, Inland port facilities planning. Navigational aids, types, requirements of signals, lighthouses, beacon light, buoys.

Dredging & coastal protection: Types of dredgers, choices, usage of dredged material, sea wall protection-sea wall revetment, bulkhead.

UNIT IV

Harbour: Characteristics of good harbour, classification of harbours, Site selection, Harbour dimensioning and layout, features of harbour, Breakwaters - function, types, general design principles, wharves, quays, jetties, piers, pier heads, dolphin, fenders, mooring accessories.

UNIT V

Harbour Facility: Repair facilities, wet docks, lift docks, dry docks, gates for graving docks, floating docks, slipways, locks, and gates. Ferry, Transfer bridges, floating landing stages, transit sheds, warehouses, cold storage, aprons, cargo handling equipment, purpose and general description stack area.

Text Books

1. Bindra S.P., Docks & Harbour Engineering, Dhanpat Rai Publications, 5th Edition, 2012
2. Srinivasan R., Harbours, Docks & Tunnel Engineering, Charotar Publishing House, Anand, 30th Edition 2022.
3. Dock and Harbor Engineering by Ozha & Ozha, Charota Books, Anand. 8th Edition, 2016

Reference Books

1. Port Engineering by Pera Bruun, Gulf Publishing Company 4th Edition, 1993
2. Coastal Hydraulics Sea and Inland Port Structures by Muir Wood, A.M., and Fleming. C.A Hall stead press. 2nd Edition, 2013
3. Alonzo Def. Quinn, Design and Construction of Ports and Marine Structure, McGraw - Hill Book Company, New York, 2nd Edition, 1972
4. Dock and Harbor Engineering by Seetharaman, S, Umesh Publications. 30th Edition, 2022

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
PHYSICO-CHEMICAL PROCESSES FOR WATER AND WASTEWATER TREATMENT
(PROFESSIONAL ELECTIVE - IV)

Course Code:GR24A4009 **L/T/P/C: 3/0/0/3**
IV Year I Semester

Pre-Requisites: Environmental Engineering
Course Outcomes:
1. Knowledge of surface water methods of data collection and analysis.
2. Ability to prepare the treatment flow of water and wastewater treatment plants.
3. Recognize the various principles involved in the treatment of waste water.
4. Design reactors for homogenous reactions under isothermal conditions for single and multiple reactions.
5. Knowledge on thermal characteristics of various reactions.

UNIT I
Water purification in natural systems- variation in water flow and the steps to estimate - water for domestic and industrial requirement -waste water quantity- List the standards of potable water quality, gas flow, physical processes, chemical processes, and biological processes. Primary, secondary and tertiary treatment.

UNIT II
Unit operations, unit processes - Aeration and gas transfer - Sedimentation, different types of settling, sedimentation tank design. Coagulation and flocculation, coagulation processes, stability of colloids, destabilization of colloids, destabilization in water and wastewater treatment, transport of colloidal particles, design aspects.

UNIT III
Filtration: filtration processes, Hydraulics of flow through porous media, Rate control patterns and methods, Filter effluent quality parameters, mathematical model for deep granular filters, slow sand filtration, rapid sand filtration, pre-coat filtration, design aspects.
Disinfection: Types of disinfectants, Kinetics of disinfection, chlorination and its theory, Design of Chlorinators.

UNIT IV
Precipitation: Hardness removal, Iron, Mn, and heavy metal removal; Adsorption, adsorption equilibria and adsorption isotherm, rates of adsorption, Sorption kinetics in batch reactors, continuous reactors, factors affecting adsorption.

UNIT V
Ion Exchange - exchange processes, materials and reactions, methods of operation, Application, design aspects. Membrane Processes, Reverse osmosis, Ultrafiltration, Electrodialysis.

Text Books

1. Metcalf and Eddy, Wastewater Engineering: Treatment and Reuse, McGraw Hill Education, 4th Edition, 2017.
2. Benefield, L.D. and Randall C.W., Biological Processes Design for wastewaters, Prentice-Hall, Inc.1980.
3. Shyam. R. Asolek and Soli. J. Arceivala, Wastewater Treatment for Pollution Control and Reuse, McGraw-Hill Professional; 3rd edition, 2006.

Reference Books

1. Hammer MJ, Water and Wastewater Technology, PHI Publications, 7th edition 2013.
2. RANGWALA, Water Supply and Sanitary Engineering, Charotar Publishing House Pvt. Ltd., 29th Edition, 2016.
3. Husain, S,K, Textbook of Water Supply and Sanitary Engineering, Cbs Publishers And Distributors Pvt Ltd, 3rd Edition, 2018.
4. E W Steel and Terence J McGhee, Water supply and Sewerage, McGraw Hill Book Company, 6th edition 1991.
5. S.K. Garg, Environmental Engineering Vol. I and II, Khanna Publishers, 35th Edition, 2022.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
REHABILITATION AND RETROFITTING OF STRUCTURES
(PROFESSIONAL ELECTIVE - IV)

Course Code:GR24A4010 **L/T/P/C: 3/0/0/3**
IV Year I Semester

Pre-requisite: Concrete Technology, Design of Reinforced Concrete Structures

Course Outcomes:

1. Identify various mechanisms for Structural distress and deterioration.
2. Summarize the measures to prevent corrosion in concrete and steel structures
3. Apply the Inspection and Repair methods of distressed concrete and steel structures
4. Examine the methods of Rehabilitation in distressed concrete and steel structures
5. Inspect health monitoring and conditional assessment surveys on concrete and steel Structures

Unit I

Structural distress mechanisms- Maintenance and Repair Strategies - Inspections - Assessment procedure for evaluating a damaged structure, causes of deterioration - Cracks - causes – structural and non- structural damages- Physical deterioration due to moisture, temperature, shrinkage, freeze-thaw, abrasion, erosion, cavitation, crystallization of salts, Efflorescence, exposure to severe environment like marine exposure, Chemical deterioration due to corrosion of reinforcement (chloride induced, carbonation induced), Alkali-silica reaction, sulphate attack, Acid attack - case studies

UNIT II

Basics of corrosion phenomena- electrochemical process - Corrosion protection techniques - Corrosion inhibitors, Corrosion resistant steels, Coatings to reinforcement, cathodic protection- Case studies

UNIT III

Inspection and Testing - Damage assessment techniques- Non-Destructive testing systems – Drone Technology in condition assessment of structures - Repairs in under-water structures- -materials for repair - Repair of structures distressed due to fire, Leakage, earthquake - Demolition Techniques - Engineered demolition methods - Effects due to climate, temperature, Sustained elevated temperature- fire damaged structures - Fire rating of structures- Case studies.

UNIT IV

Simple systems of rehabilitation of structures - Guniting, Epoxy injection, Shoring,

Underpinning, Use of carbon fiber wrapping, FRPs and carbon composites in repairs - strengthening methods in concrete and steel structures – Retrofitting -FRP wrapping- base isolators-different types of dampers- Jacketing - Case studies

UNIT V

Structural health monitoring of structures- Sensors -Building instrumentation- smart sensing technology - strain rosette - Condition survey- Special Concretes - Quality assurance for concrete- Construction chemicals for repairs- design and construction errors- Case studies

Text Books

1. P.I.Modi & C.N. Patel, Repairs and Rehabilitation of Concrete Structures, PHI Publication, 2016.

2. B.L.Guptha, Amit Gupta, Maintainence and Repair of Civil Structures, Standard publishers and Distributors,2007.

3. Allen R.T. &Edwards S.C, Repair of Concrete Structures, Blakie and Sons, UK, 1987

Reference Books

1. Varghese. P.C Maintenance Repair and Rehabilitation & Minor works of building, Prentice Hall India Pvt Ltd 2014

2. Shetty M.S., "Concrete Technology- Theory and Practice", S.Chand and Company, 8thedition 2018.

3. Dov Kominetzky. M.S., "Design and Construction Failures", Galgotia PublicationsPvt.Ltd.,2001

4. CPWD and Indian Buildings Congress, Hand book on Seismic Retrofit of Buildings, Narosa Publishers, 2008.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
TRANSPORTATION ENGINEERING LAB

Course Code: GR24A4014 **L/T/P/C: 0/0/4/2**
IV Year I Semester

Prerequisites: Concrete Technology, Building Materials and Construction Planning
Course Outcomes:

1. Estimate desired characteristics of aggregates.
2. Distinguish suitable materials for road construction.
3. Categorize pavement materials by their physical and mechanical properties.
4. Demonstrate various experiments on bitumen to measure various properties.
5. Demonstrate bituminous mixes as per pavement requirement.

Task1: TESTS ON AGGREGATES

1. Crushing value
2. Impact value
3. Specific gravity and water absorption
4. Abrasion test
5. Shape test- Elongation Index
6. Shape test- Flakiness Index

Task2: TESTS ON BITUMEN

1. Penetration test
2. Ductility test
3. Softening point test
4. Flash and fire point tests

Task3: TESTS ON BITUMINOUS MIXES

1. Bitumen Extraction test- Demonstration
2. Marshall Stability test -Demonstration

Reference Books

1. Highway Engineering – S. K. Khanna & C. E. G. Justo. New Chand & Brothers;2019
2. Highway Material Testing - S. K. Khanna (Author), C. E. G. Justo (Author), A. Veeraragavan (Author), Nem Chand & Bros;5th edition, 2022

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
COMPUTER APPLICATIONS IN STRUCTURAL ENGINEERING LAB

Course Code:GR24A4015 **L/T/P/C: 0/0/4/2**
IV Year I Semester

Prerequisites: Graphics for Engineers, CAD Lab, Structural analysis, Design of reinforced concrete structures, Design of Steel structures

Course Outcomes

1. Apply the concept of analyzing the 2D beam and frame with various support and load combinations.

2. Develop the 3D model by analyzing and designing a multi-storeyed building with wind and seismic load and its load combinations.

3. Design RCC water tank through analyzing and designing multi-storeyed building with different shapes.

4. Create the steel sections and truss members by analyzing and designing with suitable elements and shapes.

5. Develop the geometric shapes for the reinforcement detailing of beams, footings, and staircases.

Syllabus:

1. Analysis of beams for simply supported, over hanging, cantilever and fixed conditions under different load conditions.

2. Analysis and Design of multi-storeyed building with simple 2D frame.

3. Analysis and Design of multi-storeyed building with3D frame with Dead Load and Live Load

4. Analysis and Design of multi-storeyed building with 3D frame under Wind load and its load combinations.

5. Analysis and Design of multi-storeyed building with 3D frame under Seismic Load and its load combinations.

6. Analysis and Design of RCC Rectangular Over Head Tank.

7. Analysis and Design of RCC Circular Over Head Tank.

8. Analysis and Design of beams for various steel sections (I, C, T, L and composite sections).

9. Analysis and Design of Simple truss.

10. Reinforcement Detailing of Simply Supported, Cantilever and Flanged Beams.

11. Reinforcement Detailing of Isolated footing (Circular/Rectangular and Square).

12. Reinforcement Detailing of Combined footing with Strap beam.

13. Reinforcement Detailing of Staircases.

Reference Books

1. STAAD. Pro Reference Guide, Chetan Publication; 2010th Edition (1 January2010).

2. Advanced Structural Analysis, A K Jain, Nem Chand & Bros. 3rd Edition, 2015.

3. Advanced Structural Analysis, Devadas Menon, Alpha Science Intl.,Ltd (Publisher),2009.

4. B.C. Punmia, Ashok Kumar Jain, Arun Kumar Jain Reinforced Cement Concrete Design, Laxmi Publications, 2015

5. IS:5525 -1969: Recommendation for detailing of reinforcement in reinforced concrete works.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
PROJECT WORK – PHASE I

Course Code:GR24A4016
L/T/P/C: 0/0/12/6

IV Year I Semester

Pre-Requisites: Knowledge of all Civil Engineering subjects and Laboratories, communication skills

Course Outcomes:

1. Practice and acquire the knowledge within the chosen area of technology for Project Development.
2. Identify, discuss, and justify the technical aspects of the chosen project with a comprehensive and systematic approach.
3. Design and develop Engineering Projects by implementing technical aspects.
4. Work as an individual or in a team in development of Technical Projects.
5. Compile and report effectively the project related activities and findings

IV YEAR

II SEMESTER

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
DESIGN OF PRESTRESSED CONCRETE STRUCTURES
(PROFESSIONAL ELECTIVE- V)

Course Code: GR24A4017 **L/T/P/C: 3/0/0/3**

IV Year II Semester

Prerequisite: Strength of Materials, Concrete Technology, Design of Reinforced Concrete Structures and Design of Steel Structures.

Course Outcomes:

1. Acquire the basic aspects of pre stressed concrete fundamentals which include pre and post- tensioning processes.
2. Determine the losses in pre-stressed concrete structures.
3. Analyze and design the pre stressed concrete beams and also analyze an end block and transmission length.
4. Analyze and design the composite sections of pre stressed concrete.

5. Determine the deflection and crack width of prestressed concrete members.

UNIT I

Introduction: Historic development – General principles of Prestressing, Pre-tensioning and Post tensioning – Advantages and limitations of Prestressed concrete – Materials – High strength concrete, high tensile steel and their characteristics. I.S.Code provisions, Methods and Systems of Prestressing; Pre-tensioning and post tensioning methods – Analysis of Post tensioning - Different systems of Prestressing like Hoyer System, Magnel System, Freyssinet system and Gifford – Udall System.

UNIT II

Losses of Prestress: Losses of Prestress in Pre-tensioned and Post-tensioned members due to various causes like Elastic shortage of concrete, Shrinkage of concrete, Creep of concrete, Relaxation of steel, Slip in anchorage bending of member and Frictional losses. Analysis of sections for flexure; Elastic analysis of concrete beams prestressed with Straight, Concentric, Eccentric, Bent and Parabolic Tendons.

UNIT III

Design of PSC Beams: Allowable stress, Design criteria as per IS.Code – 1343, Elastic design of simple sections like; Rectangular and I-section for Flexure, Shear, and Principal stresses – Kern – Lines, Cable profile.

Analysis of End Blocks: by Guyon's method and Mugnel method - Anchorage Zone Stresses – Approximate method of design – Anchorage zone reinforcement – Transfer of prestress in pre-tensioned members.

UNIT IV

Composite section: Introduction – Analysis of stresses – General designs considerations. Composite construction with Precast PSC Beams and Cast-In-Situ RC Slabs. Creep and Shrinkage eff sections.

UNIT V

Deflections of PSC Beams: Importance of control of deflection – Factors influencing Deflection – Short term deflection of Uncracked members and Prediction of long-term deflections. Crack width calculations.

Text Books

1. Prestressed Concrete by Krishna Raju; - Tata Mc.Graw Hill Publications, 6th edition, 2018.

2. Prestressed Concrete by K.U.Muthu, Azmil Ibrahim, Maganti Janardhana, M. Vijayanand, PHI Learning Private Limited, Delhi, 2016.

3. Prestressed Concrete by Shrikanth B. Vanakudre, Ashish A. Yaligar, Khanna Book Publishing Co.(P) LTD. First edition 2021, New Delhi.

Reference Books

1. Design of Prestressed concrete structures (Third Edition) by T.Y. Lin & Ned H.Burns, John Wiley & Sons. 2010.

2. Prestressed Concrete by Ramamrutham; Dhanpatrai Publications, 2016.

3. Prestressed Concrete Design, by Dr. Praveen Nagarajan , Pearson Education India publisher, 2013.

4. Prestressed Concrete Analysis and Design: Fundamentals, by Antoine E. Naaman, Techno Pr 3000 publisher, 2004.

5. Analysis and Design of Prestressed Concrete Structures, by Shamsher Bahadur Singh, Wiley publisher, 2023.

6. Prestressed Concrete by N.Rajasekharan; - Narosa publications.

7. Prestressed Concrete by N. Rajagopalan Narosa Publishing House, 2010

Codes: IS 1343 - BIS code of practice for Prestressed concrete.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
URBAN TRANSPORTATION AND PLANNING
(PROFESSIONAL ELECTIVE -V)

Course Code:GR24A4018 **L/T/P/C: 3/0/0/3**

IV Year II Semester

Prerequisite: Transportation Engineering.

Course Outcomes:
1. Interpret the urban activity system and travel patterns
2. Demonstrate the classical methods of urban transportation planning
3. Apply four stage travel demand modeling
4. Identify urban transportation problems.

5. Estimate urban travel demand.

Unit I

Urban morphology - Urbanization and travel demand –Urban activity systems and travel patterns – Systems approach – Trip based and Activity based approach – Urban Transportation Planning – Goals, Objectives and Constraints

Unit II

Inventory, Model building, Forecasting and Evaluation - Study area delineation – Zoning - UTP survey; Trip generation models – Trip classification - productions and attractions – Trip rate analysis - Multiple regression models - Category analysis

Unit III

Trip distribution models – Growth factor models, Gravity model and Opportunity modes; Modal split models – Mode choice behavior – Trip end and trip interchange models - Probabilistic models – Utility functions - Logit models - Two stage model.

Unit IV

Traffic assignment – Transportation networks – Minimum Path Algorithms - Assignment methods – All or Nothing assignment, Capacity restrained assignment and Multi path assignment – Route-choice behavior; Land use transportation models – Urban forms and structures - Location models - Accessibility – Land use models - Lowry derivative models

Unit V

Quick response techniques - Non-Transport solutions for transport problems; Preparation of alternative plans - Evaluation techniques – Plan implementation - Monitoring - Financing of Project – Urban development planning policy; Urban flooding- Overview- reasons and impact of Urban Floods, Factors for Urban Flooding, Steps taken to Mitigate Urban Flooding

Text Books

1. Traffic Engineering and Transportation Planning, Kadiyali, LR, Khanna Publishers, New Delhi. 9th Edition, 2024

2. Principles of Urban Transport Systems Planning, Hutchinson, B.G., Mc Graw Hill, New York, 1974.

3. Transportation Engineering - An Introduction, Khisty C.J. & B.K.Lall, Pearson Education Inc., 3rd Edition 2017.

Reference Books

1. John W Dickey, Metropolitan Transportation Planning, Tata McGraw-Hill publishing company Ltd, New Delhi 2nd Edition, 1983
2. NPTEL videos on Urban Transportation Planning, Dr. V. Tamizh Arasan, IIT Madras, September 2020
3. Paul.H. Wright, Transportation Engineering – Planning & Design, John Wiley & Sons, New York, 4th Edition, 1998.
4. Bruton, M. J., An Introduction to Transportation Planning (The Living Environment), UCL Press, London, UK, 3rd Edition, 1992.
5. Papacostas C.S. and Prevedouros, P.D., Transportation Engineering & Planning, PHI, New Delhi, 3rd Edition, 2015.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
DESIGN OF HYDRAULIC STRUCTURES
(PROFESSIONAL ELECIVE - V)

Course Code:GR24A4019 **L/T/P/C:**

3/0/0/3

IV Year II Semester

Pre-Requisites: Hydrology and Water Resource Engineering

Course Outcomes:

1. Plan and assess the capacity of reservoir by mass curve method and design different types of irrigation channels.

2. Evaluate the forces acting on gravity dams and analyze the stability of the gravity dam.

3. Apply the principles of design of the earthen dams and Ogee spillways.

4. Design various diversion head works by using Bligh's and Khosla's theory.

5. Design of various hydraulic structures like canal falls, canal regulator works, and cross drainage works along with their suitability& explain the components of hydroelectric schemes.

UNIT I

Reservoir Planning and Canals design: Estimation of crop water requirement; Fixing the capacities of reservoirs by mass curves of inflow and outflow. Analysis for surface and sub-surface flow at hydraulic structures, Cross section of channels, Silt control methods in canals. Estimation of channel losses. Design of unlined channels by Lacey's method.

UNIT II

Gravity dams: Forces acting on a gravity dam, causes of failure of a gravity dam, elementary, common profile and practical profile of a gravity dam, limiting height of a low gravity dam, Factors of Safety - 'stability Analysis, Foundation fora Gravity Dam, drainage and inspection galleries and their impact, stress analysis of a gravity dam.
Spillways: types of spillways, Design principles of Ogee spillways – Spillway gates.

UNIT III

Earth dams: Types of Earth dams, causes of failure of earth dam, criteria for safe design of earth dam, seepage through earth dam-graphical method, measures for control of seepage through embankments and foundations.

UNIT IV

Diversion Head works: Types of Diversion head works- weirs and barrages, layout of diversion head work - components. Causes and failure of weirs and Barrages on permeable foundations, Silt Ejectors and Silt Excluders weirs on Permeable Foundations - creep.
Theories - Bligh's, Lanet and Khosla's theories, Determination of uplift pressure- Various Correction Factors - Design principles of weirs on permeable foundations using creep theories-exit gradient, U/s and D/s Sheet Piles - Launching Apron.

UNIT V

Canal falls: Types of falls and their location, design principles of Notch fall and sarada type fall. Canal regulation works, principles of design of distributor and head regulators, canal cross regulators- canal outlets, types of canal modules, proportionality, sensitivity, and flexibility. Cross drainage works types: selection of site, design principles of aqueduct siphon aqueduct and super passage. Components of Hydroelectric schemes and selection of turbines

Text Books

1. Irrigation Engineering and Hydraulic Structures - S.K Garg , 2013, 25th Revised Edition.

2. Irrigation and Water Power Engineering - B.C.Punmia, Pande B.B.Lal, Ashok Kumar Jain and Arun Kumar Jain - Laxmi Publications - 16th Edition , 2009.

3. Irrigation Engineering and Hydraulic Structures - S.R.Sahasrabuddhe , 2011, 3rd Edition , S.K.Kataria & Sons

Reference Books

1. Irrigation Engineering and Hydraulic structures. S.R.Sahasrabudhe, 2013 S.K.Kataria &sons

2. Irrigation and water power engineering. B.C.Punmia, Pande B.B.Lal, Ashok kumar jain, Arun kumar Jain- Laxmi publications 16th edition 2009.

3. Theory and Design of Irrigation Structures-Volume II – R.S. Varshney, S.C.Gupta andR.L.Gupta 2014

4. Water Power Engineering by M.M.Dandekar and K.N.Sharma, 2nd edition 2013.

5. IS Code 6512: Criteria for Design of Solid Gravity Dams, 1984.

6. IS Code 7894: Code of Practice for Stability Analysis of Earth Dams, 1975.

7. IS Code 8826: Guidelines for Design of Large Earth and Rockfill Dams, 1978.

8. IS Code 6966: Part 1: 1989 Guidelines for hydraulic design of barrages and weirs: Part1 Alluvial Reaches

9. IS Code 7720: 1991 Criteria for Investigation, Planning and Layout for Barrages and Weirs

10. IS code: 7112-2002 Criteria for design of cross section for Unlined canals in Alluvial Soils

11. IS code: 10430 :2000 Criteria for Design of Lined Canals and Guidance for selectionof type of lining.

GOKARAJU RANGARAJ INSTITUTE OF ENGINEERING AND TECHNOLOGY
CONSTRUCTION PROJECT PLANNING & SYSTEMS
(PROFESSIONAL ELECIVE - V)

Course Code:GR24A4020 **L/T/P/C: 3/0/0/3**

IV Year II Semester

Course Outcomes:

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

1. Recall how structures are built and projects are developed on the field
2. Analyse good idea of basic construction dynamics- various stakeholders, project objectives, processes, resources required and project economics
3. Interpret Plan, control and monitor construction projects with respect to time and cost, and also to Optimise construction projects based on costs.
4. Examine how construction projects are administered with respect to contract structures and issues.
5. Summarize ideas and understandings to others with effective communication processes

UNIT I

Construction Planning and Scheduling: Definition of Projects; Stages of project planning: pre-tender planning, pre-construction planning, detailed construction planning, role of client and contractor, level of detail. Process of development of plans and schedules, work break-down structure, activity lists, assessment of work content, concept of productivities, estimating durations, sequence of activities, activity utility data; Techniques of planning- Bar charts, Gantt Charts. Networks: basic terminology, types of precedence relationships, preparation of CPM networks: activity on link and activity on node representation, computation of float values, critical and semi critical paths, calendaring networks. PERT Assumptions underlying PERT analysis, determining three-time estimates, analysis, slack computations, calculation of probability of completion. Allocation of Resources- materials, equipment, staff, labour and finance; resource levelling and optimal schedules; Project organisation, documentation and reporting systems.

UNIT II

Construction Methods and Contract Management: Control & monitoring; Temporary Structures in Construction; Construction Methods for various types of Structures; Major Construction equipment; Automation & Robotics in Construction; Modern Project management Systems; Advent of Lean Construction; Importance of Contracts Management; Planning and organizing construction site and resources- Site: site layout including enabling structures, developing site organization, Documentation at site; Manpower: planning, organizing, staffing, motivation.

UNIT III

Construction Materials and Resource Leveling: Materials, concepts of planning, procurement and inventory control; Equipment: basic concepts of planning and organizing; Funds: cash flow, sources of funds; Histograms and S-Curves. Earned Value; Resource Scheduling- Bar chart, line of balance technique, resource constraints and conflicts; resource aggregation, allocation, smoothening and levelling. Common Good Practices in Construction.

UNIT IV

Project Monitoring & Control-Supervision, record keeping, periodic progress reports, periodical progress meetings. Updating of plans: purpose, frequency and methods of updating. Common causes of time and cost overruns and corrective measures. Basics of Modern Project management systems such as Lean Construction; Use of Building Information Modelling (BIM) in project management.

UNIT V

Quality Control and Quality Assurance- Quality control, concept of quality, quality of constructed structure, use of manuals and checklists for quality control, role of inspection, basics of statistical quality control. Safety, Health and Environment on project sites: accidents; their causes, effects and preventive measures, costs of accidents, occupational health problems in construction, organizing for safety and health.

Text Books

1. Varghese, P.C., "Building Construction", Prentice Hall India, 2007.
2. National Building Code, Bureau of Indian Standards, New Delhi, 2017.
3. Punmia, B.C., Khandelwal, K.K., Project Planning with PERT and CPM, Laxmi Publications, 2016.

Reference Books

1. Chudley, R., *Construction Technology*, ELBS Publishers, 2007.
2. Peurifoy, R.L. Construction Planning, Methods and Equipment, McGraw Hill, 2011
3. Nunnally, S.W. Construction Methods and Management, Prentice Hall, 2006
4. Jha, Kumar Neeraj., Construction Project management, Theory & Practice, Pearson Education India, 2015

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

EARTHQUAKE ENGINEERING

(PROFESSIONAL ELECIVE - VI)

Course Code:GR24A4021 **L/T/P/C: 3/0/0/3**

IV Year I Semester

Prerequisites: Engineering Mechanics, Structural Design, Design of RCC Structures

Course Outcomes:

1. Recognize the importance of earthquake phenomenon and determine the response of structural system subjected to vibration including earthquake.

2. Apply the concept of seismic resistant design and concept of lateral load distribution on buildings.

3. Determine the principles of earthquake resistant design in the structure due to ground motion as per codal provisions.

4. Estimate the behaviour of the masonry building design under seismic action.

5. Apply the concept of ductile detailing in RCC structures.

Unit I

Earthquakes and its concepts: Engineering Seismology, Earthquake phenomenon, Cause of earthquakes, Faults, Plate tectonics, Seismic waves, Magnitude/Intensity of an earthquake-scales, Energy Released-Earthquake measuring, instruments seismogram, Seismoscope, Seismograph, Earthquake ground motion, Seismic zones of India. Theory of Vibrations, Elements of a vibratory system, Degrees of Freedom, Continuous system, Lumped mass idealization, Oscillatory Motion-Simple Harmonic Motion- Free vibration of single degree of freedom (SDOF) system.

Unit II

Fundamentals and Design Principles: Concept of Earthquake Resistant Design, Ductility, Hysteric response & energy dissipation, response modifications factor, design spectrum, capacity design, Classification of structural system, IS code provisions for seismic design of structures, multi-storeyed buildings, design criteria, P-Δ effects, storey drift, design examples ductile detailing of RCC structures.

Unit III

Seismic RCC Design: Reinforced Concrete Buildings, Principles of earthquake resistant deign of RC members, Structural models for frame buildings, Seismic methods of analysis, IS codal methods for seismic design, Vertical irregularities, Plan configuration problems, Lateral load resisting systems- Determination of design lateral forces as per IS 1893 (Part-1) :2016, Equivalent lateral force procedure- Lateral distribution of base shear – Response Spectrum.

Unit IV

Masonry Buildings: Introduction- Elastic properties of masonry assemblage, Categories of masonry buildings, Behaviour of unreinforced and reinforced masonry walls, Behaviour of walls, Box action and bands- Behaviour of infill walls, Improving seismic behaviour of masonry buildings, Load combinations and permissible stresses, Seismic design requirements, Lateral load analysis of masonry buildings.

Unit V:

Ductility: Ductility Considerations in Earthquake Resistant Design of RC Buildings, Impact of Ductility Requirements for Ductility, Assessment of Ductility, Factors affecting Ductility, Ductile detailing, considerations as per IS 13920-2016, Behaviour of beams, columns, and

joints in RC buildings during earthquakes. Lateral Load Resisting Systems, Special Moment Resisting Frames, shear walls and diaphragms.

Textbooks

1. S. K. Duggal, Earthquake Resistant Design of Structures, 2nd Edition, Oxford University Press, 2013.

2. Pankaj Agarwal & Manish Shrikhande, Earthquake Resistant Design of Structures, Prentice-Hall of India Pvt. Ltd., 2nd Edition, 2006.

3. T. Paulay & M. J. N. Priestley, Seismic Design of Reinforced Concrete and Masonry Buildings, John Wiley & Sons, 1st Edition, 1992.

Reference Books

1. Vinod Hosur, Earthquake-Resistant Design of Building Structures, Wiley India Pvt. Ltd., 1st Edition, 2012.

2. R. N. Iyengar, Elements of Mechanical Vibration, I. K. International Publishing House Pvt. Ltd., 1st Edition, 2010.

3. A. S. Arya, Masonry and Timber Structures Including Earthquake-Resistant Design, Nemchand & Bros., Roorkee, 1st Edition, 1992.

4. C. V. R. Murty, Earthquake Tips – Learning Earthquake Design and Construction, National Information Center of Earthquake Engineering, IIT Kanpur & BMTPC, New Delhi, 2005.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

PAVEMENT DESIGN (PROFESSIONAL ELECTIVE -VI)

Course Code:GR24A4022

L/T/P/C:3/0/0/3

IV Year II Semester

Pre-Requisites: Transportation Engineering, Concrete Technology.

Course Outcomes:

1. Illustrate highway design methods, constraints and controlling factors.
2. Apply the design standards in designing principal elements of the highway.
3. Identify the resource constraints and utilize the available materials in a sustainable way.
4. Examine the basic parameter of traffic engineering and the methods which help to estimate those parameters.
5. Estimate the major failure modes of flexible and rigid pavement and helps in proper maintenance.

UNIT I

Introduction to pavement design: Types of Pavements-Functions of individual layers, Variables considered in Pavement Design- Factors affecting Pavement Design: Wheel loads, Tire Pressure, Contact Pressure, ESWL & ESAL concepts

UNIT II

Material characteristics: Tests on sub-grade, Tests on aggregates-Aggregate properties and their importance- Tests on Bitumen-Requirements of design mix-Marshall method of mix design.

UNIT III

Stresses in flexible and rigid pavements: Stresses in Flexible Pavements-Layered systems concept-One layer system-Boussinesq two-layer system-Burmister theory of Pavement design. Stresses in Rigid pavements - Importance of Joints in rigid Pavements-Types of joints use of tie bars and dowel bars-Relative Stiffness- Modulus of Subgrade Reaction-Stresses due to warping Stresses due to loads-Stresses due to friction.

UNIT IV

Flexible and rigid pavement design: Flexible Pavement Design concepts-CBR method of Flexible Pavement design-IRC method of design-Asphalt Institute method and AASTHO methods. Rigid Pavement design concepts-IRC method of Rigid pavement design-PCA method-Design of tie bars and dowel bars.

UNIT V

Highway construction and maintenance: Construction: Construction of Bituminous Pavements, construction of Cement Concrete Roads. Highway maintenance –Pavement failures: failures in flexible Pavements, Rigid Pavement failures, Pavement evaluation - Overlay design by Benkelman Beam method.

Text Books

1. Highway and traffic Engineering-Subash Saxena, CBS Publisher distributors Pvt. Ltd. (2020) Delhi.

2. Highway Engineering-S.K. Khanna & C.E.G. Justo, Nemchand & Bros.10 th edition 2018.

3. Pavement Design by R Srinivasa Kumar, University Press (India) Pvt Ltd, 2013

Reference Books

1. Principles of traffic and highway engineering- Garber & Hoel, 5 th edition, 2014.

2. Pavement Analysis and Design – Yang H. Huang, 2nd edition.

3. Principles of Pavement Design – E. J. Yoder, M. W. Witczak,2nd edition, 1991.

4. Ministry of transport, "Road Development plan for India,19881-2001", Indian Road Congress.

5. New Delhi,1984.
6. Alam Singh, "Soil Engineering in Theory and Practice" Asia Publishing House, CBS Publisher & Distributors P Ltd; 2nd edition (January 1, 2010).
7. Mittal, Satyendra, and Shukla J. P., "Soil Testing for Engineering" Khanna Publisher, Delhi.2008

8. The Desing of Flexible pavements IRC 37-2001.

9. The Desing of Rigid pavements IRC 58-2002.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
IRRIGATION MANAGEMENT
(PROFESSIONAL ELECTIVE-VI)

Course Code:GR24A4023 **L/T/P/C: 3/0/0/3**

IV Year II Semester

Pre-Requisites: Hydrology and Water Resources Engineering

Course Objectives:

1. Examine the fundamentals of soils physical & chemical properties with respect to soil water plant relationship.
2. Estimate water requirement of various principal crops.
3. Design and development of various irrigation methods.
4. Identify conveyance of water through field channels and through underground pipe lines and land management.
5. Analyse irrigated areas and design of drainage systems

Course Outcomes:

1. Explain physical & chemical properties with respect to soil water plant relationship.
2. Acquire the knowledge to estimate water requirement for various principal crops.
3. Apply the various methods to design and development of irrigation structures.
4. Design the conveyance of water through field channels through underground pipe lines.
5. Analyze irrigated areas and design drainage systems.

UNIT I

Introduction: Necessity of irrigation and Scope, Benefits of Irrigation, Types of Irrigation, Physical and Chemical properties of soils, Field Capacity, Temporary and Permanent Wilting Points, Hydraulic Conductivity.

UNIT II

Water Requirement for Crops: Meteorological Parameters needed in estimating water requirement of crops, their measurements, Methods for estimating evapotranspiration of crops, Consumptive Use, Irrigation Requirement of Principal Crops, Duty, Delta and Base Period and Interrelationships, Factors Affecting the Duty, Cropping Patterns, Irrigation Efficiencies.

UNIT III

Methods of Irrigation: Surface Irrigation Methods, Border, Check, Furrow, Sub-irrigation Methods and their Relative Merits, Principles of Design of Surface Irrigation Methods, Micro- Irrigation, Sprinkler and Drip Irrigation Methods and their advantages and disadvantages.

UNIT IV

Planning of Irrigation Projects, Command Area Development Programmes, Classification of

Irrigable Soils, soils Management, Texture and structure of Soils, Soil groups of India, Soil Water plant Relations in Irrigation, Measurement of Soil Moisture. Land Grading Survey and Design, Equipment of Land Grading, Field Layout suiting different crops. Conveyance of Irrigation Water, Field Channels, Different lining materials, Design of field channels, Drop structures, Conveyance of water through underground pipe lines.

UNIT V

Irrigation Management, Diagnostic Analysis of Irrigation System, Micro Irrigation, Water Logging, Reclamation, Water Quality for Irrigation, Participatory Irrigation Management, Strategies, Conflict Management, Legal aspects in water sharing and management.

Text Books

1. Irrigation: Theory and Practice by Michael. A.M, S. Chand,2nd Edition, 2009.

2. Land and Water Management Engineering by V.V.N. Murthy, KalyaniPublishers, 2013.

3. Irrigation –Theoryand Practice" by Withers and Vipond, S, Cornell University Press,1980.

Reference Books

1. Irrigation Water Management Principle and Practice 2nd Edition 2014 Edition by Majumdar.

2. Irrigation Engineering and Hydraulic structures by Santhosh kumar Garg, Khanna Publishers.

3. Soil and Water Management Systems by Schwab G.O., Fangmeir, D.D. and Elliot W.J,John Wiley& Sons, 1996.

4. Irrigation and Water Resources Engineering by Asawa, G.L, New age Publishers,2005.

5. Theory and Design of Hydraulic structures by Varshney, Gupta & Gupta (1979).

6. Irrigation Engineering by R.K. Sharma and T.K. Sharma, S. Chand Publishers 2015.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

CONSTRUCTION EQUIPMENT AND AUTOMATION
(PROFESSIONAL ELECTIVE-VI)

Course Code:GR24A4024

L/T/P/C: 3/0/0/3

IV Year II Semester

Prerequisites: Building Materials and Construction Planning, Concrete Technology

Course Outcomes:

1. Examine how structures are built and projects are developed on the field
2. Explore modern construction practices
3. Examine the proper selection, application, utilization, and productivity of heavy equipment.
4. Interpret cost analysis for owning and operating heavy equipment.
5. Optimize construction projects cost based on Equipment Operational and Maintenance costs.

UNIT I

Conventional construction methods Vs Mechanized methods and advantages of latter; Equipment for Earthmoving, Dewatering; Concrete mixing, transporting & placing; plastering machines; Prestressing jacks and grouting equipment;

UNIT II

Cranes, Hoists, and other equipment for lifting; Equipment for transportation of materials. Equipment Productivities; Use of Drones for spread out sites; Use of robots for repetitive activities

UNIT III

Earthmoving, Excavating, and Lifting Equipment Selection - Bulldozers, Front-end Loaders, Scrapers, Trucks, Excavators, Backhoes, Front shovels, Cranes; Piles and Pile-Driving Equipment; Production of Crushed-stone Aggregate; Concreting Equipment

UNIT IV

Planning Process for Equipment and Methods; Cost of Owning and Operating Construction Equipment - Ownership cost, Depreciation, Operating cost, Ownership, and operating costs calculation methods

UNIT V

Equipment Life and Replacement Procedures - Physical, profit and economic life, Replacement analysis; Engineering Fundamentals of Moving Earth - Rolling resistance, Effect of grade on tractive effort

Text Books

1. D. G. Gransberg, C. M. Popescu and R. C. Ryan, Construction equipment management for engineers, estimators, and owners, Taylor & Francis, New York, 2006.

2. R. L. Peurifoy, C. J. Schexnayder, A. Shapira and R. Schmitt, Construction planning, equipment, and methods, 8th ed., McGraw Hill, New York, 2008.
3. Arora and Bindra, Building Construction, Dhanpat Rai, 2012.

Reference Books

1. F. Harris, R. McCaffer and F. Edum-Fotwe, Modern construction management, 6 t h ed., Blackwell Publishing, Oxford, 2006
2. K. Knutson, C. J. Schexnayder, C. M. Fiori and R. Mayo, Construction management fundamentals, 2 nd ed., McGraw Hill, New York, 2008.
3. Cameron K. Andres, Ronald C. Smith, Principles and Practices of Commercial Construction, 8th Edition, Prentice Hall, 2009.
4. National Building Code of India, Bureau of Indian Standards, 2005.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
ENTREPRENEURSHIP AND PROJECT MANAGEMENT

Course Code:GR24A4025 **L/T/P/C: 3/0/0/3**

Prerequisites: Geotechnical Engineering, Concrete Technology

Course Outcomes:

1. Simplify to do Project Planning and develop Project Schedules
2. Identify Critical Path in CPM & PERT Networks; Compute Floats and Slacks for Activities & Events respectively to Progress and Complete the Project in Time.
3. Summarize the various construction methods, Statements of various Activities and their ITPs with the Knowledge of Project Quality Plans.
4. Categorize Construction Equipment requirement and deploys in best possible manner for better productivity; Conducts Field Tests for Soils at specified frequency.
5. Utilize the Concept of Entrepreneurship & Social Entrepreneurship; Becomes an entrepreneur being familiar with Characteristics of Entrepreneurship & Entrepreneurs

UNIT - I

Construction Project Planning- Stages of project planning: Steps involved in Project Planning pre-tender planning, Scheduling, Steps involved in Scheduling, Process of development of Schedules, Gantt Chart, Milestone Chart,

UNIT - II

Construction Project Monitoring: CPM and PERT Networks, basic terminology, types of precedence relationships Preparation of CPM Networks for Construction Activities, Critical Path, Float-Types of Float, computation of Float values, work break-down structure, Three-Time Estimate, PERT- Assumptions underlying PERT analysis, determining three time estimates, analysis, slack computations, calculation of probability of completion.

UNIT - III

Construction Methods: basics: Types of foundations and construction methods; Basics of Formwork and Striping of Formwork; Common building construction methods conventional walls and slabs; conventional framed structure with blockwork walls; Precast concrete construction methods; Project Quality Plan (PQP), Method Statements, Inspection and Test Plans (ITPs), Quality Control Vis-à-vis Quality Assurance. Acceptance Criteria of Concrete, Core Cutting of Concrete Members. Load Test for Flexural Members

UNIT - IV

Construction Equipment basics: Conventional construction methods Vs Mechanized methods and advantages of Mechanized methods; Equipment for Excavation-Excavators, Front End

Loaders and Earthmoving-Tippers, Compaction of Soils, OMC, Dozers, Motor graders, Rollers-Static and Vibratory (Tandem), Field Tests to Test Density of Soils-Core Cutting, Sand Replacement and Nuclear Density Gauge. Concrete Mix-Nominal and Design Mix. Concrete mixing – Batching Plants, transporting (Transit Mixers) and placing - Concrete Pumping and Boom Placers, Cranes, Tower Crane.

UNIT – V

Entrepreneurship: Concept of Entrepreneurship – entrepreneurs; Types of Entrepreneurship, Importance of Entrepreneurship, Main Characteristics of Entrepreneurship, Purpose of Entrepreneurship, Nature of Entrepreneurship, 10 characteristics of Entrepreneurs, Examples of Entrepreneurship, How do you start Entrepreneurship, Benefits of Entrepreneurship, Difference between Entrepreneurship and Business, Risks of Entrepreneurship, 7 Practical Tips to Become an Entrepreneur with No Money, Social Entrepreneurship, Challenges of Social Entrepreneurship.

Text Books

1. Jha, Kumar Neeraj., Construction Project management, Theory& Practice, Pearson Education India, 2015.
2. Punmia, B.C., Khandelwal, K.K., Project Planning with PERT and CPM, Laxmi Publications, 2016.

Reference Books

1. Peurifoy, R.L. Construction Planning, Methods and Equipment, McGraw Hill, 2011.
2. National Building Code, Bureau of Indian Standards, New Delhi, 2017.
3. Chudley, R., Construction Technology, ELBS Publishers, 2007.
4. Nunnally, S.W. Construction Methods and Management, Prentice Hall, 2006.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
PROJECT WORK – PHASE II

Course Code:GR24A4026
L/T/P/C: 0/0/12/6
IV Year II Semester

Pre-Requisite: Knowledge of all Civil Engineering subjects and Laboratories, communication skills

Course Outcomes:
1. Practice and acquire the knowledge within the chosen area of technology for Project Development.
2. Identify, discuss, and justify the technical aspects of the chosen project with a comprehensive and systematic approach.
3. Design and develop Engineering Projects by implementing technical aspects.
4. Work as an individual or in a team in development of Technical Projects.
5. Compile and report effectively the project related activities and findings.

OPEN ELECTIVES

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
HUMAN RESOURCE DEVELOPMENT AND ORGANIZATIONAL BEHAVIOUR
(OPEN ELECTIVE)

Course Code: GR24A3010 **L/T/P/C: 3/0/0/3**

Course Outcomes: After completing this course, students will be able to:
1. Acquaint with the determinants of intra -individual, inter-personnel and inter-group behaviour in organizational setting.
2. Understand individual behavior in organizations, including diversity, attitudes, job satisfaction, emotions, moods, personality, values, perception, decision making, and motivational theories and apply in the organizational context.
3. Assess the group behavior in organizations, including communication, leadership, power and politics, conflict, and negotiations in the framework of organization and to familiarize the concepts, techniques and practices of human resource development in the current organizational view.
4. Impart and apprise the capable of applying the principles and techniques as professionals for developing human resources in an organization.
5. Report the current trends and applications in HRD and Balanced Scorecard to measures the performance and to develop, implement, and evaluate organizational human resource development strategies aimed at promoting organizational effectiveness in different organizational environments.

UNIT-I: Introduction to OB :
Organisational Behaviour- Concept and Emergence of OB Concept; Nature and Theoretical frameworks; Models of Organisational Behaviour, Challenges and Opportunities for Organisational Behavior;

UNIT-II: Individual Behaviour:
Individual Behaviour: Personality, Learning, Values and Attitudes, Perception, Stress at work. Management's assumptions about people- McGregor's Theory X and Theory Y. Motivation - Maslow's Need Hierarchy, Herzberg's Two Factors Theory, Vroom's Expectancy Theory.

UNIT-III: Inter-personal and Group Behaviour:

Interpersonal communication and Feedback; Transactional Analysis (TA); Johari Window. Group Behaviour: Group Dynamics, Cohesiveness and Productivity; Management of Dysfunctional groups; Group Decision Making. Leadership- Concept and Styles.

UNIT-IV: Introduction to Human Resource Development:
Concept; Relationship between human resource management and human resource development; HRD mechanisms, processes and outcomes; HRD matrix; Roles and competencies of HRD professionals; Challenges in HRD, steps in HRD Process.

UNIT-V: HRD Applications and Trends:
Coaching and mentoring; Career management and development; Competency mapping; Balanced Score Card. HRD in Organisations: Selected cases covering HRD practices in government organisations, manufacturing and service industries and MNCs.

TEXT BOOKS:
1. Robbins, Stephen P. and Timothy A. Judge, Organisational Behaviour, Prentice -Hall, New Delhi.
2. Werner J. M., DeSimone, R.L., Human resource development, South Western.

REFERENCE BOOKS:
1. Luthans, Fred, Organizational Behaviour, McGraw-Hill, New York.
2. Gregory, Moorhead and Ricky W. Griffin, Managing Organizational Behaviour, Thomson South Western Publication.
3. Pareek, Udai and V. Sisodia, "HRD in the New Millennium, Tata McGraw - Hill Publishing Co. Ltd., New Delhi, 1999.
4. Haldar, U. K., Human resource development, Oxford University Press India.
5. Rao, T.V., Future of HRD, Macmillan Publishers India.
6. Rao, T.V., HRD Score Card 2500: Based on HRD audit, Response Books, SAGE Publications.
7. Mankin, D., Human resource development, Oxford University Press India.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
CYBER LAW AND ETHICS
(OPEN ELECTIVE)

Course Code: GR24A3024 **L/T/P/C: 3/0/0/3**

Course Outcomes: After completing this course, students will be able to:
1. Identify and analyze statutory, regulatory, constitutional, and organizational laws that affect the information technology professional.
2. Locate and apply case law and common law to current legal dilemmas in the technology field.
3. Apply diverse viewpoints to ethical dilemmas in the information technology field and recommend appropriate actions.
4. Understand cybercrime and ethical practices and the student will be able to know and learn web technologies and related issues.
5. In position to interface with various issues pertaining to Intellectual Property, copy rights, patents rights etc. and provide an overview of cybercrime and framework.

UNIT-I: The Legal System: Sources of Law and The Court Structure:
Enacted law -Acts of Parliament are of primary legislation, Common Law or Case law- Principles taken from decisions of judges constitute binding legal rules. The Court System in India and Foreign Courtiers. (District Court, District Consumer Forum, Tribunals, High Courts, Supreme Court), Arbitration: As an alternative to resolving disputes in the normal courts, parties who are in dispute can agree that this will instead be referred to arbitration.

UNIT-II: Introduction cyber law:
Computers and its Impact in Society, Overview of Computer and Web Technology, Need for Cyber Law, Cyber Jurisprudence at International and Indian Level. , NITI Aayog and some current aspects.

UNIT-III: Constitutional & Human Rights Issues in Cyber space :
Freedom of Speech and Expression in Cyberspace, Right to Access Cyberspace, Access to Internet, Right to Privacy, Right to Data Protection.

UNIT-IV: Cyber Crimes & Legal Framework:
Cyber Crimes against Individuals, Institution and State, Hacking, Digital Forgery, Cyber Stalking/Harassment, Cyber Pornography, Identity Theft & Fraud, Cyber terrorism, Cyber Defamation, Different offences under IT Act

UNIT-V: Intellectual Property Issues in Cyber Space:
Interface with Copyright Law, Interface with Patent Law, Trademarks & Domain Names Related issues.

TEXT BOOKS:
1. Chris Reed & John Angel, Computer Law, OUP, New York, (2007).
2. Justice Yatindra Singh, Cyber Laws, Universal Law Publishing Co, New Delhi, (2012)

3. Verma S, K, Mittal Raman, Legal Dimensions of Cyber Space, Indian Law Institute, New Delhi, (2004)
4. Jonthan Rosenoer, Cyber Law, Springer, New York, (1997).

REFERENCE BOOKS:

1. Sudhir Naib, The Information Technology Act, 2005: A Handbook.
2. S. R. Bhansali, Information Technology Act, 2000
3. University Book House Pvt. Ltd. Jaipur (2003).
4. Vasu Deva, Cyber Crimes and Law Enforcement, Commonwealth Publishers, New Delhi.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
ECONOMIC POLICIES IN INDIA
(OPEN ELECTIVE)

Course Code: GR24A4013 **L/T/P/C: 3/0/0/3**

Course Outcomes: After completing this course, students will be able to:
1. Familiarize with the nature of business environment and its components.
2. The students will be able to demonstrate and develop conceptual framework of business environment.
3. Understand the definition of ethics and the importance and role of ethical behaviour in the business world today.
4. Explain the effects of government policy on the economic environment.
5. Outline how an entity operates in a business environment.

UNIT-I: Business environment:
Factors effecting Business Environment-need for industrial policies, Overview of Indian Economy, Trends towards market economy, problems of underdevelopment – meaning, Main problems, reasons, of underdevelopment.

UNIT-II: Factors and measure:
Meaning of Economic development, National income, Per capital income, Quality of life, Capital Formation – Savings, Investment.

UNIT-III: NITI Aayog and Planning in India:
Niti Aayog and its function, how is Niti Aayog different from planning commission, Meaning, Importance, Main reasons of adopting, planning in India, Objectives of planning, Economic development, moderation, stability, self-sufficiency, employment etc, foreign aid, Employment. Allocation of Resources.

UNIT-IV: Private and Public Sector, Public Sector:
Role and growth, Achievements of the public sector, Private Sector – Importance Problems, New foreign Trade Policy.

UNIT-V: Present Economic Policy:
Main feature, Globalization, Expansion of Private sector, more market orient approach. Public distribution system, Industrial policies before and after 1991, Industrial Licensing, Monetary and Fiscal Policy, elements of Indian current GDP and review of current budget.

TEXT BOOKS:
1. Francis Cherunilam: Business Environment: Text and Cases. 18/e. Himalaya. 2009.
2. Misra and Puri: Indian Economy, Himalaya, 2009.

REFERENCE BOOKS:
1. Indian Economy- A. N. Agarwal
2. Indian Economy – Mishra &Puri

3. Indian Development and planning – M. L. Jhingan
4. Indian Economy – R. S. Rastogi Yozna and Kurukshetra Magazines

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
INDIAN KNOWLEDGE SYSTEM
(OPEN ELECTIVE)

Course Code: GR24A3023 **L/T/P/C: 3/0/0/3**

Course Outcomes: After completing this course, students will be able to:
1. Understand nature, scope and related fields of Indian knowledge system.
2. Demonstrate the scientific literature available in ancient Indian traditions
3. Understanding the application of Bharatiya Jnana Parampara
4. Understand Indian approach towards Wellbeing
5. Appreciate vast contribution of ancient Indian researchers, engineers, scientists and architects to the modern world

UNIT-I: Introduction to Indian Knowledge Systems:
Meaning, Nature, Scope and Salient Aspects of Bharatiya Jnana Parampara - Introduction to Vedas, Upanishads, Vidya, Kala, Jnana, Shastra - Practices and Continuity of Tradition

UNIT-II: Overview of History of Indian Education and Scientific Literature:
Gurukul System - Role of Sanskrit in Natural Language Processing - Scientific Literature – Vedic. Literature - Available Scientific Treatises - Interlinkings

UNIT-III: Introduction to Scientific Theories from Pure Sciences from Ancient Indian Knowledge Systems:
Overview of theories from available ancient Indian Literature about Physics, Chemistry and Mathematics - Interlinking's and applications

UNIT-IV: Introduction to Ancient Indian Wellness Systems:
Concept of Wellness – Yoga System - Ayurveda System - Ancient Indian Aesthetics Achievements of the public sector, Private Sector – Importance Problems, New foreign Trade Policy.

UNIT-V: Development of Engineering, Science, Technology & Fine Arts in India:
Various Industries - Silk, Cotton and Ship Building - Evolution of Indian Fine Arts – Cave and Temp Architecture, Vastu - Vidya, Sculpture, Forts and Stepwells, Observatories and Paintings - Music and Natyakala - Cultural Traditions & Folk Arts.

Pedagogy for Teachers: Apart from Classroom Instruction, the following Methods are Suggested.
1. Project based activities and learning.
2. Presentation and case studies.
3. Film screening and book reviews.
4. Visit to historical places, archives centre, research centre or library nearby.

Note: Activities mentioned above are only suggestive. Teacher-educators should encourage students to be innovative.

TEXT BOOKS:

1. B. Mahadevan, Bhat Vinayak and Nagendra Pavan R.N., (2022) 'Introduction to Indian Knowledge Systems: Concepts and Applications' PHI learning PVT, New Delhi ISBN [9789391818203]
2. Dharmapal (1971) 'Indian Science and Technology in the Eighteenth Century'. Other India Press, Goa.
3. Kapil Kapoor, Singh Avdhesh Kumar, (2005) 'Indian Knowledge Systems' D.K. Printworld (P) Ltd. ISBN 10: 8124603367 / ISBN 13: 9788124603369
4. Chakradeo, Ujwala, Temples of Bharat, Aayu Publications, New Delhi, 2024.
5. D.N. Bose, S.N. Sen and B. V. Subbarayappa, A Concise History of Science in India, Indian National Science Academy, New Delhi, 2009.
6. Datta B. and A. N. Singh, History of Hindu Mathematics: Parts I and II, Asia Publishing House, Bombay, 1962.
7. Kapoor, K. (2021), Indian Knowledge System: Nature, Philosophy, Character in Indian Knowledge System, vol. 1, Pub. Indian Institute of Advanced Studies, Shimla
8. Mahadevan, B., Bhat, V.R., Pavana, N. (2022), Philosophical Systems, in Introduction to Indian Knowledge System, Pub. PHI Learning, New Delhi.
9. Mahadevan, B., Bhat, V.R., Pavana, N. (2022), Knowledge: Framework and Classification, in Introduction to Indian Knowledge System, Pub. PHI Learning, New Delhi.

VIDEO RESOURCES:

1. Introductory lectures by Prof. Gauri Mahulikar
2. Introductory lectures by Prof. Kapil Kapoor

WEBSITES:

- https://iksin dia.org/index.php
- Official Website of IKS- Indian Knowledge System
- https://www.youtube.com/watch?v=uKcf-hSlcUE
- Address by Prof Kapil Kapoor | Indian Institute of Advanced Study (FDP 2021)
- https://www.youtube.com/watch?v=MDJTXNiH2_A
- Mukul Kanitkar on Bharatiya Knowledge System
- https://www.youtube.com/watch?v=uARMhv97pjk
- https://www.youtube.com/watch?v=oTwgf56GbsA
- Scientific History of India | Mukul Kanitkar Lecture in DTU
- https://youtu.be/gNJNmPJqXJc?si=WFBbuUT65mLZzpOW
- Ancient India's Scientific Achievements & Contribution in Mathematics, Astronomy, Science & Medicine

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
A PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS
(OPEN ELECTIVE)

Course Code: GR24A4012 **L/T/P/C: 3/0/0/3**

Course Outcomes:
1. Study of Shrimad- Bhagwad-Gita wiil help the student in developing his personality and achieve the highest goal in life
2. The person who has studied Geeta will lead the nation and mankind to peace and prosperity
3. Study of Neethishatakam will help in developing versatile personality of students
4. To develop self-developing attitude towards work without self-aggrandizement and to develop suffering free meditative mind
5. To develop tranquil attitude in all favorable and unfavorable situations and to develop high spiritual intelligence

UNIT-I: Neetisatakam-Holistic development of personality
- Verses- 19,20,21,22 (wisdom)
- Verses- 29,31,32 (pride & heroism)
- Verses- 26,28,63,65 (virtue)

UNIT-II: Neetisatakam-Holistic development of personality
- Verses- 52,53,59 (dont's)
- Verses- 71,73,75,78 (do's)

UNIT-III: Approach to day to day work and duties
- Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48,
- Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35,
- Chapter 18-Verses 45, 46, 48.

UNIT-IV: Statements of basic knowledge
- Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68
- Chapter 12 -Verses 13, 14, 15, 16,17, 18
- Personality of Role model. Shrimad Bhagwad Geeta:

UNIT-V:
- Classification, Chapter2-Verses 17, Chapter 3-Verses 36,37,42,
- Chapter 4-Verses 18, 38,39
- Chapter18 – Verses 37,38,63

TEXT BOOKS/ REFERENCE BOOKS:
1. "Srimad Bhagavad Gita" by Swami Swarupananda Advaita Ashram (Publication Department), Kolkata.
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
ENGINEERING MATERIALS FOR SUSTAINABILITY
(OPEN ELECTIVE)

Course Code: GR24A3009 **L/T/P/C: 3/0/0/3**

Course Outcomes: After completing this course, students will be able to:
1. Describe the different types of environmental factors effecting materials
2. Report the work in sustainability for research and education
3. Illustrating the broad perspective in thinking for sustainable practices by utilizing the engineering knowledge and principles gained from this course
4. Perform cost/benefit analysis and life-cycle analysis of green buildings.
5. Identify the balance affordability, functionality, and environmental responsibility to create sustainable and effective building designs.

UNIT-I: Sustainability:
Introduction, need, and concept of sustainability, Social- environmental and economic sustainability concepts. Sustainable development, Nexus between Technology and Sustainable development, Challenges for Sustainable Development. Multilateral environmental agreements and Protocols – Clean Development Mechanism (CDM), Environmental legislations in India – Water Act, Air Act

UNIT-II: Environmental management standards:
ISO 14000 series, Life Cycle Analysis (LCA) – Scope and Goal, Bio-mimicking, Environment Impact Assessment (EIA) – Procedures of EIA in India

UNIT-III:
Green Building Materials, Basic concepts of sustainable habitat, green buildings, green materials for building construction, material selection for sustainable design, green building certification, Methods for increasing energy efficiency of buildings. Sustainably managed Materials, Depleting natural resources of building materials; renewable and recyclable resources; energy efficient materials; Embodied Energy of Materials

UNIT-IV:
Green cement, Biodegradable materials, Smart materials, Manufactured Materials, Volatile Organic Compounds (VOC's), Natural Non-Petroleum Based Materials, Recycled materials, Renewable and Indigenous Building Materials, Engineering evaluation of these materials

UNIT-V:
Green Building Planning and Specifications**,** Environment friendly and cost effective Building Technologies, Integrated Life cycle design of Materials and Structures, Green Strategies for Building Systems, Alternative Construction Methods, Energy Conservation Measures in Buildings, Waste &Water management and Recycling in Sustainable Facilities, Heating, Ventilation and Air Conditioning, Passive Solar & Daylight, Plumbing and its Effect on Energy Consumption

TEXT BOOKS:

1. Alternative Building Materials and Technologies – By K S Jagadeesh, B V Venkata Rama Reddy & K S Nanjunda Rao – New Age International Publishers, 2007
2. Integrated Life Cycle Design of Structures – By AskoSarja – SPON Press, 2011
3. Non-conventional Energy Resources – By D S Chauhan and S K Srivastava – New Age International Publishers, 2021

REFERENCE BOOKS:

1. Emerald Architecture: case studies in green buildings, The Magazine of Sustainable Design, 2008
2. Understanding Green Building Guidelines: For Students and Young Professionals, Traci Rose Rider, W. W. Norton & Company Publisher.2009
3. Understanding Green Building Materials, Traci Rose Rider, W. W. Norton & Company Publisher.2011
4. Green Buildings (McGraw hill publication): by Gevorkian, 2006

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
GEOGRAPHIC INFORMATION SYSTEMS AND SCIENCE
(OPEN ELECTIVE)

Course Code: GR24A3022 **L/T/P/C: 3/0/0/3**

Course Outcomes: After completing this course, students will be able to:
1. Interpret the fundamental concepts of Geographic Information Science and Technology along with different data structures.
2. Demonstrate Map creation and design principles, including thematic map display, employment of map projections and cartographic design.
3. Analyze the types of digital maps for different themes.
4. Apply the spatial analysis to remote sensing data to generate thematic maps.
5. Solve the real-life problems associated with geospatial and remote sensing.

UNIT-I:
Fundamentals of GIS – Information Systems, Modelling Real World Features Data, Data Formats, Applications of GIS, – Spatial and Non-spatial, Components, Data Collection and Input, Data Conversion, Database Management – Database Structures, Files; Standard Data Formats, Compression Techniques, Hardware – Computing, printing and scanning systems; Software – Standard Packages like Arc view, ArcGIS (commercial) & Auto-CAD Map, Map Info etc. QGIS open software- Salient features.

UNIT-II:
Topology – Types of Errors, Editing and Error Rectification, Types of Topology, Modeling topological Relationships, Tolerances.

UNIT-III:
Map – mapping concepts, analysis with paper-based maps, limitations, Computer Automated Cartography– History and Developments, GIS- Definition, advantages of digital maps.

UNIT-IV:
Spatial Analysis and Modelling – Proximity Analysis, Overlay Analysis, Buffer Analysis, Network Analysis, Spatial Auto Correlation, Gravity Modelling, DTM/DEM, Integration with Remote Sensing data

UNIT-V:
GIS Project Planning and Implementation – Under Standing the Requirements, Phases of Planning, Specifications, Data Procurement, Tendering, Human Resources, Back Up, Monitoring Progress

TEXT BOOKS:
1. Concepts & Techniques of GIS by C. P. Lo Albert, K. W. Yonng, Prentice Hall (India) Publications, 2nd edition, 2016.
2. Fundamental of GIS by Mechanical designs John Wiley &Sons, 4th edition, 2008.

3. Principals of Geographic Information Systems – Peter Beur and Rachael A.Mc Donnell, Oxford Publishers 2016.

4.

REFERENCE BOOKS:

1. Remote Sensing and Geographical Information systems by M. Anji Reddy JNTU Hyderabad.4th Edition 2014, B. S. Publications.
2. Introduction to Geographic Information Systems by Kang-tsung Chang, Tata McGraw-Hill Publishing Company Limited- 2008.
3. Remote sensing of the environment –An earth resource perspective by John R Jensen, Prentice Hall 4. GIS by Kang – tsung chang, TMH Publications & Co., 2nd edition, 2013.
4. Basics of Remote sensing & GIS by S.Kumar, Laxmi Publications, 1st edition,2016.
5. Remote Sensing and its applications by LRA Narayana, UniversityPress 1999.
6. Remote sensing and image interpretation by Thomas Lillesand, 7th Edition, John Wiley & sons,6th Edition 2011.
7. Fundamentals of Geographic Information systems by Michael N. Demers, 4th Edition, Wiley Publishers, 2012.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
PLUMBING -WATER AND SANITATION
(OPEN ELECTIVE)

Course Code: GR24A4011 **L/T/P/C: 3/0/0/3**

Course Outcomes: After completing this course, students will be able to:
1. Coordinate plumbing works from inception to completion with Owners, Architects, other consultants, and contractors.
2. Select proper plumbing materials and systems.
3. Read and interpret plumbing drawings.
4. Supervise code based plumbing installations. Understand methods to conserve water and energy, Protect health and safety of end users.
5. Enjoy better job opportunities and career options

UNIT-I: Introduction to Plumbing and Sanitation Importance of Codes, Architectural and Structural Coordination Codes and Standards: Scope, purpose; codes and standards in the building industry, UIPC-I (Uniform Illustrated Plumbing Code-India), NBC (National Building Code) and other codes, Local Municipal Laws, approvals, general regulations, standards, water supply, sewerage system, drainage system, workmanship, water conservation, protection of pipes and structures, waterproofing. of GIS – Information Systems, Modelling Real World Features Data, Data Formats, Applications of GIS, – Spatial and Non-spatial, Components, Data Collection and Input, Data Conversion, Database Management – Database Structures, Files; Standard Data Formats, Compression Techniques, Hardware – Computing, printing and scanning systems; Software – Standard Packages like Arc view, ArcGIS (commercial) & Auto-CAD Map, Map Info etc. QGIS open software- Salient features.
Architectural and Structural coordination: Provisions for plumbing systems, coordination during the planning stage, various agencies involved and their roles, space planning for plumbing systems, water tanks, pump room, centralized hot water systems, toilet locations.

UNIT-II: Plumbing Terminology:
Definitions, use/purpose of the following. ***Plumbing Fixtures:*** accessible, readily accessible, aerated fittings, bathroom group, carrier, flood level rim, floor sink, flush meter valve, flush tanks, lavatories, macerating toilet, plumbing appliances, plumber. ***Traps:*** indirect waste, vent, blow off, developed length, dirty arm, indirect waste, receptors, slip joints, trap, and vent. ***Drainage:*** adapter fitting, adjusted roof area, air break, air gap, area drain, base, bell and spigot joint, building drain, branch, (DFU) Drainage Fixture Units, grease interceptor, joints, roof drain, smoke test, stack. ***Water supply:*** angle valve, anti-scald valve, backflow, bypass, check valve, cross connection, gate valve, gray water, joints.

UNIT-III: Plumbing Fixtures and Fittings:
Definitions of plumbing fixtures, fittings, appliances and appurtenances; maximum flow rates, water closets, urinals, flushing devices, washbasins, bath/shower, toilets for differently abled, kitchen sinks, water coolers, drinking fountain, clothes washer, dish washer, mop sink, overflows, strainers, prohibited fixtures, floor drains, floor, location of valves, hot water

temperature controls, installation standard dimensions in plan and elevation.

UNIT-IV:

Traps, Interceptors, Indirect Waste and Vents Traps required, trap arms, developed length, trap seals, venting to traps, trap primers, prohibited traps, building traps. Discharge for indirect waste piping, nature of contents or systems, proper methods to install indirect waste piping, air gap and air break, sink traps, dish washers. Vent requirement, purpose of venting, trap seal protection, materials, vent connections, **Sanitary Drainage and Storm Drain** Preamble, one pipe and two pipe systems, different pipe materials and jointing methods, special joints, hangers and supports, protection of pipes and structures, alternative materials, workmanship, prohibited fittings and practices.

Water Supply, Gray and Reclaimed Water: Preamble, one pipe and two pipe systems, different pipe materials and jointing methods, special joints, hangers and supports, protection of pipes and structures, alternative materials, workman ship, prohibited fittings and practices, change in direction of flow, T and Y fittings, Storm drain required, prohibited connections, subsoil drains, sub-drains, gutters, channels or scuppers, roof drains, catchment, collect/capture storm water, discharging storm water, Rain Water Harvesting (RWH) definition, need, catchment, conduits, settlement tanks, treatment, possible uses, recharging pits, NBC requirements.

UNIT-V:

Water Supply, Gray and Reclaimed Water (Preamble, sources of water, potable and non-potable water, reclaimed water, calculating daily water requirement and storage, hot and cold water distribution system. pipe materials and jointing methods, alternative materials, hangers and supports, workmanship, prohibited fittings and practices, protection of pipes and Plumbing (Water and Sanitation) structures, pressure controls, unions, thermal expansion, types of valves, Definition of gray water, approvals, specifications and drawings, safety, total gray water discharge, holding tanks, valves and piping.

Introduction to water treatment plant (WTP) and STP: Introduction to Net Zero concept, need to reduce and reuse, rating of Water Efficient Plumbing fixtures and fittings, 24x7 water supply, metering and sub-metering, typical daily water and wastewater calculations for a project.

TEXT BOOKS:

1. Elements of Water Pollution Control Engineering, O.P. Gupta, Khanna Book Publishing, New Delhi. Edition ·1, 2019.
2. Plumbing Engineering" Author: R. G. Saran Publisher: S. K. Kataria & Sons Latest Edition: 2022 (Revised Edition)
3. "Water Supply and Sanitary Engineering" Authors: G. S. Birdie and J. S. Birdie Publisher: Dhanpat Rai Publishing Company Latest Edition: 2022 (33rd Revised Edition)
4. "Plumbing: Design and Installation" Author: L. G. Wade Publisher: Cengage Learning Latest Edition: 2019 (4th Edition)

REFERENCE BOOKS:

1. "Plumbing Engineering Design Handbook" (Volumes I & II) Publisher: American Society of Plumbing Engineers 2022 Edition (Volume 1: Fundamentals; Volume 2: Systems)
2. Water Efficiency and Sanitation Standard published by IPA Indian Plumbing Association (IPA) and IAPMO International Association of Plumbing and Mechanical Officials (India)

Water Pollution, Berry, CBS Publishers, 2023 edition.
3. ‘A Guide to Good Plumbing Practices’, a book published by IPA, 2016 edition.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
NON-CONVENTIONALENERGYSOURCES
(OPEN ELECTIVE)

Course Code: GR24A3035 **L/T/P/C: 3/0/0/3**

Course Outcomes: After completing this course, students will be able to:
1. Recall the concepts of Solar Energy and Solar collectors.
2. Illustrate the PVSolar system with energy backup.
3. Analyze the basic physics of wind power generation.
4. Determine the energy generation from biomass, biogas, and geothermal energy.
5. Discuss Tidal power systems and fuel cells.

UNIT-I: Solar Radiation:
Solar spectrum-Solar Radiation on Earth's surface- Solar radiation geometry-Solar radiation measurements-Solar radiation data-Solar radiation on horizontal and tilted surfaces. Solar Thermal Conversion-Flat plate collectors, concentrated collectors- construction and thermal analysis- Solar applications-Solar ponds- Heliostat systems- water heater-air heater- solar still.

UNIT-II: Photo Voltaic System:
Photo voltaic cells-Equivalent circuit- V-I Characteristics- Photovoltaic modules-constructional details- design considerations-Tracking-Maximum power point tracking–algorithms-PV solar system design with energy backup-Solar Thermo electric Conversion.

UNIT-III: Wind Energy:
Fundamentals of wind energy-power available in wind-BetzLimit-Aerodynamics of wind turbine- Wind turbines-Horizontal and vertical axis turbines–their configurations-Wind Energy conversion systems.

UNIT-IV: Biogas and Geothermal Energy:
Various fuels-Sources- Conversion technologies–Dry Processes-Biogas generation–Aerobic and anaerobic digestion- Factors affecting the generation of biogas –Classification of biogas plants-Different Indian digesters- Digester design considerations- Gasification process-Gasifiers-Applications. Geothermal Energy-sources-Hydro thermal convective-Geo-pressure resources-Petro-thermal systems(HDR)-Magma Resources-Prime Movers

UNIT-V: Tidal Energy:
Principle of operation-Open and closed cycles, Energy from Tides-Principle of Tidal Power—Components of tidal Power plants-Operation Methods-Estimation of Energy in Single and double basin systems-Energy and Power from Waves-Wave energy conversion devices-Fuel Cells-Design andPrincipleofoperation-TypesofFuelCells-Advantagesanddisadvantages-TypesofElectrodes- Applications-Basics of Batteries –Constructional details of Lead acid batteries- Ni-Cd Batteries.

TEXT BOOKS:

1. John Twidell & Wier, Renewable Energy Resources,CRCPress,2009.
2. D.P.Kothari, Singal, Rakesh, Ranjan, Renewable Energy Sources and Emerging Technologies, PHI, 2009.

REFERENCE BOOKS:

1. G.D.Rai–Non-Conventional Energy sources, Khanna publishers.
2. B.H.Khan,“Non-ConventionalEnergyResources”,2ndedition,TataMcGraw-Hill,New Delhi.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

CONCEPTSOF CONTROLSYSTEMS
(OPEN ELECTIVE)

Course Code: GR24A3046 **L/T/P/C: 3/0/0/3**

Course Outcomes: On completion of the course, the student will be able to

1. Infer the basic concept control systems.
2. Develop the mathematical model of the systems.
3. Analyze the time domain specifications and steady state error.
4. Outline the concept of stability of the system.
5. Solve the frequency response analysis

UNIT-I: Basic Concepts of Control System:

Terminology - plant, process, system, disturbances, controlled variable, manipulated variable etc., Block diagram of basic control system, application areas with examples. Classifications of control systems

UNIT-II: Mathematical Modelling of Systems:

Translational and rotational mechanical systems, electrical systems, Force voltage and force current analogy, Block diagram and signal flow graph representation of physical systems along with rules, properties, comparison and limitation, Mason's gain formula.

UNIT-III: Time Response Analysis:

Standard test signals along with examples of their usage, steady state errors for step, ramp and parabolic inputs, analysis of first and second order systems, Transient response specifications with numerical examples, Basic control actions and two position, proportional, P, PI, PID controllers, Limitations of time domain analysis.

UNIT-IV: Stability:

Concept of stability, types of stability, Routh's stability criterion, special cases with numerical examples, stability of closed loop system, concept of root locus, open loop and closed loop transfer poles, step by step procedure for root loci, numerical examples.

UNIT-V: Frequency Response Analysis:

Need of frequency response analysis, Sinusoidal response of linear system, methods used in frequency response, Bode Plot, Frequency domain specifications.

TEXT BOOKS:

1. IJNagrath, M.Gopal, Control System Engineering,New Age International Publishers, Fifth edition.
2. NormanSNise, Control system engineering, JohnWiley& Sons,Inc.,Sixth edition

REFERENCE BOOKS:

1. RichardC.Dorf, Robert HBishop, Modern control systems, Pearson Education International,

Twelfth edition.
2. ANagoorKani, Control Systems, CBS Publishers. Jon. S. Wilson; "Sensor Technology Hand Book", Elsevier Inc., 2005.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
ARTIFICIALNEURAL NETWORKS AND FUZZY LOGIC
(OPEN ELECTIVE)

Course Code: GR24A4037 **L/T/P/C: 3/0/0/3**

Course Outcomes: On completion of the course, the student will be able to
1. Outline importance of BNN, ANN and its learning techniques and architectures.
2. Summarize the algorithms for various applications using Back propagation networks.
3. Interpret the concept of Fuzzy and Crispsets.
4. Model Fuzzy membership Function and rules for Applications.
5. Analyze the parameters of Genetic Algorithm.

UNIT-I: NEURALNETWORKS I (Introduction &Architecture):
Neuron, Nerve structure and synapse, Biological Neural network, Artificial Neuron and its model, activation functions, Neural network architecture: single layer and multilayer feed forward networks, recurrent networks. Various learning techniques.
to Information Theory, Shanon Capacity, Multimedia Data, Data Processing, Boolean Logics, Information Content, Entropy, Source Coding, Channel Coding, Modulation Schemes, Internet.

UNIT-II: NEURAL NETWORKS II (Back Propagation Networks):
Architecture: perceptron model, solution, single layer artificial neural network, multilayer perception model; back propagation learning methods, effect of learning rule co-efficient; back propagation algorithm, factors affecting back propagation training, application of Neural Networks in Load Forecasting.

UNIT-III: FUZZYLOGIC I (Introduction):
Basic concepts of fuzzy logic, Fuzzy sets and Crispsets, Fuzzy set theory and operations, Properties of fuzzy sets, Fuzzy and Crisp relations, Fuzzy to Crisp conversion.

UNIT-IV: FUZZYLOGIC II (Fuzzy Membership, Rules):
Membership functions, interference in fuzzy logic, fuzzy if-then rules, Fuzzy implications and Fuzzy algorithms, Fuzzifications & Defuzzification's, Fuzzy Controller, application of Fuzzy logic control in washing machines

UNIT-V: GENETICALGORITHMS(GA):
Basic concepts, working principle, procedures of GA, flow chart of GA, Genetic representations, (encoding) Initialization and selection, Genetic operators, Mutation, Generational Cycle, application of genetic algorithm in economic load dispatch.

TEXT BOOKS:
1. JMZurada,"An Introduction to ANN",JaicoPublishing House.
2. Neural Networks, Fuzzy Logic, And Genetic Algorithms: Synthesis and Applications -byS. Rajasekaran, G. A. Vijayalakshmi Pai, PHI publishers.

REFERENCE BOOKS:

1. HungT.Nguyen,Nadipuram R.Prasad,CarolL. Walker andElbertA.Walker,"AFirstCourse in Fuzzy and Neural Control" Chapman & Hall, CRC.
2. Driankov,Dimitra,"AnIntroductiontoFuzzyControl",NarosaPublication.
3. TimothyJRoss, "Fuzzy Logic with Engg. Applications",McGraw.Hill.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
INDUSTRIAL AUTOMATION AND CONTROL
(OPEN ELECTIVE)

Course Code: GR24A3056 **L/T/P/C: 3/0/0/3**

Course Outcomes: After completing this course, students will be able to:
1. Explain the major automation theories, approaches and methodologies used in manufacturing.
2. Apply the knowledge for implementing the automated flow lines.
3. Employ the assembly systems and line balancing for automation
4. Implement the knowledge of material handling and storage systems in current industries.
5. Design adaptive control system for automated manufacturing.

UNIT-I: Introduction:
Introduction to automation, principles, reasons, types and strategies of automation, pneumatic and hydraulic components circuits, Automation in machine tools. Mechanical feeding, tool changing and machine tool control transfer the automaton.

UNIT-II: Automated flow lines:
Methods of work part transport transfer, Mechanical buffer storage control function, design and fabrication consideration. Analysis of Automated flow lines: General terminology and analysis of transfer lines without and with buffer storage, partial automation, implementation of automated flow lines.

UNIT-III: Assembly system and line balancing:
Assembly process and systems assembly line, line balancing methods, ways of improving line balance, flexible assembly lines.

UNIT-IV: Automated material handling and storage systems:
Types of equipment, functions, analysis and design of material handling systems, conveyor systems, automated guided vehicle systems. Automated storage and retrieval systems; work in process storage, interfacing handling and storage with manufacturing.

UNIT-V: Adaptive control systems:
Introduction, adaptive control with optimization, adaptive control with constraints, application of adaptive control in machining operations. Consideration of various parameters such as cutting force, temperatures, vibration and acoustic emission in the adaptive controls systems.

TEXT BOOKS:
1. Mikell P.Groover, Automation, Production Systems, and Computer- integrated Manufacturing, prentice Hall, 2014
2. Serope Kalpakjian and Steven R. Schmid, edition, Pearson, 2013

REFERENCE BOOKS:
1. Automation, Production Systems, and Computer-Integrated Manufacturing. (2016). India:

Pearson India.
2. Bolz, R. W. (2012). Manufacturing Automation Management: A Productivity Handbook. United States: Springer US.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

OPERATIONS RESEARCH
(OPEN ELECTIVE)

Course Code: GR24A3034 **L/T/P/C: 3/0/0/3**

Course Outcomes: On completion of the course, the student will be able to

1. Formulate and solve linear programming problems using simplex and duality approaches for resource allocation.
2. Apply non-linear optimization techniques (single and multi-variable unconstrained methods) to practical engineering and management problems.
3. Analyze and solve transportation and assignment models for effective decision-making in logistics and resource allocation.
4. Evaluate inventory control systems and queuing models to optimize stock management and service efficiency.
5. Apply replacement and dynamic programming models for long-term decision-making in capital budgeting, maintenance, and system optimization.

UNIT-I: Introduction & Linear Programming:

Introduction: Development, Definition, Characteristics and Phases of Operations Research, Types of models: Operations Research models – Applications: Linear Programming Problem (LPP) formulation, Graphical solution method, Simplex method – Artificial variables techniques (Two–phase method, Big-M method), Duality principle

UNIT-II: Non-Linear Programming:

Introduction – Difference between linear and nonlinear programming, applications in engineering & management; **Single-variable unconstrained optimization**: Uni-modal functions, Elimination methods – Bisection/interval halving, Fibonacci method, Golden Section method; **Multi-variable unconstrained optimization**: Gradient of a function, optimality condition, Gradient methods – Steepest Descent Method, Conjugate Gradient Method (Fletcher–Reeves)

UNIT-III: Transportation & Assignment Models:

Transportation models: Formulation, Methods for finding feasible solution and optimal solution, Unbalanced transportation problems, degeneracy; **Assignment models**: Formulation, Optimal solution, Variants of Assignment Problem (e.g., unbalanced, maximization, traveling salesman problem)

UNIT-IV: Inventory & Queuing Models:

Inventory models: Single-item deterministic models, Purchase inventory models with one price break and multiple price breaks, Shortages not allowed, Stochastic models – demand as discrete or continuous variable, Instantaneous production, instantaneous demand and continuous demand (no setup cost)

Queuing models: Introduction, Single-channel system: Poisson arrivals, exponential service times, infinite/finite population, Multi-channel systems: Poisson arrivals, exponential service

times with infinite population

UNIT-V: Replacement & Dynamic Programming:
Replacement models: Replacement of items that deteriorate with time (with and without time value of money), Replacement of items that fail completely, Group replacement policy
Dynamic programming: Introduction – Bellman's Principle of Optimality Applications: capital budgeting, shortest path problem, linear programming problem

TEXT BOOKS:
1. Operations Research/ Prem Kumar Gupta, Dr. D.S. Hira
2. Operations Research / S. D.Sharma-Kedarnath
3. Operation Research /J.K.Sharma/MacMilan.

REFERENCE BOOKS:
1. A.K. Operations Research / R.Pannerselvam,PHI Publications.
2. Introduction to O.R /Taha/PHI
3. Operations Research / Wagner/ PHI Publications.
4. Introduction to O.R/Hiller and Libermann (TMH).
5. Operations Research /A.M.Natarajan, P.Balasubramani,A. Tamilarasi/Pearson Education.
6. Operations Research: Methods and Problems / Maurice Saseini, ArhurYaspan and Lawrence Friedman
7. O.R/Wayne L.Winston/Thomson Brooks/cole

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
COMPOSITE MATERIALS
(OPEN ELECTIVE)

Course Code: GR24A3066 **L/T/P/C: 3/0/0/3**

Course Outcomes: On completion of the course, the student will be able to
1. Identify the types of composite materials and their characteristic features
2. Explain the methods employed in composite fabrication.
3. Differentiate the strengthening mechanisms of composite and its corresponding effect on performance
4. Analyze the various criterions for isotropic, anisotropic and composite materials, prediction of laminates failure.
5. Examine experimental techniques utilized for failure mode of composites.

UNIT-I:
Definition and applications of composite materials, Fibers- glass, carbon, ceramic and aramid fibers; Matrices- polymer, graphite, ceramic and metal matrices; characteristics of fibers and matrices. Lamina- assumptions, macroscopic viewpoint, generalized Hooke's law, reduction of homogeneous orthotropic lamina, isotropic limit case, orthotropic stiffness matrix, commercial material properties, rule of mixtures, transformation matrix, transformed stiffness

UNIT-II:
Manufacturing of composite materials, bag moulding, compression moulding, pultrusion, filament welding, other manufacturing processes

UNIT-III:
Basic assumptions of laminated anisotropic plates, symmetric laminates, angle ply laminates, cross ply laminates, laminate structural moduli, evaluation of lamina properties, determination of lamina stresses, maximum stress and strain criteria.

UNIT-IV:
Von Mises Yield criterion for isotropic materials, generalized Hill's criterion for anisotropic materials, Tsai- Hill's criterion for composites, prediction of laminate failure, thermal analysis of composite laminates

UNIT-V:
Analysis of laminated plates- equilibrium equations of motion, energy formulation, static bending analysis, buckling analysis, free vibrations, natural frequencies.

TEXT BOOKS:
1. Gibson R.F. Principles of Composite Material Mechanics, second edition, McGraw Hill,1994.
2. Hyer M.W., Stress Analysis of Fiber- Reinforced Composite Materials, McGraw Hill,1998.

REFERENCE BOOKS:

1. Clyne, T. W. and Withers, P. J., "Introduction to Metal Matrix Composites", Cambridge University Press, 1993.
2. Strong, A.B., "Fundamentals of Composite Manufacturing", SME, 1989.
3. Sharma, S.C., "Composite materials", Narosa Publications, 2000.
4. Broutman, L.J. and Krock,R.M., " Modern Composite Materials", Addison-Wesley, 1967.
5. Introduction to Composite Materials Design by Ever J. Barbero 3rd Edition 2017

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
DIGITAL ELECTRONICS FOR ENGINEERING
(OPEN ELECTIVE)

Course Code: GR24A3076 **L/T/P/C: 3/0/0/3**

Course Outcomes: After completing this course, students will be able to:
1. Get basic knowledge on logic gates, Universal gates and their switching logics.
2. Realize Boolean expressions using NAND/NOR gates and reduce them using K map.
3. Know all types of combinational and sequential circuits.
4. Acquire knowledge on realization of logic families using diodes and transistor, and also on different types of integrated circuits.
5. Understand the characteristics and applications of operational amplifiers in different modes of operation.

UNIT-I: Number Systems:
Number systems, Complements of Numbers, Codes- Weighted and Nonweighted codes and its properties. Boolean Algebra: Basic Theorems and Properties, Switching Functions- Canonical and Standard Form, Algebraic Simplification, Digital Logic Gates, EX-OR gates, Universal Gates, Multilevel NAND/NOR realizations.

UNIT-II: Minimization of Boolean functions:
Karnaugh Map Method - Up to four Variables, Don't Care Map Entries, Tabular Method, Combinational Logic Circuits: Adders, Subtractors, Comparators, Multiplexers, Demultiplexers, Encoders, Decoders and Code converters, Hazards and Hazard Free Relations.

UNIT-III: Sequential Circuits Fundamentals:
Basic Architectural Distinctions between Combinational and Sequential circuits, SR Latch, Flip Flops: SR, JK, JK Master Slave, D and T Type Flip Flops, Excitation Table of all Flip Flops, Fundamentals of shift registers, ripple and decade counters.

UNIT-IV: Realization of Logic Gates Using Diodes & Transistors:
AND, OR and NOT Gates using Diodes and Transistors, DCTL, RTL, DTL, TTL, CML and CMOS Logic Families and its Comparison, standard TTL NAND Gate Analysis & characteristics, TTL open collector O/Ps, Tristate TTL, MOS & CMOS open drain and tristate outputs, CMOS transmission gate.

UNIT-V: Integrated Circuits:
Classification, chip size and circuit complexity, basic information of op-amp, ideal and practical Op-amp, internal circuits, Op-amp characteristics, DC and AC Characteristics, 741 op-amp and its features, modes of operation-inverting, non-inverting, differential.

TEXT BOOKS:
1. Switching and Finite Automata Theory - ZviKohavi& Niraj K. Jha, 3rd Edition, Cambridge, 2010.

2. Modern Digital Electronics – R. P. Jain, 3rd Edition, 2007- Tata McGraw-Hill
3. Linear Integrated Circuits, D. Roy Chowdhury, New Age International(p) Ltd.
4. Op-Amps & Linear ICs, Ramakanth A. Gayakwad, PHI

REFERENCE BOOKS:

1. Digital Design- Morris Mano, PHI, 4th Edition,2006
2. Operational Amplifiers & Linear Integrated Circuits, R.F. Coughlin & Fredrick F. Driscoll, PHI
3. Operational Amplifiers & Linear Integrated Circuits: Theory & Applications, Denton J. Daibey, TMH.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

SENSOR TECHNOLOGY
(OPEN ELECTIVE)

Course Code: GR24A3085 **L/T/P/C: 3/0/0/3**

Course Outcomes: On completion of the course, the student will be able to

1. Demonstrate the concept of resistive sensors which can be employed for real life applications
2. Realize the concept of reactive sensors and understand the implications while deploying them in practice.
3. Understand the working principle of special purpose sensors and the need or developing smart sensors.
4. Comprehend the design and development of various wearable sensors for use in healthcare applications.
5. Able to design and perform experiments on the sensors and develop the projects based on the customer needs.

UNIT-I: Introduction to Sensor Systems:

General concepts and terminology of Sensor systems, Transducers classification-sensors and actuators, General input-output configurations, Static and dynamic characteristics of measurement system.

UNIT-II: Resistive sensors:

Potentiometers, strain gages (piezo-resistive effect), resistive temperature detectors (RTD), thermistors, light dependent resistor (LDR), resistive hygrometers, resistive gas sensors.

UNIT-III: Inductive sensors:

Variable reluctance sensors, Hall effect, Eddy current sensors, Linear variable differential transformers (LVDT), variable transformers, magneto-elastic, magneto- resistive, and magneto strictive sensors. Capacitive sensors- variable capacitor, differential capacitor.

UNIT-IV: Accelerometers:

Characteristics and working principle of accelerometer sensors, Types- Capacitive, Piezoresistive, piezoelectric; Gyroscopes: Characteristics and working principle, Rotor Gyroscope; Diaphragm Pressure Sensor-resistive & capacitive type (micro press sensor).

UNIT-V: Overview of various smart sensors:

Digital temperature sensor (DS1621, TMP36GZ), Humidity sensor (DHT11, DHT22), Gas sensor (MQ2,MQ8), Pressure sensors (BMP180), Accelerometers (ADXL335); Structural health monitoring sensors, Introduction to MEMS and Flexible sensors.

TEXT BOOKS:

1. B. C. Nakra, K.K. Choudhury, "Instrumentation, Measurement and Analysis"-3rd Edition, Tata McGraw, 2009
2. Jacob Fraden, "Hand Book of Modern Sensors: Physics, Designs and Applications", 3rd

Edition.,

REFERENCE BOOKS:

1. Er. R.K. Rajput, "Electronic Measurements and Instrumentation", S. Chand & Company Ltd. 3rd Edition.
2. A.K.Sawhney, "Electrical and Electronic Measurements and Instrumentation", Dhanpat Rai.
3. Bentley, John P., "Principles of Measurement Systems", 4th Edition, Pearson/Prentice Hall, 2005
4. Jon. S. Wilson; "Sensor Technology Hand Book", Elsevier Inc., 2005.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
COMMUNICATION TECHNOLOGIES
(OPEN ELECTIVE)

Course Code: GR24A4078 **L/T/P/C: 3/0/0/3**

Course Outcomes: On completion of the course, the student will be able to
1. Understand the information theory and its coding styles.
2. Acquire knowledge on wireless communications and services.
3. Understand the various mobile networks and generations
4. Acquire knowledge on optical communications.
5. Know about network security through encryption and decryption.

UNIT-I: Information Theory:
Introduction to Information Theory, Shanon Capacity, Multimedia Data, Data Processing, Boolean Logics, Information Content, Entropy, Source Coding, Channel Coding, Modulation Schemes, Internet.

UNIT-II: Wireless Communication Technologies:
Introduction to Wireless Communication Technologies, WLAN, Wifi, Bluetooth, Other Wireless PAN And WAN Technologies, Satellite Communications, Broadcast Services.

UNIT-III: Cellular Mobile Networks:
Introduction to Cellular Mobile Networks, GSM(2G), UMTS (3G), LTE(4G), 5G Mobile Networks, Mobile Network Planning Aspects.

UNIT-IV: Optical Communication:
Introduction to Optical Communications, Optical Fiber, FTTC, FTTH, FTTBS, Free Space Optical Link, Channel Model with Different Factors, Deep Space Optical Communications.

UNIT-V: Network Security and Management:
Introduction to Network Security and Management, Symmetrical Encryption, Asymmetrical Encryption, Authentication, Hash-Value, Integrity Check, Telecommunications Management Network, SNMP, Functionalities of Network Management, Trends and Future Development.

TEXT BOOKS:
1. Shun-Ping Chen, “Fundamentals of Information and Communication Technologies” 2020
2. B.P. Lathi, “Communication systems”- BS Publications, 2006..

REFERENCE BOOKS:
1. Simon Haykin, John Wiley “Digital Communications” 2005.
2. Herbert Taub, Donald L Schilling Gautham Saha “Principles of Communication systems” 3rd edition McGraw-Hill 2008.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
DATA SCIENCE FOR ENGINEERS
(OPEN ELECTIVE)

Course Code: GR24A3092 **L/T/P/C: 3/0/0/3**

Course Outcomes: After completing this course, students will be able to:
1. Illustrate a flow process for data science problems.
2. Demonstrate the mathematical foundations for data science.
3. Analyze the data science process and predictive modelling.
4. Develop R codes for data science solutions.
5. Correlate results to the solution approach followed.

UNIT-I:
Introduction to R, Variables and datatypes in R, Data frames, Recasting and joining of dataframes, Recasting and joining of dataframes, Arithmetic, Logical and Matrix operations in R, Advanced programming in R : Functions, Control structures, Data visualization in R Basic graphics.

UNIT-II:
Linear Algebra and Statistics for Data Science: Solving Linear Equations, Linear Algebra Distance, Hyperplanes and Halfspaces, Eigenvalues, Eigenvectors, Statistical Modelling, Random Variables and Probability Mass/Density Functions, Sample Statistics.
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UNIT-III:
Introduction to Data Science, Solving Data Analysis Problems - A Guided Thought Process, Predictive Modelling, Linear Regression, Model Assessment, Diagnostics to Improve Linear Model Fit.

UNIT-IV:
Simple Linear Regression Model Building, Cross Validation, Multiple Linear Regression Modelling Building and Selection.

UNIT-V:
Classification, K - Nearest Neighbors (KNN), K - Nearest Neighbors implementation in R, K - means Clustering, K - means implementation in R.

TEXT BOOKS:
1. Data Science for Engineers, 1st Edition, Raghunathan Rengaswamy, Resmi Suresh, CRC Press, Taylor & Francis Group.
2. Introduction to Linear Algebra, Fifth Edition, Gilbert Strang, ISBN: 978-09802327-7-6.
3. Applied Statistics and Probability for Engineers, Douglas Montgomery, George C Runger, Fifth Edition, John Wiley & Sons, Inc.

REFERENCE BOOKS:

1. Hands On Introduction To Data Science Hardcover – 2 April 2020 by Chirag Shah (Author)
2. Essential Math for Data Science: Take Control of Your Data with Fundamental Linear Algebra, Probability, and Statistics by Thomas Nield (Author)

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

DATA ANALYTICS USING OPEN SOURCE TOOLS
(OPEN ELECTIVE)

Course Code: GR24A3103 **L/T/P/C: 3/0/0/3**

Course Outcomes: On completion of the course, the student will be able to

1. Interpret about graphics techniques in data analysis.
2. Implement data modeling techniques for a dataset.
3. Develop the simulation for mining and clustering the data.
4. Infer the data using business intelligence and predictive analytics
5. Implement the data analytics using Programming Environments

UNIT-I: Graphics:

A Single Variable – Dot and Jitter Plots, Histograms and Kernel Density Estimates, The Cumulative Distribution Function, Rank-Order Plots and Lift Charts, Summary Statistics and Box Plots, Practice using Numpy, Two Variables- Scatter Plots, Smoothing, Logarithmic Plots, Banking, Practice using Matplotlib, Time As A Variable- Time-Series Analysis, More Than Two Variables- False-color plots, Multiplots.

UNIT-II: Modeling Data:

Guesstimation and the back of the envelope- Principles, Perturbation Theory and Error Propagation, Models from scaling arguments- Models, Arguments from Scale, Mean-Field Approximations, Common Time-Evolution Scenarios, Arguments from probability models- The Binomial Distribution and Bernoulli Trials, The Gaussian Distribution and the Central Limit Theorem, Power-Law Distributions and Non-Normal Statistics, Bayesian Statistics.

UNIT-III: Mining Data:

Simulations- Monte Carlo Simulations, Resampling Methods, Discrete Euent Simulations with *SimPy*, Finding Clusters- Distance and Similarity Measures, Clustering Methods, Pre and Postprocessing, *Pycluster,* Seeing the Forest for the trees- PCA, Kohonen Maps, PCA with R.

UNIT-IV: Applications:

Reporting, Business intelligence and Dashboards- Corporate Metrics and Dashboards, Data Quality Issues, Financial calculations and modeling- The Time Value of Money ,Uncertainty in Planning and Opportunity Costs, Cost Concepts and Depreciation, Predictive analytics- algorithms for classification.

UNIT-V: Programming Environments and Data analytics:

Programming Environments: Software Tools, A Catalog of Scientific Software - Matlab, R, Python Results from Calculus: Common Functions, Calculus, Useful Tricks -Binomial theorem, Linear transformation.

Working with data: Sources for Data, Cleaning and Conditioning, Sampling, Data File Formats, The Care and Feeding of Your Data Zoo.

TEXT BOOKS:

1. Philipp K. Janert, Data Analysis with Open Source Tools, O'Reilly Media, Inc, November 2010: First Edition

REFERENCE BOOKS:

1. G James, D. Witten, T Hastie, and R. Tibshirani, An Introduction to Statistical Learning: with Applications in R, Springer, 2013
2. Chambers, John, Software for Data Analysis Programming with R, Springer, 2008
3. Trevor Hastie Robert Tibshirani Jerome Friedman, The Elements of Statistical Learning, Data Mining, Inference, and Prediction (2nd Edn.), Springer, 2014
4. Mark Gardener, Beginning R: The Statistical Programming Language, Wiley, 2013
5. Upadhyaya and A. Upadhyaya, Material Science and Engineering, Anshan Publications, 2007

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
AUGMENTED REALITY AND VIRTUAL REALITY
(OPEN ELECTIVE)

Course Code: GR24A4096 **L/T/P/C: 3/0/0/3**

Course Outcomes: On completion of the course, the student will be able to
1. Analyze about augmented reality.
2. Identify AR devices for various applications.
3. Analyze about virtual reality.
4. Interpret about usage of VR devices and human factors involved.
5. Apply AR & VR technology in various domains.

UNIT-I:
Introduction to Augmented Reality, The Relationship Between Augmented Reality and Other Technologies, Augmented Reality Concepts, How Does Augmented Reality Work?, Ingredients of an Augmented Reality Experience.

UNIT-II:
Augmented Reality Hardware, Major Hardware Components for Augmented Reality Systems, Augmented Reality Software, Major Software Components for Augmented Reality Systems, Software used to Create Content for the Augmented Reality Application.

UNIT-III:
Virtual Reality: The Three I's of Virtual Reality, A Short History of Early Virtual Reality, Early Commercial VR Technology , VR Becomes an Industry, The Five Classic Components of a VR System.
Input Devices: Trackers, Navigation, and Gesture Interfaces: Three-Dimensional Position Trackers, Navigation and Manipulation Interfaces

UNIT-IV:
Output Devices: Graphics, Three-Dimensional Sound, and Haptic Displays : Graphics Displays, Sound Displays, Haptic Feedback.
Human Factors in VR: Methodology and Terminology, User Performance Studies, VR Health and Safety Issues, VR and Society

UNIT-V:
Augmented Reality Applications, What Makes a Good Augmented Reality Application? Application Areas: Education, Gaming, Robotics, Health care, Manufacturing, Evaluating Augmented Reality Applications.

TEXT BOOKS:
1. Alan B. Craig, Understanding Augmented Reality, Concepts and Applications, Morgan Kaufmann, 2013.

2. Burdea, G. C. and P. Coffet. Virtual Reality Technology, Second Edition. Wiley IEEE Press, 2003/2006.

REFERENCE BOOKS:

1. LaValle, "Virtual Reality", Cambridge University Press, 2016.
2. Alan B Craig, William R Sherman and Jeffrey D Will, "Developing Virtual Reality Applications: Foundations of Effective Design", Morgan Kaufmann, 2009.
3. John Vince, "Virtual Reality Systems ", Pearson Education Asia, 2007.
4. Anand R., "Augmented and Virtual Reality", Khanna Publishing House, Delhi.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
SERVICES SCIENCE AND SERVICE OPERATIONAL MANAGEMENT
(OPEN ELECTIVE)

Course Code: GR24A4115 **L/T/P/C: 3/0/0/3**

Course Pre-Requisite(s): Fundamentals of Management, Operations Research
Course Outcomes: After completing this course, students will be able to:
1. Understand concepts of services and its significance in the economy and society and distinguish it from goods.
2. Understand the service strategy, design, and development.
3. Comprehend ways to design services and able to understand service guarantee, recovery, and failures.
4. Forecast the service demand, supply and facilitate various methods to operate and manage services.
5. Understand the service productivity and how innovation can be approached from services point of view.

UNIT-I:
Introduction: Service operations, Role of service in economy and society, Indian service sector.
Nature of Services and Service Encounters: Differences between services and operations, Service package, characteristics, various frameworks to design service operation system, Kind of service encounter, importance of encounters
Service-Dominant Logic: From Goods-Dominant logic to Service-Dominant logic, Value Co-creation.

UNIT-II:
Service Strategy and Competitiveness: Development of Strategic Service Vision (SSV), Data Envelopment Analysis.
New Service Development: NSD cycle, Service Blueprinting, Elements of service delivery system Service Design: Customer Journey and Service Design, Design Thinking methods to aid Service Design.
Locating facilities and designing their layout: models of facility locations (Huff's retail model), Role of service-scape in layout design.
Service Quality: SERVQUAL, Walk through Audit, Dimensions of Service quality & other quality tools.

UNIT-III:
Service Guarantee & Service Recovery: Service guarantee and its types; Service failure – reasons for failure and service recovery strategies.

UNIT-IV:
Simple Forecasting Demand for Services: A review of different types of forecasting methods for demand forecasting.
Managing Capacity and Demand: Strategies for matching capacity and demand, Psychology of

waiting, Application of various tools used in managing waiting line in services.
Managing Facilitating Goods: Review of inventory models, Role of inventory in services Managing service supply relationship: Understanding the supply chain/hub of service, Strategies for managing suppliers of service
Vehicle Routing Problem: Managing after sales service, understanding services that involve transportation of people and vehicle, Techniques for optimizing vehicle routes.

UNIT-V:
Service Innovation: Services Productivity, Need for Services Innovation
Student Project:
Option 1: Choose any service organization around and present it from the perspective of: nature of service, classification of service, blueprint or service design analysis, service quality, and any additional perspective you would like to add.
Option 2: Choose any latest research paper in services and explain your understanding and feedback on the same.

TEXT BOOKS:
1. Fitzsimmons & Fitzsimmons, Service Management: Operations, Strategy, Information Technology, McGraw Hill publications (7th edition)

REFERENCE BOOKS:
1. Wilson, A., Zeithaml, V. A., Bitner, M. J., & Gremler, D. D. (2012). Services marketing: Integrating customer focus across the firm. McGraw Hill.
2. Lovelock, C. (2011). Services Marketing, 7/e. Pearson Education India
3. Reason, Ben, and Lovlie, Lavrans, (2016) Service Design for Business: A Practical Guide to Optimizing the Customer Experience, Pan Macmillan India,
4. Chesbrough, H. (2010). Open services innovation: Rethinking your business to grow and compete in a new era. John Wiley & Sons.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

IT PROJECT MANAGEMENT
(OPEN ELECTIVE)

Course Code: GR24A4116 **L/T/P/C: 3/0/0/3**

Course Outcomes: On completion of the course, the student will be able to

1. Learn the techniques to effectively plan manage, execute the projects.
2. Learn the techniques to control projects within time and cost targets with a focus on Information Technology and Service Sector.
3. Learn various agile methodologies.
4. Apply agile project management techniques such as Scrum on real time applications.
5. Develop real time applications using agile project management techniques such as DevOps.

UNIT-I:

Project Overview and Feasibility Studies- Identification, Market and Demand Analysis, Project Cost Estimate, Financial Appraisal

Project Scheduling: Project Scheduling, Introduction to PERT and CPM, Critical Path Calculation, Precedence Relationship, Difference between PERT and CPM, Float Calculation and its importance, Cost reduction by Crashing of activity.

UNIT-II:

Cost Control and Scheduling: Project Cost Control (PERT/Cost), Resource Scheduling & Resource Leveling **Project Management Features:** Risk Analysis, Project Control, Project Audit and Project Termination.

UNIT-III:

Agile Project Management: Introduction, Agile Principles, Agile methodologies, Relationship between Agile Scrum, Lean, DevOps and IT Service Management (ITIL).

Other Agile Methodologies: Introduction to XP, FDD, DSDM, Crystal

UNIT-IV:

Reporting **Scrum:** Various terminologies used in Scrum (Sprint, product backlog, sprint backlog, sprint review, retro perspective), various roles (Roles in Scrum), Best practices of Scrum.

UNIT-V:

DevOps: Overview and its Components, Containerization Using Docker, Managing Source Code and Automating Builds, Automated Testing and Test-Driven Development, Continuous Integration, Configuration Management, Continuous Deployment, Automated Monitoring.

TEXT BOOKS:

1. Mike Cohn, Succeeding with Agile: Software Development Using Scrum
2. Notes to be distributed by the course instructor on various topics

REFERENCE BOOKS:

1. Pichler, Agile Product Management with Scrum
2. Roman Ken Schwaber, Agile Project Management with Scrum (Microsoft Professional

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
MARKETING RESEARCH AND MARKETING MANAGEMENT
(OPEN ELECTIVE)

Course Code: GR24A4117 **L/T/P/C: 3/0/0/3**

Course Outcomes: On completion of the course, the student will be able to
1. Understand the significance of marketing management concepts, marketing environment, consumer behaviour elements and strategies related to STP.
2. Understand various product management strategies and importance of branding, packing.
3. Comprehend the dynamics of marketing mix elements such as pricing, distribution, and promotion mix elements to leverage marketing concepts for effective decision making.
4. Demonstrate analytical skills in identification and resolution of problems pertaining to marketing management and marketing research and uses of various statistical tools in marketing research.
5. Understanding about the concepts of internet marketing and the fundamentals of business- to-business marketing strategy, CRM strategies.

UNIT-I:
Marketing Concepts and Applications: Introduction to Marketing & Core Concepts, Marketing of Services, Importance of marketing in service sector.
Marketing Planning & Environment: Elements of Marketing Mix, Analyzing needs & trends in Environment - Macro, Economic, Political, Technical & Social
Understanding the consumer: Determinants of consumer behavior, Factors influencing consumer behavior
Market Segmentation: Meaning & Concept, Basis of segmentation, selection of segments, Market Segmentation strategies, Target Marketing, Product Positioning

UNIT-II:
Product Management: Product Life cycle concept, New Product development & strategy, Stages in New Product development, Product decision and strategies, Branding & packaging.

UNIT-III:
Pricing, Promotion and Distribution Strategy: Policies & Practices – Pricing Methods & Price determination Policies. Marketing Communication – The promotion mix, Advertising & Publicity, 5 M's of Advertising Management. Marketing Channels, Retailing, Marketing Communication, Advertising

UNIT-IV:
Marketing Research: Introduction, Type of Market Research, Scope, Objectives & Limitations Marketing Research Techniques, Survey Questionnaire design & drafting, Pricing Research, Media Research, Qualitative Research
Data Analysis: Use of various statistical tools – Descriptive & Inference Statistics, Statistical Hypothesis Testing, Multivariate Analysis - Discriminant Analysis, Cluster Analysis, Segmenting and Positioning, Factor Analysis

UNIT-V:

Internet Marketing: Introduction to Internet Marketing. Mapping fundamental concepts of Marketing (7Ps, STP); Strategy and Planning for Internet Marketing

Business to Business Marketing: Fundamental of business markets. Organizational buying process. Business buyer needs. Market and sales potential. Product in business markets. Price in business markets. Place in business markets. Promotion in business markets. Relationship, networks and customer relationship management. Business to Business marketing strategy

Home Assignments:

Written Analyses of Cases – Students are expected to report on their analysis and recommendations of what to do in specific business situations by applying concepts and principles learned in class (Case Studies to be shared by Faculty) e.g. "Marketing Myopia"

1. Field visit & live project covering steps involved in formulating Market Research Project.
2. Measuring Internet Marketing Effectiveness: Metrics and Website Analytics.

TEXT BOOKS:

1. Marketing Management (Analysis, Planning, Implementation & Control) – Philip Kotler.
2. Fundamentals of Marketing – William J. Stanton & Others.
3. Marketing Management – V.S. Ramaswamy and S. Namakumari.
4. Marketing Research – Rajendra Nargundkar.
5. Market Research – G.C. Beri.
6. Market Research, Concepts, & Cases – Cooper Schindler.

REFERENCE BOOKS:

1. Marketing Management – Rajan Saxena.
2. Marketing Management – S.A. Sherlekar.
3. Service Marketing – S.M. Zha.
4. Journals – The IUP Journal of Marketing Management, Harvard Business Review.
5. Research for Marketing Decisions by Paul Green, Donald, Tull.
6. Business Statistics, A First Course, David M Levine at al, Pearson Publication.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
BASICS OF JAVA PROGRAMMING
(OPEN ELECTIVE)

Course Code: GR24A3133 **L/T/P/C: 3/0/0/3**

Course Outcomes: After completing this course, students will be able to:
1. Apply OOP principles by writing Java programs using data types, operators, and control structures.
2. Analyze Java programs by implementing classes, constructors, arrays, and inheritance, and differentiate overloading and overriding.
3. Demonstrate modular design with packages, interfaces, and abstract classes, and evaluate exception handling.
4. Implement multithreading and synchronization and utilize collections for efficient data management.
5. Design modern Java applications using JavaFX, Spring Boot, and Hibernate/JPA

UNIT-I:
Object Oriented Thinking: Introduction, Need of object-oriented programming, principles of object-oriented languages, Applications of OOP, history of JAVA, Java Virtual Machine, Java features, Program structures, Installation of JDK.
Variables, Primitive data types, Identifiers- Naming Conventions, Keywords, Literals, Operators- Binary, Unary and Ternary, Expressions, Primitive Type conversion and casting, flow of control- branching, conditional, loops.

UNIT-II:
CLASSES, INHERITANCE, POLYMORPHISM:
Classes and Objects: Classes, Objects, creating objects, methods, constructors- constructor overloading, cleaning up unused objects- Garbage collector, class variable and methods- static keyword, this keyword, arrays, Command line arguments, Nested Classes
Strings: String, String Buffer, String Tokenizer
Inheritance and Polymorphism: Types of Inheritance, deriving classes using extends keyword, super keyword, Polymorphism – Method Overloading, Method Overriding, final keyword, abstract classes.

UNIT-III:
INTERFACES, PACKAGES, EXCEPTIONS
Interfaces: Interface, Extending interface, interface Vs Abstract classes.
Packages: Creating Packages, using Packages, Access protection, java I/O package. Exceptions
Introduction, Exception handling Techniques: try…catch, throw, throws, finally block, user defined Exception.

UNIT-IV:
MULTI-THREADING, COLLECTIONS
java.lang.Thread, the main Thread, creation of new Threads, Thread priority, multithreading-

using isalive() and join(), Synchronization, suspending and resuming Threads, Communication between Threads. Exploring java.io, Exploring java.util
Collections: Overview of Collection Framework : Array List, LinkedList, Vector, HastSet, Tree Set, HashMap, Hash Table, Tree Map, Iterator, Comparator

UNIT-V:
Introduction to Spring Framework Overview of the Spring ecosystem, concepts of Inversion of Control (IoC) and Dependency Injection (DI), Spring Boot basics for rapid application development, and building a simple REST API with Spring Boot.
Data Access with Java Introduction to JDBC, an overview of JPA (Java Persistence API), using Hibernate with Spring Data JPA, and creating a simple CRUD application as an example.

Teaching Methodologies:
Power Point Presentations
Tutorial Sheets
Assignments

TEXT BOOKS:
1. Java: The Complete Reference, 10thedition, Herbert Schildt, McgrawHill.
2. Java Fundamentals: A Comprehensive Introduction, Herbert Schildt and Dale Skrien, TMH.
3. Java for Programming, P.J.Dietel Pearson Education.

REFERENCE BOOKS:
1. Object Oriented Programming through Java, P.Radha Krishna, Universities Press.
2. Thinking in Java, Bruce Eckel, Pearson Education
3. Programming in Java, S.Malhotra and S.Choudhary, Oxford University Press

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

INTRODUCTION TO DBMS
(OPEN ELECTIVE)

Course Code: GR24A3141 **L/T/P/C: 3/0/0/3**

Course Outcomes: On completion of the course, the student will be able to

1. Demonstrate the concepts of data mining, its applications
2. Apply data preprocessing techniques such as cleaning, integration, transformation, and reduction.
3. Implement clustering algorithms and evaluate their performance using similarity measures
4. Analyze association rules using Apriori and other frequent pattern mining techniques.
5. Examine outlier detection methods and justify their applications in real-world scenarios.

UNIT-I:

Introduction to Database And System Architecture: Database Systems and their Applications, Database Vs File System, View of Data, Data Models, Database Languages- DDL and DML, Transaction Management, Database users and Administrators, Database System Structure.

UNIT-II:

Introduction to Database Design: ER Diagrams, Entities, Attributes and Entity sets, Relationships and Relationship set, Extended ER Features, Conceptual Design with the ER Model, Logical database Design.

Relational Model: Introduction to Relational Model, Basic Structure, Database Schema, Keys, Relational Algebra

UNIT-III:

SQL Queries and Constraints: SQL Data Definition, Types of SQL Commands, Form of Basic SQL Query, SQL Operators, Set Operators, Nested Queries, Aggregate Operators, NULL values, Integrity Constraints Over Relations, Joins, Introduction to Views, Destroying Altering Tables and Views, Cursors, Triggers.

UNIT-IV:

Schema Refinement and Normal Forms: Introduction to Schema Refinement, Functional Dependencies, Properties of Decomposition, Reasoning about FD, Normal Forms,

UNIT-V:

Transaction Management: Transaction Concept, Transaction State, Concurrent Executions, Serializability, Testing for Serializability.

Concurrency Control: Lock based Protocols, Timestamp based protocols,

Recovery System: Recovery and Atomicity, Log based recovery, Shadow Paging, Recovery with concurrent Transactions.

Teaching Methodologies:

Power Point Presentations

Tutorial Sheets

Assignments

TEXT BOOKS:

1. "Data base Management Systems", Raghurama Krishnan, Johannes Gehrke, TATA McGraw Hill 3rdEdition
2. "Data base System Concepts", Silberschatz, Korth, McGraw hill, V Edition.
3. "Introduction to Database Systems", C.J.Date Pearson Education.

REFERENCE BOOKS:

1. "Database Management Systems", P. Radha Krishna HI-TECH Publications 2005.
2. "Database Management System", Elmasri Navate, Pearson Education.
3. "Database Management System", Mathew Leon, Leo

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

INTRODUCTION TO DATA MINING

(OPEN ELECTIVE)

Course Code: GR24A4124 **L/T/P/C: 3/0/0/3**

Prerequisites: Students are expected to have knowledge of transactional and relational databases, probability, and statistics.

Course Outcomes: On completion of the course, the student will be able to

1. Demonstrate the concepts of data mining, its applications
2. Apply data preprocessing techniques such as cleaning, integration, transformation, and reduction.
3. Implement clustering algorithms and evaluate their performance using similarity measures
4. Analyze association rules using Apriori and other frequent pattern mining techniques.
5. Examine outlier detection methods and justify their applications in real-world scenarios.

UNIT-I:

Introduction: Why Data mining, What is Data Mining, What Kinds of Data Can Be Mined, What Kinds of Patterns Can Be Mined, Which Technologies are used, Data Mining Task Primitives, Integration of a Data Mining System with a Database or a Data Warehouse System, Major issues in Data Mining.

UNIT-II:

Data Preprocessing: Need for Preprocessing the Data, Data Cleaning, Data Integration and Transformation, Data Reduction.

UNIT-III:

Association Rule Mining: Introduction to association rule mining. Apriori algorithm and other frequent pattern mining techniques. Measuring the strength of association rules.

UNIT-IV:

Classification: Issues Regarding Classification and Prediction, Classification by Decision Tree Induction, Bayesian Classification, Rule-Based Classification, Classification by Back propagation, k-Nearest-Neighbor Classifiers.

UNIT-V:

Clustering: Introduction to clustering and similarity measures.
Clustering algorithms: k-means, hierarchical clustering, density-based clustering.
Evaluating clustering results: silhouette score, Davies-Bouldin index.

Teaching Methodologies:

Power Point Presentations
Tutorial Sheets
Assignments

TEXT BOOKS:

1. Data Mining Concepts and Techniques - Jiawei Han & Micheline Kamber, Morgan Kaufmann Publishers, Elsevier, Third Edition, 2012.
2. Introduction to Data Mining Pang-Ning Tan, Michael Steinbach and Vipin Kumar, Pearson Education.

REFERENCE BOOKS:

1. Data Mining Techniques – Arun K. Pujari, Second Edition, Universities Press.
2. Data Warehousing in the Real World, Sam Aanhory and Dennis Murray, Pearson Edn Asian

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
INTRODUCTION TO OPERATING SYSTEMS
(OPEN ELECTIVE)

Course Code: GR24A3143 **L/T/P/C: 3/0/0/3**

Prerequisite: Students should have prior knowledge of:
- Basics of Programming, and
- Fundamentals of Data Structures and Algorithms, such as stacks, queues, and linked lists.

Course Outcomes: After completing this course, students will be able to:
1. Explain the objectives, structure, and functions of an operating system, including process, memory, storage, and security management, and demonstrate how OS services interact with users and hardware.
2. Apply process management concepts such as process states, scheduling algorithms, and interprocess communication; design and solve synchronization problems using semaphores, monitors, and classical solutions.
3. Analyze memory management strategies such as paging, segmentation, and swapping, and evaluate virtual memory techniques including demand paging, page replacement, and thrashing control.
4. Implement basic file operations and explain file system structure, directory management, allocation methods, and disk scheduling techniques for efficient storage management.
5. Identify, prevent, and recover from deadlocks; apply system protection principles and access control mechanisms to safeguard resources and files in different operating system environments.

UNIT-I: Introduction:
Overview, Objectives, User view, System view, Operating system definition, Computer System Organization, Computer System Architecture, OS Structure, OS Operations, Process Management, Memory Management, Storage Management, Protection and Security.
Operating System services, User and OS Interface, System Calls, Types of System Calls, System Programs, Operating System Design and Implementation, OS Structure.

UNIT-II: Process and CPU Scheduling:
Process concepts: The Process, Process State, Process Control Block, Threads, Process Scheduling-Scheduling Queues, Schedulers, Context Switch, Operations on Processes, System calls-fork(), exec(), wait(), exit(), Interprocess communication.
Process Scheduling: Basic concepts, Scheduling Criteria, Scheduling algorithms, Multiple-Processor Scheduling, Real-Time Scheduling, Thread scheduling. Process Synchronization, Critical Section Problem, Peterson's solution, Synchronization Hardware, Semaphores, Classic Problems of Synchronization, Monitors.

UNIT-III: Memory Management and Virtual Memory:
Memory Management Strategies - Background, Swapping, Contiguous Memory Allocation, Segmentation, Paging, Structure of Page Table.
Virtual Memory Management - Background, Demand Paging, Page Replacement, Page

Replacement Algorithms, Allocation of Frames, Thrashing.

UNIT-IV: Storage Management and File System:
Storage Management - File System, Concept of a File, System calls for File Operations – open (), read (), write (), close (), seek (), unlink (), Access methods - Directory and Disk Structure, File System Mounting, File Sharing, Protection.
File System Structure, File System Implementation, Directory Implementation, Allocation methods, Free-space Management, Efficiency, and Performance. Mass Storage Structure – Overview, Disk Structure, Disk Attachment, Disk Scheduling.

UNIT-V: Deadlocks and Protection:
Deadlocks - System Model, Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock.
Protection – System Protection, Goals of Protection, Principles of Protection, Domain of Protection, Access Matrix, Access Control, Revocation of Access Rights, Capability-based Systems, Language-based Protection.

TEXT BOOKS:
1. William Stallings, Operating Systems: Internals and Design Principles, 9th Edition, PHI, 2019.
2. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Operating System Principles, 7th Edition, Wiley, 2006.

REFERENCE BOOKS:
1. Andrew S. Tanenbaum, Modern Operating Systems, 5th Edition, PHI, 2022.
2. Gary J. Nutt, Operating Systems: A Modern Perspective, 3rd Edition, Addison-Wesley, 2004.
3. R. Elmasri, A.G. Carrick, D. Levine, Operating Systems, First Edition, McGraw Hill, 2009.
4. Charles Crowley, Operating System: A Design-oriented Approach, Irwin Publishing, First Edition, 1996.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

INTERNET OF THINGS

(OPEN ELECTIVE)

Course Code: GR24A3145 **L/T/P/C: 3/0/0/3**

Prerequisite:

The fundamental knowledge in C programming, Data Structures and Operating Systems

Course Outcomes: On completion of the course, the student will be able to

1. Understand IoT architecture and fundamental networking protocols and models.
2. Develop Arduino-based IoT applications integrating sensors and actuators.
3. Program Raspberry Pi using Python for cloud-connected IoT solutions.
4. Analyse various IoT applications including smart home and industrial systems.
5. Apply cloud and edge computing for IoT data analytics.

UNIT-I:

Introduction to IoT and Sensor Networks: Introduction to Internet of Things (IoT), Characteristics and Applications of IoT, IoT Architecture and Reference Models(IETF, ITU-T), Physical Design of IoT- Devices, Gateways, and Data Centers, Functional Blocks of IoT- Sensing, Actuation, Communication, Enabling Technologies: RFID, Wireless Sensor Networks.

Networking and Communication Protocols: MQTT, CoAP, ZigBee, HTTP Sensor Networks-Types, Topologies, and Protocols, Introduction to IoT Security and Privacy Fundamentals.

UNIT-II:

Machine to Machine (M2M) and Embedded Programming for IoT: Machine-to-Machine Communications Overview, Difference between IoT and M2M, Interoperability in IoT, Standards and Protocols.

Arduino: Introduction to Arduino Programming for IoT, Integration of Sensors and Actuators with Arduino, Hands-on Exercises- Sensor Data Acquisition and Actuator Control, Basic Communication Protocols, Implementation on Arduino-IoT Device Interoperability, Challenges and Solutions.

UNIT-III:

Raspberry Pi with Python Programming for IoT: Introduction to Python Programming , Basics, Overview of Raspberry Pi and its Role in IoT, Interfacing Raspberry Pi with Sensors and Actuators (UART, SPI, I2C).

Data Acquisition and Processing: Data Acquisition and Local Processing, Sending Data to Cloud Platforms, Implementation of IoT Projects Using Raspberry Pi.

Case Studies: Smart Home Automation, Healthcare Monitoring, Environmental Sensing.

UNIT-IV:

IoT Applications: Smart Homes-Smart Home Origin, Technologies, Implementation,
Smart Grids- Characteristics, Benefits, Architecture, Components, Smart Cities-Characteristics, Frameworks, Challenges, Industrial IoT-Requirements, Design Considerations, Applications.

UNIT-V:

Cloud and Edge Computing Models with IoT Use Cases: Introduction to Cloud Computing and Cloud Storage Models, Edge and Fog Computing Concepts for IoT, Web Servers and Cloud Platforms for IoT (AWS IoT, Azure IoT, etc.).

IoT Use Cases: Smart Cities, Smart Homes, Connected Vehicles, Smart Grid, Industrial IoT

TEXT BOOKS:

1. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press, 2017.
2. Vijay Madisetti, Arshdeep Bahga, "Internet of Things: A Hands-On Approach", 2015.
3. IOT Fundamentals: Networking Technologies, Protocols and Use Cases for IOT, Rowan. Trollope, David Hanes, Patrick Gassetete, Jerome Henry, Pearson Education Limted, 2017.

REFERENCE BOOKS:

1. Terokarvinen, kemo, karvinen and villeyvaltokari, "Make sensors": 1st edition, Maker Media, 2014.
2. Waltenegus Dargie, Christian Poellabauer, Fundamentals of Wireless Sensor Networks: Theory and Practice, 2010.
3. Charles Bell, Beginning Sensor networks with Arduino and Raspberry Pi, Apress, 2013.
4. Fei Hu, Security and Privacy in Internet of Things (IoTs), CRC Press, Taylor & Francis Group, 2020.
5. S. Sahoo, S. Sahoo, S. Mishra, Software-Defined Networking for Future Internet Technology: Concepts and Applications, Routledge, 2022.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

SCRIPTING LANGUAGES

(OPEN ELECTIVE)

Course Code: GR24A4134 **L/T/P/C: 3/0/0/3**

Prerequisites: Basic knowledge of programming concepts (loops, functions, arrays) and fundamentals of databases.

Course Outcomes: On completion of the course, the student will be able to

1. Understand PHP basics including variables, constants, control structures, arrays, and functions for web application development.
2. Apply MySQL database concepts with PHP to design, query, and manage relational databases securely.
3. Implement advanced PHP features such as authentication, file upload, email handling, and encryption in dynamic websites.
4. Design and develop Perl programs using arrays, hashes, subroutines, and advanced features like file system interaction, modules, and object-oriented constructs.
5. Apply Python programming concepts including functions, built-in modules, exception handling, and OOP paradigms for web and general-purpose scripting.

UNIT-I: PHP Basics:

Basics - Features, Data types, Variables, Constants, Expressions, String interpolation, Control structures, Embedding PHP Code in Web pages.

Functions: Creating a Function, Function Libraries, Arrays, Strings and Regular Expressions.

UNIT-II: MySQL Basics:

Introduction: Database Concepts, Overview of MySQL database, Installation. Connection establishment and Accessing MySQL Server, Querying the database. Data Definition Language. Functions and Logical operators, Access Privilege System.

UNIT-III: Advanced PHP Programming:

PHP and Web Forms, Files, PHP Authentication and Methodologies - File-based, Database-based, IP-based. Uploading Files with PHP, Sending Email, PHP Encryption Functions, Mcrypt package.

UNIT-IV: PERL:

Names and Values, Variables, Scalar Expressions, Control Structures, Arrays, List, Hashes, Strings, Pattern and Regular Expressions, Subroutines.

Advanced PERL: Finer points of Looping, Pack and unpack, File system, Data structures, Packages, Modules, Objects, Interfacing to the Operating System.

UNIT-V: Python:

Introduction, Syntax and Indentation, Statements, Functions, Built-in-Functions, Basics of Object-Oriented Paradigm, Modules and Packages, Exception Handling.

TEXT BOOKS:

1. David Barron, The World of Scripting Languages, Wiley India Pvt. Ltd., 1st Edition, 2003.
2. Jason Gilmore, Beginning PHP and MySQL, From Novice to Professional, Apress (Dreamtech India), 3rd Edition, 2008.
3. Steve Holden and David Beazley, Python Web Programming, New Riders Publications, 1st Edition, 2001.

REFERENCE BOOKS:

1. James Lee and Brent Ware, Open Source Web Development with LAMP: Using Linux, Apache, MySQL, Perl, and PHP, Addison-Wesley (Pearson Education), 1st Edition, 2003.
2. Julie Meloni and Matt Telles, PHP 6 Fast & Easy Web Development, Cengage Learning, 1st Edition, 2008.
3. Ivan Bayross and Sharanam Shah, PHP 5.1, The X Team, SPD Publications, 1st Edition, 2006.