GANDHI INSTITUTE OF TECHNOLOGY AND MANAGEMENT (GITAM)

(Deemed to be University)

VISAKHAPATNAM * HYDERABAD * BENGALURU

Accredited by NAAC with A^{++} Grade

GITAM School of Technology

REGULATIONS AND SYLLABUS

2 Year Postgraduate Programme

PCIVL02: M.Tech.Computer Aided Structural Analysis and Design

w.e.f. 2021-22 admitted batch

(Updated on 31st July 2023)

Vision

To become a global leader in higher education.

Mission

To impart futuristic and comprehensive education of global standards with a high sense of discipline and social relevance in a serene and invigorating environment.

Quality Policy

To achieve global standards and excellence in teaching, research, and consultancy by creating an environment in which the faculty and students share a passion for creating, sharing and applying knowledge to continuously improve the quality of education.

GITAM School of Technology

Vision

To become a global leader in holistic engineering education and research

Mission

1. To impart a strong academic foundation and practical education through a flexible curriculum, state of the art infrastructure, and best learning resources

2. To actively pursue academic and collaborative research with industries and research institutions, both in India and abroad

3. To build a congenial and innovative eco system by enabling the latest technologies, thus helping the students, to solve the challenges of societal importance

4. To provide our students with the appropriate leadership, management, communication skills and professional ethics for career success and to continuously impact the global lives

M.Tech. in Computer Aided Structural Analysis and Design
REGULATIONS
(w.e.f. 2021-22 admitted batch)

1. ADMISSION

1.1 Admission into M.Tech. in **Computer Aided Structural Analysis and Design** program of GITAM deemed to be University is governed by GITAM admission regulations.

2. ELIGIBILITY CRITERIA

2.1 A pass in B.E./B.Tech./AMIE in Civil Engineering or its equivalent.

2.2 Admissions into M.Tech. will be based on the following:

(i) Score obtained in GAT (PG), if conducted.
(ii) Performance in Qualifying Examination / Interview.
(iii) Candidates with valid GATE score shall be exempted from appearing for GAT (PG).

2.3 The actual weightage to be given to the above items will be decided by the authorities at the time of admissions.

3. CHOICE BASED CREDIT SYSTEM

3.1 Choice Based Credit System (CBCS) was introduced with effect from 2015-16 admitted batch and revised with effect from academic year 2020-21 in order to promote:

- Student centered Learning
- Activity based learning
- Students to learn courses of their choice
- Cafeteria approach

3.2 Learning objectives and outcomes are outlined for each course to enable a student to know what he/she will be able to do at the end of the program.

4. STRUCTURE OF THE PROGRAM

4.1 The Program Consists of

i) Core Courses (compulsory) which give exposure to a student in core subjects relatedarea.

ii) Program Electives.

iii) Open Electives

iv) Mandatory and Audit Courses

4.2 Each course is assigned a certain number of credits depending upon the number of contact hours (lectures/tutorials/practical) per week.

4.3 In general, credits are assigned to the courses based on the following contact hours per week per semester.

- One credit for each Lecture / Tutorial hour per week.
- One credit for two hours of Practicals per week.

4.4 The curriculum of the four semesters M.Tech. program is designed to have a total of 68 credits for the award of M.Tech. degree

5. MEDIUM OF INSTRUCTION

The medium of instruction (including examinations and project reports) shall be English.

6. REGISTRATION

Every student has to register for the courses in each semester at the time specified in the academic calendar.

7. ATTENDANCE REQUIREMENTS

7.1 A student whose attendance is less than 75% in all the courses put together in any semester will not be permitted to attend the semester-end examination and he/she will not be allowed to register for subsequent semester of study. He/she has to repeat the semester along with his / her juniors.

7.2 However, the Vice-Chancellor on the recommendation of the Principal / Director of the Institute/School may condone the shortage of attendance to the students whose attendance is between 65% and 74% on genuine grounds and on payment of prescribed fee.

8. EVALUATION

8.1 The assessment of the student's performance in a theory course shall be based on two components: Continuous Evaluation (40 marks) and semester-end examination (60 marks).

8.2 A student has to secure a minimum of 40% in any theory course in the two components (ref.8.1) put together to be declared to have passed the course, subject to the condition that the student must have secured a minimum of 24 marks out of 60 marks (i.e. 40%) in the theorycomponent at the semester-end examination.

8.3 Practical/ Project Work/ Viva voce/ Seminar etc. course are completely assessed under Continuous Evaluation for a maximum of 100 marks, and a student has to obtain a minimum of 40% to secure Pass Grade. Details of Assessment Procedure are furnished below in Table 1.

8.4 Audit courses are assessed through continuous evaluation for satisfactory or not satisfactoryonly. No credits will be assigned.

S.No.	Component of Assessment	Marks Allotted	Type of Assessment	Scheme of Evaluation
1	Theory Courses	40	Continuous Evaluation	Thirty (30) marks for mid Semester examinations. Three mid examinations shall be conducted for 15 marks each; performance in best two shall be taken into consideration. Ten (10) marks for Quizzes, Assignments and Presentations. Sixty (60) marks for Semester-endexaminations
		60	Semester-end Examination	
	Total	100		

Table 1: Assessment Procedure

2	Practical Courses	100	Continuous Evaluation	i) Fifty (50) marks for regularity and performance, records and oral presentations in the laboratory. Weightage for each component shall be announced at the beginning of thesemester. ii) Ten (10) marks for case studies. Forty (40) marks for two tests of 20 marks each (one at the mid-term and the other towards the end of the semester) conducted by the concerned lab teacher.
3	TechnicalSeminar (II Semester)	100	Continuous Evaluation	Through five periodic seminars of20 marks each
4	Project Work (III Semester)	100	Continuous Evaluation	Forty (40) marks for periodicassessment on originality,innovation, sincerity and progress of the work, assessed by the project supervisor. Thirty (30) marks for mid-term evaluation for defending the project, before a panel of examiners. iii) Thirty (30) marks for final report presentation and viva-voce, by apanel of examiners*.
5	Project Work (IV Semester)	50	Continuous Evaluation	Twenty (20) marks for periodic assessment on originality innovation,sincerity and progress of the work, assessed by the project supervisor. Fifteen (15) marks for mid-termevaluation for defending the project, before a panel of examiners*. iii) Fifteen (15) marks for interim report presentation and viva-voce.
		50	Semester-end Examination	Fifty (50) marks for final project report and viva-voce examination assessed by external examiners.
	Total	100		

6	Audit Courses	100	Continuous Evaluation	Audit courses are assessed for PASS or FAIL only. No credits will be assigned to these courses. If a student secures a minimum of 40 out of 100 marks during continuous evaluation, he / she will be declared PASS, else FAIL. PASS grade is necessary to be eligible to get thedegree

**Panel of Examiners shall be appointed by the concerned Head of the Department*

9. PROVISION FOR ANSWER BOOK VERIFICATION AND CHALLENGEEVALUATION

9.1 If a student is not satisfied with his/her grade, the student can apply for answer book verification on payment of prescribed fee for each course within one week after announcement of results.

9.2 After verification, if a student is not satisfied with revaluation marks/grade, he/she canapply for challenge valuation within one week after announcement of answer book verification result or two weeks after the announcement of results, which will be valuedby two examiners i.e., one Internal and one External examiner in the presence of the student on payment of prescribed fee. The challenge valuation fee will be returned, if the student is successful in the appeal by securing a better grade.

10. SUPPLEMENTARY AND SPECIAL EXAMINATIONS

10.1 The odd semester supplementary examinations will be conducted after conducting regular even semester examinations during April/May.

10.2 The even semester supplementary examinations will be conducted after conducting regular odd semester examinations during October/November.

10.3 A student who has secured 'F' Grade in Project work shall have to improve his/her workand reappear for viva-voce after satisfactory completion of work approved by panel of examiners.

10.4 A student who has completed period of study and has "F" grade in final semester coursesis eligible to appear for special examination.

11. MASSIVE OPEN ONLINE COURSES (MOOCs)

Greater flexibility to choose variety of courses is provided through Massive Open Online Courses (**MOOCs**) during the period of study. Students without any backlog courses up to first semester are permitted to register for MOOCs in second semester up to a maximumof 6 credits from program elective / open elective/audit courses. However the Departmental Committee

(DC) of the respective campuses has to approve the courses under MOOCs. The grade equivalency will be decided by the respective Board of Studies(BoS).

12. GRADING SYSTEM

12.1 Based on the student performance during a given semester, a final letter grade will be awarded at the end of the semester in each course. The letter grades and the corresponding grade points are as given in Table 2.

Table 2: Grades and Grade Points

Sl.No.	Grade	Grade Points	Absolute Marks
1	O (outstanding)	10	90 and above
2	A+ (Excellent)	9	80 to 89
3	A (Very Good)	8	70 to 79
4	B+ (Good)	7	60 to 69
5	B (Above Average)	6	50 to 59
6	C (Average)	5	45 to 49
7	P (Pass)	4	40 to 44
8	F (Fail)	0	Less than 40
9	Ab (Absent)	0	-

12.2 A student who earns a minimum of 4 grade points (P grade) in a course is declared to have successfully completed the course, and is deemed to have earned the credits assigned to that course, subject to securing a GPA of 5.0 for a Pass in the semester.

13. GRADE POINT AVERAGE

13.1 A Grade Point Average (GPA) for the semester will be calculated according to the formula:

$$GPA = \frac{\Sigma [C \times G]}{\Sigma C}$$

where, C = number of credits for the course,
G = grade points obtained by the student in the course.

13.2 The Cumulative Grade Point Average (CGPA), is calculated using the above formula considering the grades obtained in all the courses, in all the semesters up to that particular semester.

13.3 CGPA required for classification of class after the successful completion of the program is shown in Table 3.

Table 3: CGPA required for Award of Class

Class	CGPA Required
First Class with Distinction	$\geq$ 8.0*
First Class	$\geq$ 6.5
Second Class	$\geq$ 5.5
Pass Class	$\geq$ 5.0

* In addition to the required CGPA of 8.0 or more, the student must have necessarily passedall the courses of every semester in the first attempt.

14. ELIGIBILITY FOR AWARD OF THE M. Tech. DEGREE

14.1 Duration of the program: A student is ordinarily expected to complete the M.Tech. Programin four semesters of two years. However a student may complete the program in not more than four years including study period.

14.2 However the above regulation may be relaxed by the Vice-Chancellor in individual cases for cogent and sufficient reasons.

14.3 A student shall be eligible for award of the M.Tech. Degree if he / she fulfills all the following conditions.

a) Registered and successfully completed all the courses and project works.

b) Successfully acquired the minimum required credits as specified in the curriculumcorresponding to the branch of his/her study within the stipulated period.

c) Has no dues to the Institute, Hostels, Libraries, NCC / NSS etc, and

d) No disciplinary action is pending against him / her.

15. DISCRETIONARY POWER

Notwithstanding anything contained in the above sections, the Vice Chancellor mayreview all exceptional cases, and give his decision, which will be final and binding.

M. Tech. in Computer Aided Structural Analysis and Design
Department of Civil Engineering
Effective from academic year 2021-22 admitted batch

Semester I

S. No	Course Code	Course Name	Category	L	T	P	C
1.	20ECE701	Theory of Elasticity	PC	3	0	0	3
2.	20ECE703	Advanced Structural Analysis	PC	3	0	0	3
3.	20ECE705	Advanced Reinforced Concrete Design	PC	3	0	0	3
4.	20ECE7XX	Program Elective I	PE	3	0	0	3
5.	20ECE7XX	Program Elective II	PE	3	0	0	3
6.	20EMC741	Research Methodology and IPR	MC	2	0	0	2
7.	20ECE721	Computer Aided Engineering (CAE) Laboratory-I	PC	0	0	4	2
8.	20ECE723	Advanced Concrete Laboratory	PC	0	0	4	2
9.	20EAC7XX	Audit Course I	AC	2	0	0	0
Total							**21**

Semester II

S. No	Course No	Course Name	Category	L	T	P	C
1.	20ECE702	Advanced steel Design	PC	3	0	0	3
2	20ECE704	Structural Dynamics	PC	3	0	0	3
3	20ECE7XX	Program Elective III	PE	3	0	0	3
4.	20ECE7XX	Program Elective IV	PE	3	0	0	3
5.	20EOE7XX	Open Elective	OE	3	0	0	3
6.	20ECE722	Computational Methods in Structural Engineering Laboratory	PC	0	0	4	2
7.	20ECE724	Computer Aided Engineering (CAE) Laboratory-II	PC	0	0	4	2
8.	20ECE792	Technical Seminar	PC	0	0	4	2
9.	20EAC7XX	Audit Course II	AC	2	0	0	0
10.	20EHS304	Universal Human Values: Understanding Harmony	MC	2	1	0	3
Total							**24**

Semester III

S. No	Course No	Course Name	Category	L	T	P	C
1.	20ECE891	Project Work I	PW			26	13
Total							**13**

Semester IV

S. No	Course No	Course Name	Category	L	T	P	C
1	20ECE892	Project Work II	PW			26	13
			Total				**13**

M. Tech. in Computer Aided Structural EngineeringNumber of Credits

Semester	I	II	III	IV	**Total**
Credits	21	24	13	13	**71**

AUDIT COURSES I and II

S.No	Course Code	Course Title	Category	L	T	P	C
1	20EAC741	English For Research Paper Writing	AC	2	0	0	0
2	20EAC742	Disaster Management	AC	2	0	0	0
3	20EAC743	Sanskrit for Technical Knowledge	AC	2	0	0	0
4	20EAC744	Value Education	AC	2	0	0	0
5	20EAC745	Constitution of India	AC	2	0	0	0
6	20EAC746	Pedagogy Studies	AC	2	0	0	0
7	20EAC747	Stress Management by Yoga	AC	2	0	0	0
8	20EAC748	Personality Development through Life Enlightenment Skills	AC	2	0	0	0
9	20EAC750	Developing Soft Skills And Personality	AC	3	0	0	0

OPEN ELECTIVES

S.No	Course Code	Course Title	Category	L	T	P	C
1	20EOE742	Business Analytics	OE	3	0	0	3
2	20EOE744	Industrial Safety	OE	3	0	0	3
3	20EOE746	Operations Research	OE	3	0	0	3
4	20EOE748	Cost Management of Engineering Projects	OE	3	0	0	3
5	20EOE752	Waste to Energy	OE	3	0	0	3
6	20EOE754	Green Buildings	OE	3	0	0	3

M.Tech. in Computer Aided Structural Analysis and Design
PROGRAM ELECTIVES

Program Elective I

S. No	Course Code	Course Title	Category	L	T	P	C
1	20ECE741	AI & ML Applications in Structural Engineering	PE	2	0	2	3
2	20ECE743	Advanced Concrete Technology	PE	3	0	0	3
3	20ECE745	Bridge Engineering	PE	3	0	0	3

Program Elective II

S. No	Course Code	Course Title	Category	L	T	P	C
1	20ECE751	Fracture Mechanics	PE	3	0	0	3
2	20ECE753	Maintenance and Rehabilitation of Structures	PE	3	0	0	3
3	20ECE755	Fire Resistant Design of Structures	PE	3	0	0	3

Program Elective III

S. No	Course Code	Course Title	Category	L	T	P	C
1	20ECE742	Computer Aided Numerical Methods	PE	3	0	0	3
2	20ECE744	Wind analysis and design of tall structures	PE	3	0	0	3
3	20ECE746	Advanced Design of Pre-Stressed Concrete Structures	PE	3	0	0	3

Program Elective IV

S. No	Course Code	Course Title	Category	L	T	P	C
1	20ECE752	Theory of Plates & Shells	PE	3	0	0	3
2	20ECE754	Optimization Methods in Structural Design	PE	3	0	0	3
3	20ECE756	Earthquake Engineering	PE	3	0	0	3

20ECE701: THEORY OF ELASTICITY

L	T	P	C
3	0	0	3

Theory of elasticity *is the branch of Solid Mechanics which deals with the stress and displacements in elastic solids produced by external forces or changes in temperature. In this course the student will be able to study deformation and stresses developed in the material caused by external forces. The linear theory of elasticity views a structure as builtof infinitesimal elements, which are solved by using concepts of physics and mathematicalapplication.*

Course Objectives

- Explain plane stress and plane strain relation.
- Determine stresses and strains by using different methods.
- Solve stress strain problems in polar coordinates.
- Evaluate stresses and strains for 3D body.
- Apply optics law to determine stresses and strains.

Unit I **8L**

Introduction : Components of stress, components of strain, Hookes law, Plane stress and plane strain, Stress at a point, Differential Equations of equilibrium, Boundary conditions, Compatibility equations, stress function.

Learning outcomes:
After completion of this unit, the student will be able to

1. Understand basic definitions and concepts of stress, strain and equilibrium equations(L2)
2. Identifying state of stresses in a material at a particular location (L3).

Unit II **8L**

Two Dimensional Problems in Rectangular Coordinates: Solution by polynomials, Saint Venant's principle, determination of displacements, bending of cantilever loaded at the end, bending of a beam subjected to uniform load.

Learning outcomes:
After completion of this unit, the student will be able to

1. Find solutions for two dimensional coordinates(L1)
2. Formulations and solution strategies of various boundary value problems((L5)

Unit III **8L**

Two Dimensional Problems in Polar Coordinates: Basic equations, Biharmonic equation for axis symmetry, pure bending of curved bars- exact analysis, thick cylinder, rotating disks.

Learning outcomes:
After completion of this unit, the student will be able to

1. Understand biharmonic equations to solving irregular two-dimensional problems.(L2)
2. Find state of stresses in Polar Coordinates (L1)
3. Identify state of stresses in thick cylinder, rotating disks (L3)

Unit IV **8L**

General theorems: Differential equations of equilibrium – conditions of compatibility, Analysis of stress and strain in Three Dimensions: Introduction - Principal stresses - Determination of principal stress – Stress invariants – Determination of Maximum shearing stress.

Learning outcomes:
After completion of this unit, the student will be able to

1. Understand state of stresses for three dimensional bodies.(L2)
2. Find solutions for three dimensional coordinates(L1)
3. Formulations and solution strategies of various boundary value problems for three dimensional bodies ((L5)

Unit V **10L**

Torsion: Torsion of straight bars – Elliptic cross section – Membrane analogy torsion of bar of narrow rectangular cross section.

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Learning outcomes:
After completion of this unit, the student will be able to

1. Understand basic definitions and concepts of torsion stresses (L2)
2. Find Membrane analogy torsion of bar of narrow rectangular cross section (L3).

Text Book(s):

1. Timoshenko, Goodier, Theory of Elasticity, 3/e, McGraw Hill Company, 2010.
2. Sadhu Singh, Theory of Elasticity, 11/e, Khanna publication, 2015.

References

1. C. T. Wang, Applied Elasticity, McGraw Hill, 1963.
2. J. P. Den Hartog, Advanced Strength of Materials, Dover Publications, 1988.

Course Outcomes

- Relate plane stress and plane strain.(L1)
- Evaluate stresses and strains by using different methods.(L5)
- Determine stress strain problems in polar coordinates.(L5)
- Solve stresses and strains for 3D body.(L6)
- Estimate stresses and strains by applying optics law.(L5)

20ECE703: ADVANCED STRUCTURAL ANALYSIS

L	T	P	C
3	0	0	3

Structural Analysis deals with the analysis of the response of a structure under various loading conditions. This course is designed to expose the learner towards various advancedmethods adapted for analysis of structures.

Course Objectives:

- To illustrate the basic concepts of structural analysis
- To analyse indeterminate structures using moment distribution method
- To analyse the indeterminate structures using flexibility matrix method
- To analyse the indeterminate structures using stiffness matrix method
- To analyse a multistoreyed frame using approximate methods

Unit I **8L**

Basic Concepts of Structural Analysis: Introduction- Classification of structures- Equations Of static equilibrium- Internal forces- Degree of Static Indeterminacy- Degree of Kinematic Indeterminacy-Stability.

Learning Outcomes:

Post completion of the unit the student will be able to:

- *Classify the various types of structures. (L2)*
- *Relate the various equations of equilibrium. (L2)*
- *Illustrate the basic concepts static & kinematic indeterminacy. (L2)*

Unit II **8L**

Analysis of indeterminate structures by Moment Distribution Method: Introduction-continuous beams-bents-rectangular portals-portals with inclined legs-2 Bay 2 storey portal frames.

Learning Outcomes:

Post completion of the unit the student will be able to:

- *Build the moment distribution table. (L3)*
- *Understand the procedure of determination of reactions using moment distribution method. (L2)*
- *Analyse the sway for frames. (L4)*

Unit III **8L**

Flexibility Method: Introduction-Method of consistent Deformation-Application of flexibility method to pin jointed frames (Max 12 Members)- Analysis of rigid portal frames (2 by 2 storey).

Learning Outcomes:

Post completion of the unit the student will be able to:

- *Build the flexibility matrix equations. (L3)*
- *Analyse pin jointed frames using flexibility method. (L4)*
- *Solve problems on rigid portal frames using flexibility method. (L3)*

Unit IV **8L**

Stiffness Method: Introduction-Relation between slope deflection method and stiffness method- Stiffness method of analysis-Choice between flexibility and stiffness methods-Displacement and forces in members of indeterminate structures (having a redundancy not more than 3) by stiffness method.

Learning Outcomes:

Post completion of the unit the student will be able to:

- *Formulate the stiffness matrix equations. (L6)*
- *Apply the stiffness method for various structures.(L3)*
- *Outline the need of stiffness method. (L2)*

Unit V **10L**

Approximate methods of analysis: Analysis of multi-storeyed frames by portal method, points of inflection method, substitute frame method.

Learning Outcomes:

Post completion of the unit the student will be able to:

- *Analyse a multi storeyed frame using portal method. (L4)*
- *Analyse a structure using points of inflection method. (L4)*
- *Analyse a multi storeyed frame using substitute frame method. (L4)*

Text book(s):

1. V.N. Vazirani, M.N Ratwani, Advanced Theory Of Structures and Matrix Method, Khanna Publishers, 2002
2. William Weaver, J.R, James M. Gere, Matrix Analysis Of Framed Structures, 2/e, Van Nostrand Publisher, 2012.

References:

1. Structural Analysis-A Matrix Approach -G.S Pandit and S.P Gupta,Volume II, Mc Graw Hill Education Private Limited
2. Advanced Structural Analysis by Ashok. K. Jain, Nem Chand Brothers, Second Edition-2006

Course Outcomes :

By the end of the course student will be able to :

- Apply basic concepts of structural analysis for analysing beams and trusses (L3)
- Analyse indeterminate structures using moment distribution method (L4)
- Analyse the indeterminate structures using flexibility matrix method.(L4)
- Analyse the indeterminate structures using stiffness matrix method. (L4)
- Analyse a multistoreyed frame using approximate methods. (L4)

20ECE705: ADVANCED REINFORCED CONCRETE DESIGN

L	T	P	C
3	0	0	3

The prerequisite for this course would be Design of Reinforced Concrete Structures. Design of few regular structures are covered in this course. The use of working stress method for achieving crack control design is explained. The popularity of flat slab design in modern construction is also discussed. Importance of fire resistance design of structures, introduction to earthquake loading and ductile detailing of beams as per codal provisions is summarized.

Course Objectives:

- To summarize the importance of limit state of serviceability.
- To outline the design knowledge of flat slabs.
- To develop an understanding of the codal provisions of fire and design of concrete beam members subjected to fire.
- To explain the definition of Earthquake forces and Structural Responses.
- To develop an understanding of the codal provisions of ductile detailing of frames

Unit I **8L**

Deflection of Reinforced Concrete Beams and Slabs: Introduction, Short-term deflection of beams and slabs, deflection due to imposed loads, short-term deflection of beams due to applied loads, Calculation of deflection by IS 456. Estimation of Crack width in Reinforced Concrete Members: Introduction, Factors affecting crack width in beams, Calculation of crack width, simple empirical method, estimation of crack width in beams by IS 456.

Learning Outcomes:

After completion of this unit, the student will be able to

- distinguish between long term and short term deflection in beams (L4)
- evaluate the short term deflection of beam using IS code method(L5)
- evaluate the long term deflection of beam using IS code method(L5)
- estimate the crack width in beams using IS code method (L5)

Unit II **8L**

Design of Flat Slabs: Direct Design Method – Distribution of Moments in column strips and middle strip – moment and shear transfer from slabs to columns – shear in flat slabs – check for one way shear – Introduction to equivalent frame method. Limitation of direct design method – Distribution of moments in column strips and middle strip.

Learning Outcomes:

After completion of this unit, the student will be able to

- illustrate the different components of flat slabs (L2)
- outline the distribution of moments in column and middle strips (L2)
- design a flat slab for a panel using direct design method (L6)
- perceive the limitations of direct design method of flat slab (L5)

Unit III **8L**

Design of Reinforced Concrete Members for Fire Resistance: Introduction, ISO 834 standard heating conditions, grading or classifications, effect of high temperature on steel and concrete, effect of high temperatures on different types of structural members, fire resistance bystructural detailing from tabulated data, analytical determination of the ultimate bending moment, capacity of reinforced concrete beams under fire, other considerations.

Learning Outcomes:

After completion of this unit, the student will be able to

- categorize the various approaches in analysis for elevated temperature structures (L4)
- assess the effect of high temperature on steel and concrete materials (L5)
- examine the effect of high temperature on different types of structural members(L4)
- evaluate the capacity of RCC beam when exposed to fire(L5)

Unit IV **8L**

Earthquake Forces and Structural Responses: Introduction, Bureau of Indian Standards for earthquake design, Earthquake magnitude and intensity, Historical development, Basic seismic coefficient and seismic zone factors, determination of design forces, Choice of method for multi-storeyed buildings, Difference between wind and earthquake forces, Partial safety factors for design, Distribution of seismic forces, Analysis of structures other than buildings.

Learning Outcomes:

After completion of this unit, the student will be able to

- summarize terminology related to earthquake (L2)
- classify different seismic waves (L2)
- distinguish between earthquake magnitude and intensity (L4)
- distinguish between wind and earthquake forces (L4)
- evaluate the earthquake forces for multi-storied structures(L5)

Unit V **10L**

Ductile detailing, Increased values of seismic effect for vertical and horizontal projections, proposed changes in IS 1893 (Fifth revision). Ductile Detailing of Frames for Seismic Forces: Introduction, General principles, Factors that increase ductility, Specifications for material for ductility, ductile detailing of beams – Requirements.

Learning Outcomes:

After completion of this unit, the student will be able to

- apply the concept of ductile detailing in RC beams (L3)
- select the reinforcement detailing in beams to meet the ductility principles as per code (L5)
- examine the factors that increase the ductility in beams (L4)
- identify the specifications for materials for ductility (L3)

Text Book(s):

1. P. C. Varghese, Advanced Reinforced Concrete Design, 2/e, Prentice Hall of India, 2011.
2. Ashok K. Jain, Reinforced Concrete, 7/e, Nem Chand and Bros., 2012.

References:

1. Park, Paulay, “Reinforced Concrete Structures”, Wiley, 2009.

Course Outcomes:

At the end of the course the student will be able to

- estimate the deflection and crack width of beams and slabs (L5)
- analyze and design the Flat Slabs (L4)
- analyze and design concrete members subjected to fire (L4)
- examine the structures for earthquake forces (L4)
- apply codal provisions for ductile detailing of flexural members (L3)

20ECE721: COMPUTER AIDED ENGINEERING (CAE) LABORATORY-I

L T P C

0 0 4 2

The prerequisite for this course would be Structural Analysis, Water Resources Engineering and Project Planning and Management. The student gets familiarity in i) analysis and design of RCC and steel Structures using STAAD Pro., ii) design water distribution network using EPANET, iii) schedule and plan a project using Construction Management principles, and iv) reading of spatial data using GIS. The use of software increases the accuracy in analysis and reduce the time to complete the given practical problem.

Course Objectives

- Demonstrate the design of reinforced concrete structural elements.
- Explain earthquake resistant design
- Explain analysis of a building for wind loading.
- Demonstrate the method of analysis of truss.

List of Experiments

1. Design of reinforced concrete beam (singly/doubly)
2. Design of reinforced concrete column subjected to biaxial bending
3. Design of reinforced concrete slab (One way/Two-way)
4. Design of reinforced concrete retaining wall (cantilever type)
5. Design of reinforced concrete shear wall
6. Lateral forces on a building due to an earthquake using equivalent static method
7. Lateral forces on a building due to wind
8. Analysis of rigid jointed plane frames
9. Analysis of simply supported/cantilever beam
10. Analysis of plane truss

References:

1. T.S Sarma,Staad Pro V8i for Beginners,Notion Press; 1 edition (2014).
2. Sham Tickoo, Learning Bentley Staad.Pro V8i for Structural Analysis,Dreamtech press (2015).
3. Technical Reference Manual for Staad, Bentley.

Course Outcomes

- Analyze and design the structural components like beams, slabs, columns, retaining wall and shear wall. (L4)
- Analyze for earthquake loading & wind loading of framed buildings. (L4)
- Analyze and design pin jointed, rigid jointed plane structures. (L4)

20ECE723: ADVANCED CONCRETE LABORATORY

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This laboratory shall expose the learner to the various non destructive testing methods to assess the compressive strength of concrete. In addition the lab shall aim to analyse the response of RC beams and columns under various loading conditions

Course objectives

- Determine mechanical properties of Plain Cement Concrete.
- Evaluate strength of concrete using NDT Methods.
- Demonstrate performance of structural members.

List of Experiments

1. Assessment of compressive strengths by Rebound hammer test
2. Calibration of Rebound hammer for compressive strength
3. Assessment of compressive strengths by UPV
4. Calibration of UPV for compressive strength
5. Rapid Estimation of compressive strength of concrete using Accelerated curing tank
6. Study on Behavior of a RC beam using loading frame
7. Study on behavior of RC column using loading frame
8. Split tensile test on a cylindrical concrete specimen
9. Stress-strain curve for concrete
10. Fatigue test on mild steel specimen

References:

1. Indian Standard, Non Destructive Testing of Concrete-Methods of Test, IS 13311 (Part 1 & 2), 1992.
2. Indian Standard, Methods of test for strength of concrete, IS 516-1959 (2006).

Course outcomes

- Evaluate mechanical properties of Plain Cement Concrete.(L5)
- Determine strength of concrete using NDT Methods. (L5)
- Interpret and analyze performance of structural members. (L5)

20ECE702: ADVANCED STEEL DESIGN

L T P C

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Prerequisite to this course is design of steel structures. This course deals with the design of Light gauge steel structures, railway steel bridges, composite members and the Gantry girders.

Course Objectives

- To explain the properties of light guage steel and design various structural elements.
- To identify loads acting on a steel bridges and design a plate girder bridge
- To illustrate behavior of composite members
- To explain the structural behavior of Composite Compression Members and slabs
- To study the Design of Gantry Girder.

Unit I **8L**

Light gauge steel structures: Local buckling of thin elements, Light gauge steel columns and compression members, Stiffened and Unstiffened compression elements, Basic design stress, Allowable design stress, Light gauge steel beams, Laterally supported light gauge steel beams web crippling. Allowable design stress in beams

Learning Outcomes

After completion of Module I, students will be able to

- **Classify** various types of light gauge sections (L2)
- **Design** beams and columns using Light Gauge Steel sections (L6)

Unit II **10L**

Steel Bridges: Introduction, classification of steel bridges, loads and load combinations. Plate girder bridges: Introduction, types, general arrangement analysis and design

Learning Outcomes

After completion of Module II, students will be able to

- **Classify** various types of steel bridges (L2**)**
- **Determine** the load on bridges (L5)
- **Design** various types of plate girder bridges (L6)

Unit III **8L**

Introduction – Composite slabs – profiled sheeting – sheeting parallel to span – sheeting perpendicular to span

Learning Outcomes

After completion of Module IV, students will be able to

- **Design** various Composite slabs (L6)

- **Explain** the behaviour of profiled sheeting along and perpendicular to span (L4)

Unit V **8L**

Plastic Analysis:

Introduction, Shape factor, Plastic Hinge, Collapse Mechanisms, Static and Kinetic Theorems, Methods of analysis, Fixed and Continuous Beams.

Learning outcomes

After completion of Module III, the student will be able to

- **Examine** possible plastic hinges **(L4)**
- **Estimate** collapse load by static theorem **(L6)**
- **Estimate** collapse load by kinetic theorem **(L6)**
- **Estimate** Plastic moment for fixed beams **(L6)**
- **Estimate** Plastic Moment for continuous beams **(L6)**

Unit V **8L**

Gantry Girder: Introduction - loading consideration and maximum load effect - selection of gantry girder – design of gantry girders for primary loads only.

Learning Outcomes

After completion of Module V, students will be able to

- **Interpret** loadings to be considered as per standards (L2)
- **Categorize** the critical section to be considered in design (L4)
- **Design** the gantry girder (L6)

Text Book(s):

1. S.K. Duggal, Limit State, Design of Steel Structures, Tata McGraw Hill, 2014.
2. N. Subramanyam, Design of Steel Structures, 1/e, Oxford University Press, 2008

References:

1. R.P. Johnson, “Composite Structures of Steel & Concrete”, Blackwell Scientific publications, UK, 1994.
2. Rama Chandra and Gehlot, V. (2007), Design of Steel Structures Vol. 1 and II, Standard Publication, New Delhi.
3. Punmia, B.C., Jain, A.K. and Jain, A.K. (2015), Comprehensive Design of Steel Structures, Laxmi Publications, New Delhi.

Course Outcomes

By the end of the course the student will be able to:

- Choose appropriate Light Guage Steel Sections for flexural and compression members (L6)
- Design a plate girder bridge (L6)
- Design of composite slabs (L6)

- Evaluate the shape factor and collapse loads (L5)
- Design of Gantry Girder (L6)

20ECE704: STRUCTURAL DYNAMICS

L T P C

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Structural dynamics, is a type of structural analysis which covers the behaviour of a structure subjected to dynamic. Any structure can be subjected to dynamic loading. The prerequisite for this course would be Mathematics and Structural Analysis and Design of Reinforced Concrete Structures. The student will be able to develop and solve equation of motion for SDOF subjected to free and forced vibrations for Single Degree of Freedom Systems, Distributed Mass Systems, Lumped Mass Systems and Multiple Degree of Freedom Systems. This course is prerequisite for Earthquake Engineering Course .

Course Objectives

- To demonstrate the principles and methods of dynamic analysis of structures
- Illustrate dynamics response of single degree freedom system using fundamental theory and equation of motion
- Interpret methods to analyze structures subjected to any kind of dynamic excitation and computing quantities like displacements, forces, stresses etc.
- Analyze and study dynamics response of Multi degree freedom system using fundamental theory and equation of motion
- Develop modal equations for damped and undamped systems.

Unit I **8L**

Free Vibration: Undamped Single-Degree-of-Freedom System: Degrees of Freedom, Undamped system, Springs in Parallel or Series, Newton's Law of Motion, Free BodyDiagram, Solution of the Differential Equation of Motion, Frequency and Period, Amplitude of Motion. **Damped Single-Degree-of-Freedom System:** Viscous Damping, Equation of Motion, Critically Damped System, Overdamped System, Underdamped System, Logarithmic Decrement.

Learning Outcomes:

After completion of Module I, the student will be able to

- **Relate** the structural idealizations studied to the properties of real structures **(L1)**
- **Define** generalized degrees of freedom for single and multi degree of freedom systems **(L1)**
- **Apply** knowledge of mathematics, science and engineering by developing the equation of motion for SDOF for free vibrations **(L3)**
- **Solve equation of motion** for free vibration for damped and undamped SDOF system **(L6)**
- **Demonstrate** logarithmic decrement from free vibrations of SDOF **(L2)**

Unit II **8L**

Response of One-Degree-of-Freedom System to Harmonic Loading: Harmonic Excitation: Undamped System, Harmonic Excitation: Damped System.

Response to General Dynamic Loading: Response to impulse loading: General nature of

impulsive loading, sinewave impulse, Rectangular impulse, square pulse of finite duration, triangular impulse, response to general force pulse, greens function, Duhamel's Integral-Undamped System, Duhamel's Integral-Damped System

Learning Outcomes:

After completion of Module II, the student will be able to

- **Apply** knowledge of mathematics, science and engineering by developing the equation of motion for SDOF for forced vibrations **(L3)**
- **Solve** equation of motion for various forced vibration for undamped and damped SDOF system **(L6)**
- **Determine** the response to forced vibration using Duhamel's Integral for SDOF **(L5)**

Unit III **8L**

Structures with distributed mass and load: Introduction, free vibration, frequency and motions of SSB, cantilever beam, fixed beam, propped cantilever beam, forced vibration of beams, Beams, with variable cross section and mass.

Learning Outcomes:

After completion of Module III, the student will be able to

- **Apply** knowledge of mathematics, science and engineering by developing the equation of motion for various beams for free and forced vibrations **(L3)**
- **Solve** equation of motion for free and forced vibration **(L6)**

Unit IV **8L**

Lumped mass MDOF systems: Determination of natural frequencies, Stiffness Method, Flexibility Method, Stodola-Vianelle method, Rayleigh method, Modified Rayleigh-Ritz method; multistory rigid frames subjected to lateral loads, damping in multi degree systems.

Learning Outcomes:

After completion of Module IV, the student will be able to

- **Determine** the natural frequencies for lumped mass systems using various techniques **(L5)**
- **Determine** the damping for lumped mass systems using various techniques **(L5)**
- **Identify** the dynamic response of Lumped mass MDOF systems. **(L3)**

Unit V **10L**

Natural Vibration Frequencies and Modes: Systems without damping, Normal Vibration Frequencies and Modes, Modal and Spectral Matrices, Orthogonality of Modes, Interpretation of Modal Orthogonality, Normalization of Modes, Modal Expansion of displacements.

Free Vibration Response: Solution of Free Vibration Equations: Undamped Systems, Free Vibration of Systems with damping. **Modal Analysis:** Modal Equations for undamped systems, Modal Equations for damped Systems, Displacement Response, Element Forces

- **Determine** the natural frequencies and natural modes of vibration of a structure for

MDOF systems **(L5)**

- **Evaluate** free vibration response of undamped and damped systems for MDOF systems. **(L5)**
- **Develop** the classical modal analysis procedure to obtain the response of MDOF systems. **(L3)**

Text Book(s):

1. John M. Biggs, Introduction to Structural Dynamics, 1/e, McGraw Hill Inc, 2014.
2. Mario Paz, William Leigh, Structural Dynamics, 5/e, Springer, 2006.

References:

1. Anil K. Chopra, Dynamics of Structures, Theory and Applications to Earthquake Engineering, 4/e, Prentice Hall of India, 2011.
2. A.Ghali, A.M.Neville, Tom G. Brown, Structural Analysis: A Unified classical & Matrix Approach, 6/e, CRC Press, 2009.
3. Jai Krishna, Chandrasekharan, and Saritha Prakasham, Elements of Earthquake Engineering, 2/e, South Asian Publishers, 2000.

Course Outcomes

After completion of the course, the students will

- Identify vibration analysis of systems/structures with different degrees of freedom.(L3)
- Analyze lumped mass systems for their dynamic behavior.(L4)
- Explain the equation of motion, dynamic response of single, and multi degree-of-freedom system.(L5)
- Summarize the solution techniques for dynamics of Multi-degree freedom systems.(L2)
- Apply structural dynamics theory to earthquake analysis, response, and design of structures.(L3).

20ECE722: COMPUTATIONAL METHODS IN STRUCTURAL ENGINEERING LABORATORY

L T P C

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MATrix LABoratory (MATLAB) is an advanced tool used to solve scientific problems. This laboratory will expose the learners to the commonly used computational techniques and code it in MATLAB to provide a realistic insight into the techniques.

Course Objectives:

- To develop MATLAB codes for solution of simultaneous linear equations.
- To construct codes for 1D Finite Element problems.
- To identify methods to code for numerical integration techniques & statistical methods.
- To model finite difference methods.

List of experiments

1. Formulate set of simultaneous equations and solutions for the analysis of continuous beam using MATLAB (Gauss elimination).
2. Developing a computer program for the analysis of continuous beam and solving the unknowns using Gauss-Seidal method (maximum 9 unknowns).
3. Solution of Plane Stress and Plane Strain problems in MATLAB.
4. Solving 1D Finite Element Problems and plotting shape functions.
5. Estimation of volume of earthwork using numerical integration techniques.
6. Forecasting of water requirement using MATLAB.
7. Determination of mean, standard deviation of a given sample of concrete strengths and developing correlation between cube strengths and cylinder strengths.
8. Forecasting global temperature and analyzing climate change.
9. Solution of beam problems using Finite Difference Techniques.

References:

1. Rudra Pratap,Getting Started with MATLAB: A Quick Introduction for Scientists & Engineers, Oxford University Press (2010).
2. Amos Gilat, MATLAB: An Introduction with Applications, 4ed Paperback (2012).

Online Reference:

1. MATLAB Documentation. https://in.mathworks.com/help/matlab/

Course outcomes:

- To build MATLAB codes for solution of simultaneous linear equations.(L6)
- To create 1D Finite Element problems in a computational scheme.(L6)
- To design codes for numerical integration techniques & statistical methods.(L6)
- To propose computational techniques for solving monte carlo and finite difference methods.(L6)

20ECE724: COMPUTER AIDED ENGINEERING (CAE) LABORATORY-II
(Soft Computing Laboratory)

L T P C

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Soft computing is an emerging approach to computing which parallel the remarkable ability of the human mind to reason and learn in an environment of uncertainty and imprecision. Now, it is the only solution when we don't have any mathematical modeling of problem solving (i.e., algorithm), need a solution to a complex problem in real time, easy to adapt with changed scenario and can be implemented with parallel computing. It has enormous applications in many application areas such as medical diagnosis, computer vision, hand written character recondition, pattern recognition, machine intelligence, weather forecasting, network optimization, VLSI design, etc.

Course Objectives:

- To develop the skills to gain a basic understanding of neural network theory and fuzzy logic theory
- To introduce students to artificial neural networks and fuzzy theory from an engineering perspective
- To improve data analysis solution to strengthen the dialogue between the statistics and soft computing in order to generate mutual improvement activities
- To provide a body of concepts and techniques for designing intelligent systems

List of Experiments:

1. Write a Python program to find deflection of a simply supported beam and draw SFD & BMD

2. Write a Python program for interactive design of reinforced concrete structure

3. Implementation of Artificial Neural Network (ANN) Structure in Python

4. Develop ANN, Fuzzy Logic and Genetic Algorithms in Python for construction project to optimize time & cost

5. Estimate earthquake-induced liquefaction potential using Artificial Intelligence (AI)

6. Determine tide level forecasting in maritime areas using AI

7. Implementation of ANN approach in Python for pavement maintenance

8. Bridge/tunnel planning using GIS and Expert System Approach in Python

9. Generate plans in all stages of construction project using AI

10. Develop Neural Network System for modular construction decision making

11. Implement fuzzy controller for dynamic traffic lights

12. Population forecasting for urban planning, water supply and sewerage system using AI
13. Risk assessment and mitigation (prediction of floods/earthquakes/cyclones) using AI

***References*:**

1. Introduction to Artificial Intelligence, Shinji Araya, Kyoritsu Shuppan, ISBN4-320-12116-3.
2. New Artificial Intelligence (Fundamental), Takashi Maeda and Fumio Aoki, Ohmsha, ISBN4-274-13179.
3. New Artificial Intelligence (Advanced), Takashi Maeda and Fumio Aoki, Ohmsha, ISBN4-274-13198-X.
4. Artificial Intelligence: a modern approach, S. Russell and P. Norvig, Prentice Hall, ISBN0-13-080302-2

Course Outcomes:

Upon completion of the course, the students are expected to

- Comprehend the fuzzy logic and the concept of fuzziness involved in various systems and fuzzy set theory. (L3)
- Understand the concepts of fuzzy sets, knowledge representation using fuzzy rules, approximate reasoning, fuzzy inference systems, and fuzzy logic. (L2)
- Understand the fundamental theory and concepts of neural networks, identify different neural network architectures, algorithms, applications and their limitations. (L2)
- Understand appropriate learning rules for each of the architectures and learn several neural network paradigms and its applications. (L2)
- Reveal different applications of these models to solve engineering and other problems. (L6)

20ECE792: TECHNICAL SEMINAR

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Students are expected to identify a research problem/case study from any domain of Structural Engineering to carry out a reconnaissance research on the topic and suggest innovative solutions for the same. It is advisable for students to choose a topic of interest to be continued as M.Tech Project in the 3rd & 4th Semester. The guidelines to carry out the research shall include the following:

1. Literature Review
2. Identification of Gap
3. Objectives and Expected Outcomes
4. Methodology / Innovative solution

Each student has to prepare a power point presentation on a selected technical topic with a novelty and get it evaluated by the faculty assigned for this purpose.

20ECE741: AI & ML APPLICATIONS IN STRUCTURAL ENGINEERING
(Application based programming in Python)

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This course will cover fundamental concepts of Artificial Neural Networks (ANNs), Fuzzy logic (FL) and optimization techniques using Genetic Algorithm (GA).

Course Objectives:

- To provide an introduction to the basic principles, techniques, and applications of soft computing
- To understand the basic areas of soft computing including Artificial Neural Networks, Fuzzy Logic and Genetic Algorithms
- To provide the mathematical background for carrying out the optimization associated with neural network learning
- To develop some familiarity with current research problems and research methods in soft computing by working on a research or design project

UNIT-I: Introduction

Introduction to Python programming, Python libraries for AI (NumPy, SciPy, Pandas, Colab), Python libraries for ML (Pandas, Matplotlib), introduction to Deep Learning (DL) and toolchain, Python programming for problem solving, implement code from flowchart or algorithm, comparing AI and conventional solutions for Civil Engineering problems.

Learning Outcomes of Unit-I:

Upon completion of the Unit-I, the students are expected to

- Understand Python programming. (L2)
- Solve write code in Python for conventional Civil Engineering problems. (L6)

UNIT-II: Applications in Structural Engineering: Part I

Develop ANN for initial design of reinforced-concrete rectangular single-span beam, Application of multi-criteria decision making methods for analysis of suspension bridges, sustainable structural design in green buildings rating systems and building codes, different AI methods (artificial neural networks, bayesian, genetic algorithms, case-based reasoning, fuzzy logic) for fracture mechanics, damage detection, localization, quantification, real time SHM for repairs or evacuations, develop fuzzy expert system for tunneling, develop artificial life algorithm for multi-reservoir management model, estimate base shear of plane steel structures subjected to earthquake load using hybrid method integrating genetic programming (GP) and simulated annealing (SA).

Learning Outcomes of Unit-II:

Upon completion of the Unit-II, the students are expected to

- Develop ANN for the design of reinforced-concrete structures. (L6)
- Integrate genetic programming (GP) and simulated annealing (SA). (L2)

UNIT-III: Applications in Structural Engineering: Part II

Determination of buckling strength of rectangular plates in terms of Ramberg-Osgood parameters, multiple degrees-of-freedom (MDOF) structural vibration control based on back propagation algorithm, adaptive neural network composed of Gaussian radial functions for mapping behavior of civil structures controlled with magneto-rheological dampers, dynamic behavior of beam structure containing multiple transverse cracks using neural network.

controller, non-destructive and vibration-based damage identification using ANN, develop soft computing system to estimate service life of reinforced concrete bridge deck, Cuckoo Search (CS) algorithm for solving structural design optimization problems, Firefly Algorithm (FA) for solving mixed continuous/discrete structural optimization problems, development of computerized material selection system based on knowledge-based system (KBS).

Learning Outcomes of Unit-III:

Upon completion of the Unit-III, the students are expected to

- Solve MDOF structural vibration control problems. (L3)
- Solve structural optimization problems in Civil Engineering. (L3)

UNIT-IV: Applications in Construction Management

Site layout using ML, ML for preliminary estimation, predicting change of rate of material, risk prediction and management systems, construction activity monitoring system, project schedule optimization, genetic-algorithm-based multi-objective optimization model for scheduling of linear construction projects, evolutionary fuzzy hybrid neural network (EFHNN) to enhance effectiveness of assessing subcontractor performance in construction industry.

Learning Outcomes of Unit-IV:

Upon completion of the Unit-IV, the students are expected to

- Perform preliminary estimation using ML. (L4)
- Model linear construction projects. (L6)

UNIT-V: Applications in Material Sciences

Concrete mix design using ML by predicting slump, compressive strength using ML, ANN for properties prediction, materials recognition & design using ML, neuro-fuzzy based prediction of durability of self-consolidating concrete to various sodium sulfate exposure regimes, ANN to predict 28-day compressive strength of normal and high strength self-compacting concrete (SCC) and high performance concrete (HPC) with high volume fly ash, applicability of ANN to predict compressive strength, artificial neural networks for predicting temperatures in timber under fire loading, design Fuzzy Expert System to determine concrete mix design, ANN for more accurate concrete strength prediction (based on parameters like concrete mix design, size and shape of specimen, curing technique and period, environmental conditions).

Learning Outcomes of Unit-V:

Upon completion of the Unit-V, the students are expected to

- Design concrete mix using ML. (L6)
- Predict concrete strength accurately using different AI systems. (L4)

Text Books:

1. Introduction to Artificial Intelligence, Shinji Araya, Kyoritsu Shuppan, ISBN4-320-12116-3.

2. Artificial Intelligence: from fundamentals to intelligent searches by Qiangfu Zhao and Tatsuo Higuchi, Kyoritsu, 2017, ISBN:978-4-320-12419-6.

References:

1. New Artificial Intelligence (Fundamental), Takashi Maeda and Fumio Aoki, Ohmsha, ISBN4-274-13179.

2. New Artificial Intelligence (Advanced), Takashi Maeda and Fumio Aoki, Ohmsha, ISBN4-274-13198-X.

3. Artificial Intelligence: a modern approach, S. Russell and P. Norvig, Prentice Hall, ISBN0-13-080302-2

Course Outcomes:

Upon completion of the course, the student are expected to

- Understand what constitutes AI and how to recognize systems with AI. (L2)
- Study various AI and Machine Learning (ML) algorithms. (L1)
- Apply knowledge representation, reasoning, and ML techniques to solve real-life problems. (L3)
- Implement traditional AI and ML techniques. (L3)
- Demonstrate practical experience by implementing and experimenting with the learned algorithms. (L6)

20ECE743: ADVANCED CONCRETE TECHNOLOGY

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This course is designed to disseminate the knowledge on recent advances in science and technology of concrete. It explores the material science of concrete and attempts to bring about the understanding of concrete behaviour from a fundamental perspective. The students will be able to understand the structure and properties of concrete making materials and a studyof topics regarding fresh and hardened concrete behaviour followed by mix proportioning of concrete. It also deals with the durability issues related to creep, shrinkage etc. He learns new methodologies, new developments, and new innovations in concrete technology. They will be gaining more comprehensive knowledge on concrete technology, including the systematic introduction of concretes and non destructive evaluation for concretes.

Course objectives:

- Learn about the materials used in concrete and use of various chemical and mineral admixtures.
- To understand the behaviour of fresh and hardened concrete and the factors affecting the strength, workability and durability of concrete.
- To impart the methods of proportioning of concrete mixtures.
- Understand the mix design and engineering properties of special concretes.
- Learn about various concreting methods

UNIT – I 10H

Concrete Making Materials: Cement – Importance of Bogue's compounds, Structure of a hydrated cement paste, Volume of hydrated product, porosity of paste and concrete, transition zone, types of cements. Aggregates – Aggregates classification, IS specifications, properties, grading, methods of combining aggregates, specified grading, testing of aggregates. Admixtures – Chemical admixtures**:** types, classifications, usage and effects on properties of concrete. Mineral admixture **-** Fly ash, Silica fume, GGBS and their effect on concrete properties in fresh state and hardened state.

Learning outcomes:

After completion of this unit the student will be able to

- Identify the functional role of ingredients of concrete, its influence at gaining strength and apply this knowledge to mix design philosophy. (L2)
- Understand the testing of concrete materials as per IS code. (L2)
- Learn the use of admixtures to design concrete mix. (L1)

UNIT – II 8H

Properties of Fresh and Hardened Concrete: Fresh concrete – workability tests on concrete, setting times of fresh concrete, segregation and bleeding. Hardened concrete – Abram's law, gel space ratio, maturity concept, stress strain behaviour, creep and shrinkage. Durability tests on concrete, Non Destructive Testing of concrete, BIS provisions.

Learning outcomes:

After completion of this unit the student will be able to

- Acquire and apply fundamental knowledge in the fresh and hardened properties of concrete.(L2,3)
- Gain ideas on strength and non-destructive testing of concrete(L1)

UNIT – III 10H

Mix design: Review of methods and philosophies of IS, BS and ACI methods, mix design for special purposes, acceptance criteria for compressive strength of concrete. High strength concrete – Microstructure – Manufacturing and properties – Design of HSC using Erntroy Shacklock method – High performance concrete – Requirements and properties of high performance concrete – Design considerations. BIS provisions.

Learning outcomes:

After completion of this unit the student will be able to

- Design the concrete mix using ACI and IS code methods.(L3)
- Design a concrete mix which fulfils the required properties for fresh and hardened concrete. (L3)
- Design and develop the self compacting and high performance concrete. (L5,6)

UNIT – IV 10H

Special Concretes: Self compacting concrete, Lightweight concrete, Polymer concrete, Fibre Reinforced concrete – Reactive Powder concrete – Requirements and guidelines – Advantages and applications. Concrete mix design: Quality control – Quality assurance – Quality audit.

Learning outcomes:

After completion of this unit the student will be able to

- Summarise the concepts of conventional concrete and its differences with other special concretes. (L2)
- Describe the application and use of quality control in mix design. (L4)

UNIT – V 8H

Concreting Methods: Process of manufacturing of concrete, methods of transportation, placing and curing – Extreme weather concreting, special concreting methods, Vacuum dewatering – underwater concrete, special from work. Form work – materials – structural requests – form work systems, failure of form work.

Learning outcomes:

After completion of this unit the student will be able to

- Understand manufacturing process of concreting methods. (L2)
- Learn about various formworks. (L2)

Text Books:

1. A.M.Neville, Properties of Concrete, ELBS publications, Oct 1996.
2. P.K.Mehta and P.J.Monteiro, Concrete: Micro Structure, Properties and Materials, Mc.

Graw-Hill Publishing Company Ltd. New Delhi, 2017.
3. M.S.Shetty, Concrete Technology, S.Chand & Co, 2009.

References:

1. A.R. Santhakumar, Concrete Technology, Oxford University Press, Oct 2006.
2. N.Krishna Raju, Design of Concrete Mixes, CBS Publications, 2000.
3. Rafat Siddique, Special Structural concretes, Galgotia Publications 2000.
4. J.Prasad, C G K Nair, Non-Destructive Test and Evaluation of Materials, Mc Graw Hill, 2011.

Course Outcomes:

- Understand the testing of concrete materials as per IS code. (L2)
- Know the procedure to determine the properties of fresh and hardened of concrete. (L1)
- Design the concrete mix using ACI and IS code methods. (L6)
- Select and Design special concretes depending on their specific applications. (L6)
- Gain ideas on concreting methods. (L1)

20ECE745: BRIDGE ENGINEERING

L T P C

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This course enables the student to understand the behaviour and design of bridges. The prerequisite for this course would be Design of Reinforced Concrete Structures and Design of Steel Structures. Fundamental concepts of load transfer and types of loading on bridges are covered. The design of superstructure for both Reinforced Concrete and steel bridges and superstructure is explained. The importance of providing bearings in bridges is justified.

Course Objectives

- Explain basic concepts related to construction of bridges.
- Classify R.C.C. bridges and design culvert and T-beam bridge.
- List design principles of different steel bridges.
- Design substructure of bridge.
- Classify different bearings.

Unit I **8L**

Introduction and Investigation for Bridges: Components Of a Bridge, Classification, Standard Specifications, Need for Investigation, Selection of Bridge Site, Preliminary Data to be Collected, Preliminary Drawings, Determination of Design Discharge, Economical Span, Location of Piers And Abutments, Vertical Clearance Above HFL, Scour Depth, Choice of Bridge Type, Importance of Proper Investigation.

Learning Outcomes:

After completion of this unit, the student will be able to

- discuss basic definitions, types and components of bridges(L6)
- select suitable geographical location and functionality of a bridge(L3)
- examine the preliminary data collected for design of bridge (L4)

Unit II **8L**

Design Consideration of RCC bridges: Various types of bridges (brief description of each type), Design of R.C.C. Culverts (Class 70R loading) and T-Beam Bridges.

Learning Outcomes:

After completion of this unit, the student will be able to

- categorize different types of bridges (L4)
- identify different types of wheel loads acting on bridge deck slab (L3)
- estimate maximum live load bending moment by effective width method (L6)
- design of RCC Slab bridge(L6)
- design of T-beam bridge (L6)

Unit III **8L**

Design Consideration of steel bridges: Various types of steel bridges (brief description of each type), Design of welded plate girder bridge. Design Principles of box girder bridges.

Learning Outcomes:

After completion of this unit, the student will be able to

- illustrate different types of steel bridge (L2)
- design a welded plater girder bridge (L6)
- demonstrate the design principles for box girder bridge (L2)

Unit IV **8L**

Sub Structure for Bridges: Pier and Abutments Caps; Materials for Piers and Abutments, Design of Pier, Design of Abutment, Backfill behind Abutment, Approach Slab.

Learning Outcomes:

After completion of this unit, the student will be able to

- discuss the subsurface investigations required for bridge design (L6)
- analyse the forces in pier design(L4)
- examine the stability of abutment(L4)
- design of approach slab (L6)

Unit V **10L**

Bridge Bearings: General features, types of bearings, design of elastomeric pad bearing.

Learning Outcomes:

After completion of this unit, the student will be able to

- summarize different types of bearing (L2)
- justify the purpose of using bearings (L5)
- design of elastomeric pad bearing (L6)

Text Book(s):

1. D. Johnson Victor, Essentials of Bridge Engineering, 6/e, Oxford and IBH Publishing, 2007.
2. Krishna Raju N., "Design of Bridges", 4th Edition, Oxford & IBH Publishing, 2010.

References:

1. Jagadish. T.R, Jayaram. M.A, "Design of Bridge Structures", 2/e, Prentice Hall of India, 2009.
2. Ponnuswamy.S, Bridge Engineering, 2/e, Tata McGraw Hill Education, 2008.

Course Outcomes

- relate basic concepts for construction of bridges (L1)
- design of a culvert and T-beam bridge (L6)
- summarize design principles of different steel bridges (L2)
- analyse and design the substructure for bridge (L4)
- compare functionality of different bearings (L2)

20ECE751: FRACTURE MECHANICS

L T P C

3 0 0 3

This course provides knowledge on basic characteristics of fatigue and fracture mechanics of civil engineering structures.

Course Objectives:

- To give a brief of linear and nonlinear fracture mechanics principles and their applications to structural design
- To discuss fracture phenomena in metals and non-metals and highlight testing methods
- To enable students to be creative in addressing computer assisted techniques for fracture study

UNIT-I: Fracture Mechanics Principles **10 L**

Introduction and historical review, Sources of micro and macro cracks, Stress concentration due to elliptical hole, Strength ideal materials, and Griffith's energy balance approach, Fracture mechanics approach to design, NDT and various NDT methods used in fracture mechanics, Airy stress function, Effect of finite crack size, Elliptical cracks, Numerical problems.

Learning Outcomes of Unit-I:

Upon completion of the Unit-I, the students are expected to

- Understand the principles of fracture mechanics. (L2)
- Solve numerical examples related to cracks. (L6)

UNIT-II: Plasticity Effects **8 L**

Irwin plastic zone correction, Dugdale's approach, Shape of plastic zone for plane stress and plane strain cases, Plate thickness effect, Determination of stress intensity factors and plane strain fracture toughness, Estimation of stress intensity factors, Experimental method-plane strain fracture toughness test, Standard test, Size requirements, Numerical problems.

Learning Outcomes of Unit-II:

Upon completion of the Unit-II, the students are expected to

1. Determine stress intensity factors for plane stress and plane strain cases. (L3)
2. Solve numerical examples related to plasticity and understand different experimental methods. (L6)

UNIT-III: Energy Release Rate **8 L**

Criteria for crack growth, Crack resistance (R-curve), Compliance, Tearing modulus, Stability, Numerical problems.

Elastic Plastic Fracture Mechanics

Fracture beyond general yield, Crack-tip opening displacement, Use of CTOD criteria, Experimental determination of CTOD, Parameters affecting critical CTOD, Numerical problems.

Learning Outcomes of Unit-III:

Upon completion of the Unit-III, the students are expected to

1. Solve numerical examples related to crack growth. (L6)
2. Use CTOD criteria to solve numerical problems. (L6)

UNIT-IV: J integral **8 L**

Use of J integral, Limitation of J integral, Experimental determination of J integral and parameters affecting J integral, Numerical problems.

Dynamics and Crack Arrest

Crack speed and kinetic energy, Dynamic stress intensity and elastic energy release rate, Crack branching, Principles of crack arrest, Crack arrest in practice, Dynamic fracture toughness, Numerical problems.

Learning Outcomes of Unit-IV:

Upon completion of the Unit-IV, the students are expected to

1. Understand J integral and solve numerical problems using J integral. (L2)
2. Evaluate crack arrest using dynamics. (L5)

UNIT-V: Applications of Fracture Mechanics **8 L**

Crack growth and stress intensity factor, Factors affecting crack propagation, Variable amplitude service loading, Means to provide fail-safety, Paris law, Required information for fracture mechanics approach, Numerical problems.

Learning Outcomes of Unit-V:

Upon completion of the Unit-V, the students are expected to

1. Understand factors affecting crack propagation. (L2)
2. Solve numerical problems using fracture mechanics approach. (L6)

Text Books:

1. K. Ramesh, e-Book on Engineering Fracture Mechanics, IIT Madras, 2007.
URL: http://apm.iitm.ac.in/smlab/kramesh/book_4.htm
2. Prashant Kumar, Elements of Fracture Mechanics, Tata McGraw Hill, New Delhi, India, 2009.
3. T. L. Anderson, Fracture Mechanics-Fundamentals and Applications, 3rd Edition, Taylor and Francis Group, 2005.
4. D. Broek, Elementary Engineering Fracture Mechanics, Kluwer Academic Publishers, Dordrecht, 1986.

References:

1. Karen Hellan, Introduction to Fracture Mechanics, Tata McGraw Hill, 2nd Edition.
2. S. A. Meguid, Engineering Fracture Mechanics, Elsevier Applied Science, 1989.
3. Ayal de S. Jayatilaka, Fracture of Engineering Brittle Materials, Applied Science Publishers, 1979.
4. Stanley Theodore Rolfe, John M. Barsom, Fracture and Fatigue Control in Structures, Prentice Hall, 1977.

5. J.F. Knott, Fundamentals of Fracture Mechanisms, Butterworths, 1973.

Course Outcomes:

Upon completion of the course, the students are expected to

1. Predict material failure for any combination of applied stresses. (L5)
2. Estimate failure conditions of a structure. (L4)
3. Determine the stress intensity factor for components of simple geometry. (L3)
4. Predict the likelihood of failure of a structure containing a defect. (L5)
5. Apply fracture mechanics to real-life Civil Engineering problems. (L3)

20ECE753: MAINTENANCE AND REHABILITATION OF STRUCTURES

L T P C

3 0 0 3

Maintenance of a building is the work done for keeping an existing building in a condition where it can continue to perform its intended functions. Proper maintenance not onlyimproves functional and aesthetic value but also extends the life of building/structure and ensures safety of the users. Normally constructed building remains in a good shape for only for40 to 50 years and starts deteriorating if not maintained properly. Inadequate maintenance andlack of repair works may lead to limited life span of buildings. However, with regular inspection and maintenance that enable timely identification of deteriorated elements and appropriate remedial measures, the life of normally constructed buildings/structures may be extended up to 100 years.

This course deals with the maintenance of buildings, concrete repair chemicals, specialmaterials used for repair and repair of various parts of a building, strengthening of reinforced concrete members by shoring, underpinning, plate bonding, RC jacketing, control on termitesand fungus in buildings, etc.

Course Objectives

- Discuss the health condition of structures.
- Explain repair strategies and inspections of damage structures.
- Assess the condition of properties of existing concrete structures.
- Discuss the techniques for repairing of concrete structures.
- Explain repair work of different structures and principles of Retrofitting and Rehabilitation.

Unit 1 **8 L**

Maintenance of Buildings: Introduction, Importance of maintenance, Types of maintenance - daily, weekly, monthly, annually. General Maintenance - Painting of Buildings - Home electricity system.

Learning outcomes:

After completion of this unit, the student will be able to

- Explain the requirement of maintenance in building. (L2)
- Explain various types of maintenance in building. (L2)
- Assess the quality aspects of existing building. (L6)

Unit 2 **8 L**

Repair Strategies: Causes of distress in structures, Construction and design failures, Condition assessment and distress-diagnostic techniques, Inspection and evaluating damaged structure.

Learning outcomes:

After completion of this unit, the student will be able to

- Explain distress diagnostic techniques.(L2)
- Carry out inspection and evaluation of damaged structure. (L5)

Unit 3 **8 L**

Durability and Serviceability of Concrete: Quality assurance for concrete construction based on concrete properties like strength, permeability, thermal properties, cracking. Effects due toclimate, temperature, chemicals, corrosion. Design and construction errors, Effects of cover and cracks.

Learning outcomes:

After completion of this unit, the student will be able to

- Explain concrete properties required for construction work. (L2)
- Explain weather effect on structure. (L2)

Unit 4 **10 L**

Materials and Techniques for Repair: Materials for Repair - special concretes and mortar, concrete chemicals, construction chemicals, expansive cement, polymer concrete, sulphur infiltrated concrete, ferro cement, fibre reinforced concrete, rust eliminators and polymers coating for rebars, foamed concrete, dry pack, vacuum concrete, asphalt sheeting
Techniques for Repairs - guniting, grouting and shotcrete, epoxy injection, jacketing, shoring and underpinning. Methods of corrosion protection - corrosion inhibitors, corrosion resistant steels, coating and cathodic protection

Learning outcomes:

After completion of this unit, the student will be able to

1. Identify materials for repair in building. (L2)
2. Explain techniques for repairs. (L2)

Unit 5 **8 L**

Repair, Retrofitting and Rehabilitation: Repair of - stone, brick and block masonry (cracks, dampness, efflorescence, joint separation, etc.), flooring, roofs (sloping, flat, pitched, etc.), concrete members due to (i) Steel Corrosion (ii) Lack of Bond (iii) shear, tension, torsion, compression failure. Rainwater Leakage in Buildings - Leakage in basement, toilet area. Control on termites (white ants) in buildings, fungus decay of wood works in buildings. Estimation of repair and retrofitting.

Learning outcomes:

After completion of this unit, the student will be able to

1. Explain the repair work of various component in existing masonry building.(L2)
2. Explain the repair work of various component in existing concrete structure.(L2)
3. Discuss principles of retrofitting and rehabilitation. (L2)

Text Books:

1. B.L. Gupta, Maintenance & Repair of Civil Structures, STANDARD PUBLICATIONS, 2009.
2. P. C. Varghese, Maintenance, Repair & Rehabilitation and Minor Works of Buildings, PHI, 2014.

References:

1. Denison Campbell, Allen and Harold, Concrete Structures: Materials, Maintenance and Repair, Longman Pub Group, 1991.
2. P. S. Gahlot, Building Repair and Maintenance Management, CBS Publishers and Distributors Pvt Ltd, 2006.
3. B. C. Punmia, Building Construction, Laxmi Publications, 2008.

Course Outcomes:

- Assess the health condition of structures. (L6)
- Inspect and evaluate damage structures. (L5)
- Test the condition of properties of existing concrete structures.(L4)
- Implement the techniques for repairing of concrete structures. (L5)
- Understand repair work of different structures and principles of Retrofitting and Rehabilitation. (L2)

20ECE755: FIRE RESISTANT DESIGN OF STRUCTURES

L T P C

3 0 0 3

The prerequisite for this course would be design of Reinforced concrete and Steel Structures. The learner will familiarize with different properties of materials for fire resistance. It deals with the design of assemblies, steel and RCC buildings exposed to fire. The learner will gain knowledge in estimating the fire resistance ratings of various components of the building. This course gives confidence for the learners to design the structures with significant fire resistance.

Course Objectives

- Explain basic properties of materials for fire resistant design
- Design of structural assemblies exposed to fire
- Design of steel buildings exposed to fire
- Evaluation of fire resistance rating of materials
- Design of concrete members exposed to fire

Unit I **8L**

Materials Properties in fire, Classification systems for high temperature concretes. Design of Structures at normal temperatures – Loads, Structural analysis, Material Properties, Probability of failures. Design of structures under fire conditions – Design equate loads for fire design, structural analysis.

Learning Outcomes

- To illustrate the properties of materials in fire (L2)
- To demonstrate deisgn of structures at normal temperaures (L2)
- To explain probabilities of failures (L5)

Unit II **8L**

Design structural assemblies exposed to fire – Frames – Redundancy – Disproportionate collapse –continuity – plastic design.

Learning Outcomes

- To design structural assemblies exposed to fire (L6)
- To demonstrate the redundancy (L2)
- To illustrate plastic design (L2)

Unit III **8L**

Design of steel buildings exposed to fire – Multi-storey steel framed buildings

Learning Outcomes

- To design various components of steel buildings exposed to fire (L6)
- To design simple steel buildings exposed to fire (L6)
- To design multi-storey steel framed buildings exposed to fire (L6)

Unit IV **8L**

Fire resistance ratings, verification methods, Generic ratings Projection system Mechanical properties of concrete at elevated temperature Test methods, Components of strain, Thermal strain, Stress related strain.

Learning Outcomes

- To assess the fire resistance ratings of various components of a building (L5)
- To summarise various mechanical properties of concrete at elevated temperatures (L2)
- To illustrate various testing methods for assessment of fire resistance (L2)

Unit V **10L**

Design of Concrete members exposed to fire member design, Simply supported slabs and beams, Tension and compression members. Design of individual members exposed to fire – Tension members – Compression members – Beams.

Learning Outcomes

- To design simply supported slabs exposed to fire (L6)
- To design beams exposed to fire (L6)
- To design tension and compression members exposed to fire (L6)

Text book(s):

1. Jain, V. K., "Fire Safety in Buildings", 2/e, New Age Publishers, 2013.
2. Andrew H. Buchanan, "Structural Design for Fire safety", Wiley – Blackwell, 2001.

References:

1. G.M. Newman and R.M. Lawson, Fire Resistant Design of Steel Structures: A Handbook to BS 5950 (1990).

Course outcomes

- Summarize the basic properties of materials for fire resistant design(L2)
- Design structural assemblies exposed to fire(L6)
- Design steel buildings exposed to fire(L6)
- Find out fire resistance rating of materials(L1)
- Determine size of concrete members exposed to fire(L5)

20ECE742: COMPUTER AIDED NUMERICAL METHODS

L T P C

3 0 0 3

To find solution of structural engineering problems, a mathematical model of the problem is formed and then its closed form or numerical solution is obtained using mathematics. Thus, the knowledge of application of various mathematical tools is essential forthe solution of structural problems. The course on Analytical and Numerical Methods for Structural Engineering equips the students with the applications of numerical and statistical methods to solve problems related to structural engineering.

Course Objectives:

- Explain algebraic equations.
- Discuss various interpolations methods.
- To understand finite difference methods for solving problems of beams and plates
- Assess numerical solution of ordinary and partial differential equations.
- Explain ordinary differential equations.

UNIT 1 **10 L**

Solutions of linear equations: Direct method – Cramer's rule, Gauss – Elimination method, Gauss – Jordan elimination, Triangulation (LU Decomposition) method. Iterative methods - Jacobi – Iteration method, Gauss – Seidel iteration, Successive over –relaxation method. Eigen values and eigen vectors: Jacobi method for symmetric matrices, Given's method for symmetric matrices, Householder's method for symmetric matrices, Rutishauser method of arbitrary matrices, Power method.

Learning outcomes:

After completion of this unit, the student will be able to

- Obtain solution of eigen value problems for structural analysis.(L4)
- Apply iterative and transformation methods in structural engineering.(L3)

UNIT 2 **8 L**

Interpolation: Linear Interpolation, Higher order Interpolation, Lagrange Interpolation, Interpolating polynomials using finites differences, Hermite Interpolation, piece-wise and spline Interpolation

Learning outcomes:

After completion of this unit, the student will be able to

- Understand various interpolation methods.(L2)
- Analyse problems using interpolation methods.(L3)

UNIT 3 **10 L**

Finite Difference and their Applications: Introduction, Differentiation formulas by Interpolating Parabolas, Backward and forward and central differences. Derivation of Differentiation formulas using Taylor series, Boundary conditions- Beam deflection – Solution of characteristic value problems- Richardson's extrapolation- Use of unevenly spaced pivotal points- Integration formulae by interpolating parabolas. Numerical solution to spatial differential equations – Application to Simply Supported Beams, Columns & rectangular

Plates.

Learning outcomes:
After completion of this unit, the student will be able to
- Evaluate deflection of beams and plates.(L5)
- Understand differentiation formulae.(L2)

UNIT 4 **10 L**

Numerical Differentiation: Difference methods based on undetermined coefficients, optimum choice of step length, Partial differentiation.
Numerical Integration: Method based on interpolation, method based on undetermined Coefficient, Gauss – Lagrange interpolation method, Radau integration method, Composite integration method, Double integration using Trapezoidal and Simpson's method. New Marks Method and Application to Beams – Calculations of Slopes & Deflections.

Learning outcomes:
After completion of this unit, the student will be able to
- Apply integration method's in structural engineering problems.(L3)
- Analyse the problems using partial differential equations.(L4)

UNIT 5 **10 L**

Ordinary Differential Equation: Euler's method, Backward Euler method, Mid-point method, single step method, Taylor's series method. Boundary value problems.

Learning outcomes:
After completion of this unit, the student will be able to
- Analyse boundary value problems.(L4)
- Apply ordinary differential equations in structural engineering.(L3)

TEXT BOOK

1.M.K.Jain, S.R.K.Iyengar, R.K.Jain, Numerical Methods For Scientific and Engineering Computations. Willey Eastern Limited. New Age International (p) Ltd.,Publishers, Reprint 2004.
2. N. Krishna Raju and K.U. Muthu, Numerical Methods for Engineering Problems, M.C. Millan Publishers, New Delhi
3. StevanC.Chopra, Raymond P.Canal, Numerical Methods for Engineers Mc. Graw Hill Book Company, April 2009

Reference Books

1. Balagurusamy, E., Numerical Methods, Tata McGraw Hill, 1999.
2. Rajaraman V., Computer Oriented Numerical Methods, 3rd Edition, Prentice Hall India, New Delhi, 1998.
3. Krishnamurthy, E.V., Sen, S.K., Computer Based Numerical Algorihms, East West Press, 1998.

Course Outcome:
After learning the course, the students should be able to:
- Solve algebraic equations.(L4)
- Carry out interpolations and curve fitting.(L6)
- Apply finite difference methods for solving problems of beams and plates.(L3)

- Obtain numerical solution of ordinary and partial differential equations.(L6)
- Evaluate ordinary differential equations.(L5)

20ECE744: WIND ANALYSIS AND DESIGN OF TALL STRUCTURES

L T P C

3 0 0 3

To study the behaviour, analysis and design of tall structures. At the end of this course the student should have understood the problems associated with large heights of structures with respect to loads (wind and earthquake and deflections of the structure). This course also familiarizes the students with design of industrial structures like Towers, steel and R.C.C Chimneys.

Course Objectives

- To **estimate** the wind load on structures based on relevant standards .
- To **infer** the behavior of shear wall .
- To **Interpret** the various loads acting on towers and their effect on the design of towers.
- To **explain** the structural behavior of RCC & Steel Chimneys due to Wind Loading.

Unit I **8L**

Introduction: Basic wind speed, Design wind speed, Design wind pressure, offshore wind velocity, Wind pressures and forces in buildings/ structures. External pressures coefficients for various roofs, Dynamic effects. Design of Tall Buildings: Analysis of tall building for lateral loads, cantilever method, Portal method, Factor method;

Learning outcomes:

After completion of this unit, the student will be able to

1. Estimate wind force on a structure based using relevant standards (L5).
2. Calculate dynamic wind forces(L6).
3. Analyse tall buildings using different methods (L4)

Unit II **8L**

Design of shear wall: Introduction, Types of shear walls, behaviour of cantilever walls with rectangular cross section, Flange cantilever shear walls, Moment – Axial load interaction for shear wall section, Interaction of shear walls and Rigid jointed frames, Shear walls with openings, Coupled shear walls.

Learning outcomes:

After completion of this unit, the student will be able to

1. Understand different types of shear walls and its use in structures(L2).
2. Analysis and Design a shear wall(L4)

Unit III **10L**

Design of Steel Towers: Introduction, Loads on towers, Analysis of towers, Masts, Stresses in towers due to vertical loads and horizontal loads, Design of members in towers, Design of foundations.

Learning outcomes:

After completion of this unit, the student will be able to

1. Understand different types of loads acting on towers(L2).
2. Analysis of towers, Masts (L4)
3. Identify Stresses developed in towers due to vertical and horizontal loads(L3)
4. Design of individual members in tower by relevant standards(L6).
5. Design a tower and its foundation((L6)

Unit IV **8L**

Design of Chimneys (RCC): Introduction, Wind pressure, Stresses in chimney shaft due to self-weight and wind, Stress in horizontal reinforcement due to wind shear, Stresses due to temperature difference. Design of RC chimney.

Learning outcomes:

After completion of this unit, the student will be able to

1. Calculate wind pressure acting on Chimneys(L5)
2. Calculate stresses due to self-weight, wind and temperature (L5).
2. Analysis and Design a R.C.C Chimneys(L4).

Unit V **8L**

Design of steel chimneys: Introduction, Types of chimneys, Forces acting on steel chimneys, design of various components, Stability of steel chimney.

Learning outcomes:

After completion of this unit, the student will be able to

1. Understand different types of steel chimneys (L2).
2. Calculate forces acting on chimney due to various components (L5).
2. Analysis and Design a Steel Chimneys (L4).

Text Book(s):

1. Ramachandra, "Design of Steel Structures", Vol – 2, 9/e, Scientific Publishers, 2010.
2. R. Park, T. Paulay, "Reinforced Concrete Structures", John Wiley and Sons, 2009.

References:

1. B. C. Punmia, Ashok Kumar Jain, Arun Kumar Jain, "Reinforced Concrete Structures", 7/e, Laxmi Publications, 2015.
2. S. N. Manohar, "Tall Chimneys", Tata Mc Graw Hill Publishers, 1985.

Course Outcomes

By the end of the course the student will be able to:

- Determine the wind load on structures based on relevant standards (L5)
- Design of shear wall (L6)
- Infer the various loads acting on towers and their effect on the design of towers (L3)
- Design of Steel & RCC Chimney (L6)

20ECE746: ADVANCED DESIGN OF PRE-STRESSED CONCRETE STRUCTURES

L T P C
3 0 0 3

This course will cover the basic pre-stressed concrete design. Principles of pre-stressing, pre-stress losses ,constituent material, loading and allowable stresses, working and ultimate stress analysis and design, shear and torsion, deflections, continuous beams and composite beams and to have a knowledge of the codal provisions

Course Objectives:

- Learn basic concepts in pre-stressed concrete.
- Design pre-stressed sections for shear and flexure.
- Understand the behaviour of pre-stressed elements.
- Understand the behaviour of pre-tensioned members.
- Learn and understand statically indeterminate structures.

UNIT – I **8 L**

Basic concepts, principles in pre-stressed concrete and Losses of Pre-stress: Loss of pre-stress in pre-tensioned and post- tensioned members due to various causes like elastic shortening of concrete, shrinkage of concrete, creep of concrete, relaxation of steel, slip in anchorage, bending of member and frictional loss – Analysis of sections for flexure.

Learning outcomes: After completion of this unit the student will be able to

- Understands the concepts, principles and losses of pre-stressed concrete members. (L1,2)
- Analyze pre-stressed concrete members. (L4)

UNIT – II **10 L**

Design of Section for Flexure: Allowable stresses, Elastic design of simple beams having rectangular and I-section for flexure, kern lines, cable profile and cable layout. Design of Sections for Shear: Shear and Principal stresses, Improving shear resistance by different pre-stressing techniques- horizontal, sloping and vertical pre-stressing, Analysis ofrectangular and I–beam, Design of shear reinforcement, Indian code provisions.

Learning outcomes:

After completion of this unit the student will be able to

- Design pre-stressed concrete members in flexure and shear using codal provisions. (L6)

UNIT – III **8 L**

Deflections of Pre-stressed Concrete Beams: Short term deflections of uncracked members, Prediction of long-term deflections, load–deflection curve for a PSC beam, IS code requirements for maximum deflections.

Learning outcomes:

After completion of this unit the student will be able to

- Predict deflections in pre-stressed concrete beams. (L5)

UNIT – IV **8 L**

Transfer of Pre-stress in Pre-tensioned Members : Transmission of pre-stressing force by bond, Transmission length, Flexural bond stresses, IS code provisions, Anchorage zone stresses in post tensioned members, stressdistribution in End block, Anchorage zone reinforcements.

Learning outcomes:

After completion of this unit the student will be able to

• Design end blocks and provide detailing of reinforcements.(L6)

UNIT-V **8 L**

Statically Indeterminate Structures: Advantages and disadvantages of continuous PSC beams, Primary and secondary moments, P and C lines, Linear transformation, concordant and non-concordant cable profiles, Analysis of continuous beams.

Learning out comes:

After completion of this unit the student will be able to

• Design composite members and other applications. (L6)

• Design continuous member. (L2,6)

TEXT BOOKS:

1. Krishna Raju, "Pre-stressed concrete", Tata Mc Graw Hill Book – Co ., New Delhi, 2012.

2. T.Y. Lin, A.P. Burns, Design of Pre-stressed Concrete Structures, John Wiley & Sons, 2004.

3. Dayaratnam, Pre-stressed Concrete, Oxford & IBH, 1982.

References:

1. R. Rajagopalan, Pre-stressed Concrete, Narosa publishers, 2004.

2. S. Ramamrutham, Pre-stressed concrete, Dhanpat Rai & Sons, Delhi, 2013.

Course Outcomes:

- Achieve Knowledge of analysis, design and development of problem solving skills. (L3)
- Analyse, Design and detail PSC elements. (L3,6)
- Understand the concepts of pre-stressed. (L2)
- Learn the behaviour of post tensioned concrete members. (L1)
- Understand about statically indeterminate structures and design of continuous beams. (L2)

20ECE752: THEORY OF PLATES & SHELLS

L T P C

3 0 0 3

The prerequisite for this course would be Engineering Mechanics, Mathematics and Advanced Mechanics of Solids. Derivation of differential equations for analysis of rectangular plates with different edge conditions and various loadings is explained. The expression for deformation due to loadings in rectangular plate is derived. Analysis of thin shell structures for inplane membrane forces using membrane theory is discussed.

Course objectives

- Analyze rectangular plates with different support conditions.
- Demonstrate pure bending of plates.
- Apply different solutions to plate problems.
- Classify shells with geometry.
- Analyze different types of shells using membrane theory.

Unit I 8L

Bending of Long Rectangular Plates to a Cylindrical Surface: Differential equation for cylindrical bending of plates – Uniformly loaded rectangular plates with simple supported edges and with built in edges.

Learning Outcomes:

After completion of this unit, the student will be able to

- develop governing differential equation for cylindrical bending of plates (L6)
- Determine the deflection equation for simply supported rectangular plate with udl (L5)
- Determine the deflection equation for rectangular plate with built in edges with udl (L5)

Unit II 8L

Pure bending of plates: slope & Curvature of bent plates – Relations between bending moments and curvature in pure bending of plates. Symmetrical bending of circular plates: Differential equation for symmetrical bending of laterally loaded circular plates, uniformly loaded circular plates.

Learning Outcomes:

After completion of this unit, the student will be able to

- explain pure bending in plates (L5)
- develop expression for stresses in circular plates for different loadings(L6)
- develop equation for deflection in circular plates for different loadings(L6)

Unit III 8L

Simply supported rectangular plates under sinusoidal loading – Navier's solution of simply supported plates, further applications of Navier's solutions, simply supported rectangular plates under hydrostatic pressure, Levy's solution for uniformly distributed load.

Learning Outcomes:

After completion of this unit, the student will be able to

- determine deflection of simply supported plate with udl using Navier solution (L5)

- determine deflection of simply supported plate with udl using Levy's solution(L)
- develop expression for moment and shear for simply supported rectangular plate under hydrostatic pressure(L6)

Unit IV **8L**

Membrane analysis: Shells of revolution (axi-symmetrical loading), Spherical shells, Conical Shells, Elliptical shell of revolution. Torus, Hyperboloid of revolution of one sheet, shells of uniform strength membrane deformation.

Learning Outcomes:

After completion of this unit, the student will be able to

- define shell geometry(L1)
- classify shells based on curvature (L2)
- demonstrate different shells of revolution under axi-symmetrical loading (L2)
- apply membrane theory for analysis of shells(L3)

Unit V **10L**

Membrane analysis of shells of translation, circular cylinder, Parabola, Cycloid, Catenary and Membrane deformations.

Learning Outcomes:

After completion of this unit, the student will be able to

- explain the behaviour of different shells of revolution (L5)
- determine the membrane forces in shells (L5)
- develop equation for membrane deformation (L6)

Text Book(s):

1. S. Timoshenko, Wernewsky Kriegar, "Theory of Plates and Shells", 2/e, McGraw Hill Education, 2010.
2. G.S.Ramaswamy, "Design and Construction of Concrete Shells", Wiley Online Library, 2005.

References:

1. Flugge, "Stresses in Shells", Springer – Verlag, 2013.
2. P.C. Varghese, Design of Reinforced Concrete Shells and Folded Plates, Prentice Hall India Learning Private Limited, 2010.

Course outcomes

- evaluate bending moment of plates (L5)
- analyze circular plates with symmetrical bending (L4)
- solve rectangular plate problem using different solutions(L6)
- compare and list different types of shells (L2)
- develop basic membrane equations for analysis of shell(L6)

20ECE754: OPTIMIZATION METHODS IN STRUCTURAL DESIGN

L T P C
3 0 0 3

It is important for the ideal implementation of optimisation in structural design that the optimisation tasks are linked to the appropriate phase in the design process.The structural design process essentially follows the same progression as any other design task. However, the interdisciplinary nature of building design, with input from clients, architects and structural and building services engineers, serves to complicate the process and may lead to a large number of iterations and revisions, even revisiting earlier design phases making the optimization process critical in the design process

Course Objectives

- Learn the different optimization methodologies applied to structural systems and linear optimization.
- Understand the dynamic programming, decision theory andsimulations.
- Assess the different optimization methodologies applied to structural systems
- To apply optimum principles to achieve economical structural systems.

Unit 1 **8 L**

Introduction: Introduction of optimization Definition - Variables - Objective Function - Constraints - theory and elements of optimization - Basic definitions –Principles of linear optimization.

Learning outcomes:

After completion of this unit, the student will be able to

- Explain the requirement of optimization specific to structural systems. (L2)
- Identify the ideal objective function for an optimization problem. (L2)
- Explain the procedure adapted for linear optimization. (L2)

Unit 2 **8 L**

Conventional optimization: Classical methods of optimization:- Lagrangian multiplier method, Monte-Carlo method Trial and error method - Illustrative examples.

Learning outcomes:

After completion of this unit, the student will be able to

- Enumerate the various conventional techniques available for structural optimization. (L2)
- Illustrate the optimization techniques through examples. (L2)

Unit 3 **8 L**

Optimization programming: Artificial variable techniques: Simplex methods - Solution of simultaneous equations - Dual formulations Penalty method - Duality theory - Primal - Dual algorithm.

Learning outcomes:

After completion of this unit, the student will be able to

- Explain about various programming techniques adapted for structural optimization. (L2)

- Explain about the role of dual formulations in structural optimization. (L2)

Unit 4 **8 L**

Structural Optimization: Structural design optimization of Reinforced concrete beams of rectangular geometry - T and L beams - and deep beams Procedure of optimization for minor and major structural elements and slab.

Learning outcomes:
After completion of this unit, the student will be able to

- Illustrate the design optimization for Reinforced concrete beams. (L2)
- Explain the procedure for design optimization of structural elements. (L2)

Unit 5 **8 L**

Structural design optimization-Applications: Applications of optimum design techniques for continuous beams and single storied frames using plastic theory. Case studies for design optimization applications for multi-storey buildings, water tanks and bridges

Learning outcomes:
After completion of this unit, the student will be able to

- Explain the applications of optimum design techniques for beams and single storied frames. (L2)
- Discuss the case studies adapted for structural optimization of multi-storey buildings, water tanks and bridges. (L2)

Text Books:

1. S.S. Bhavikatti, "Fundamentals of Optimum Design in Engineering", New Age International, New Delhi, 2014.P. C. Varghese, Maintenance, Repair & Rehabilitation and Minor Works of Buildings, PHI, 2014.
2. Andrej Cherkaev, (2012), Variational Methods for Structural Optimization, Vol.140, Applied Mathematical Sciences, Springer Science & Business Media, Netherlands.

References:

1. S.S. Rao, "Engineering Optimization", New Age International, New Delhi, 1999..
2. J.O. Paul, "Systems Analysis for Civil Engineers", John Wiley & Sons, 1988..

Course Outcomes:

- Understand the optimization methodologies applied to structural systems. (L2)
- Evaluate the performance of conventional techniques available for structural optimization. (L5)
- Apply various programming techniques for single and dual formulations in structural optimization. (L3)
- Implement the optimum design techniques for various major and minor structural elements. (L3)
- Testing the various optimization techniques for beams and single storied frames. (L5)

20ECE756: EARTHQUAKE ENGINEERING

L T P C

3 0 0 3

Earthquake engineering is an branch of engineering that designs and analyzes structures, such as buildings and bridges, with earthquakes in mind. Its overall goal is to makesuch structures more resistant to earthquakes. An earthquake (or seismic) engineer aims to construct structures that will not be damaged in minor shaking and will avoid serious damage or collapse in a major earthquake. Earthquake engineering is the scientific field concerned withprotecting society, the natural environment, and the man-made environment from earthquakesby limiting the seismic risk to socio-economically acceptable levels.

Course Objectives

- To explain the causes of earthquake and its consequences
- To interpret response spectra and design spectra
- To distinguish between Response History and response spectra analysis
- To determine the seismic force acting on Multi-storey structure
- To explain the structural behaviour of Water towers & Stack like structures due to Seismic excitation

Unit I **8L**

Earthquakes, Epicenter, Hypocenter and earthquake waves, Measurement of ground motion, Seismic Regions, Intensity and Isoseismals of an earthquake, Magnitude and energy of an earthquake, Consequences of earthquakes, Seismic zoning, Seismic effects on structure.

Learning outcomes:

After completion of this unit, the student will be able to

1. Explain the reasons for earthquakes (L2).
2. How to measure the intensity of earthquake (L1)
3. Understand where in the world earthquakes are most likely to occur (L2).
4. Differentiate between earthquake intensity and earthquake magnitude (L5).
5. Consequences of earthquake on structures (L4).

Unit II **10L**

Earthquake Response of Linear Systems: Earthquake excitation, Equation of motion, Response quantities, Response history, Response spectrum concept, Deformation, Pseudo-velocity, and Pseudo-acceleration, Response spectra, Peak structural response from the response spectrum, Response spectrum characteristics, Elastic design spectrum, comparison of design and response spectra, Distinction between design and response spectra, velocity and acceleration response spectra.

Learning outcomes:

After completion of this unit, the student will be able to

1. Develop equations to calculate earthquake force (L3).

2. Understand different concepts developed to estimate earthquake forces (L2).
3. Differentiate between velocity and acceleration (L5).

Unit III **8L**

Earthquake Analysis of Linear Systems:
Part-A: Response history analysis, Modal analysis, Multistorey buildings with symmetric plan. Multistorey buildings with unsymmetric plan, Torsional response of symmetric plan builds, structural idealization and earthquake response. Part-B: Response Spectrum Analysis: Peak response from earthquake response spectrum, Multistorey buildings with symmetric plan, Multistorey buildings with unsymmetric plan.

Learning outcomes:
After completion of this unit, the student will be able to

- Interpret the response history for a given earthquake excitation (L5)
- Construction of response spectrum (L6)
- Relate Deformation, Pseudo-velocity and Pseudo-acceleration spectra (L1)
- Estimate peak structural response quantities (L5)

Unit IV **8L**

Earthquake Response of Linear Elastic Buildings: Systems analysed, Design spectrum and response quantities, Influence of T1 and p on response, Modal contribution factors, Influence of T1on higher mode response. Influence of p on higher-mode response, Height wise variation of higher-mode response, no of modes to include.
Aseismic Design of Structure: Design data and philosophy of design, Seismic coefficients. Permissible increase in stresses and load factors, Multistorey buildings, Base shear, fundamental period of buildings, distribution of forces along the height.

Learning outcomes:
After completion of this unit, the student will be able to

1. Understanding the behaviour of structure during the phase of earthquake (L2).
2. Different types of coefficients to be considered while estimating earthquake forces (L5).
3. Distributing earthquake forces to different levels of the multi-storey building (L4).

Unit V **8L**

Dynamic analysis of structures, Effective weight considerations. Earthquake resistant construction of buildings, Ductility provisions in reinforced concrete construction.
Earthquake analysis of Water towers: Introduction, Behaviour under earthquake loads, Design features, Water tower as a rigid jointed space frame, Hydrodynamic pressures in tanks. Earthquake analysis of Stack like structures: Introduction, Fundamental period of vibration, Dynamic bending moment, Shear diagram

Learning outcomes:
After completion of this unit, the student will be able to

1. Understand dynamic analysis of earthquake and its effect on structures (L2).
2. Effect of hydrodynamic water pressure on surface of water tank (L4).
3. Design of water tanks under the effect of earthquake loads (L6).

Text Book(s):

1. Jai Krishna and Chandrasekharan, Saritha Prakasham, "Elements of Earthquake Engineering", 2/e, South Asian Publishers, 2014.
2. Anil K. Chopra, "Dynamics of Structures, Theory and Applications to Earthquake Engineering", 4/e, Prentice Hall of India, 2015.

References:

1. Roberto Villaverde, Fundamental Concepts of Earthquake Engineering,,CRC(2009).

Course Outcomes

By the end of the course the student will be able to:

- Summarize the causes of earthquake and its consequences (L2)
- Distinguish between response spectra and design spectra (L4)
- Classify between Response History and response spectra analysis (L4)
- Evaluate the seismic force acting on Multistory structure (L5)
- Design of Water towers & Stack like structures for Seismic excitation (L6)

19EMC741: RESEARCH METHODOLOGY AND IPR

L	T	P	C
2	0	0	2

This course introduces the student, to the fundamentals of research, research process, technical writing and intellectual property rights. Students will be able to use this knowledge to gain interest in their subject area and pursue their career in research.

Course Objectives

- To familiarize the meaning, objectives and sources of research
- To acquaint the student with the importance and methods of literature review/research ethics
- To impart the knowledge of technical writing for preparing reports, presentations, research proposals, conference/journal publications
- To introduce the terminology and process of obtaining intellectual property rights
- To expose the intricacies in the process of obtaining patent rights

Unit I **5L**

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

Learning Outcomes

After the completion of this unit, the student will be able to

- define the meaning of a research problem (L1)
- list the different sources of research problem (L2)
- enumerate the different criteria of good research and list the different errors in selecting research problem (L2)
- contrast the different approaches of research (L3)
- compare the different methods for data collection and analysis (L5)

Unit II **5L**

Effective literature studies approaches, analysis Plagiarism, Research ethics

Learning Outcomes

After the completion of this unit, the student will be able to

- list and elaborate the different steps of the research process (L1)
- explain the importance of carrying out an effective literature review (L2)
- identify the research gaps from literature review (L5)
- describe the ethical principles to be following during research process and authorship (L2)
- define the terminology and list the methods to avoid being accused of plagiarism (L1)
- list the different types of research misconduct (L2)

Unit III **5L**

Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

Learning Outcomes

After the completion of this unit, the student will be able to

- list the attributes, reasons and guidelines for effective technical writing (L1)
- contrast between conference paper, technical presentation and journal paper (L3)
- choose a particular research contribution for patenting or journal publication (L4)
- describe the terminology related to citation, citation index, h-index etc (L2)

Unit IV **5L**

Nature of Intellectual Property: Patents, Designs, Trademarks and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. **International Scenario**: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

Learning Outcomes

After the completion of this unit, the student will be able to

- describe the codes and standards in building intellectual property rights(L2)
- list the subject, importance and requirements for of patentability(L1)
- explain the process of patenting and commercialization in academia(L2)
- enumerate the procedure for application preparation, filing and grant of Patents(L2)

Unit V **8L**

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. **New Developments in IPR**: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

Learning Outcomes

After the completion of this unit, the student will be able to

- explain the scope of patent rights(L2)
- describe the process for licensing and transfer of technology(L2)
- identify the sources of patent information and databases(L1)
- elaborate the administration of patent system(L2)
- describe the new developments in IPR in computer software, biological systems etc(L3)

Text Book(s):

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for Science and engineering students", Tata Mcgraw Hill India, 2013.
2. Ranjit Kumar, "Research Methodology: A Step by Step Guide for beginners", 2/e, Prentice Hall of India, 2013.

References:

1. Halbert, "Resisting Intellectual Property", Taylor and Francis Limited, 2007.
2. Mayall, "Industrial Design", McGraw Hill, 1992.
3. Niebel, "Product Design", McGraw Hill, 1974.
4. Asimov, "Introduction to Design", Prentice Hall, 1962.
5. Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age", 2016
6. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand Publishers, 2008

Course Outcomes

After successful completion of the course, the student will be able to

- define the meaning, sources, approaches for research problems (L1)
- explain the guidelines for carrying out effective literature review and identify research gaps(L2)
- describe effective guidelines for preparing technical reports, research publications, presentations and research proposals(L2)
- describe the codes, standards and process of obtaining intellectual property rights(L3)
- enumerate the new developments of IPR in engineering systems(L3)

19EOE742: BUSINESS ANALYTICS

L	T	P	C
3	0	0	3

This course introduces students to the science of business analytics. The goal is to provide students with the foundation needed to apply data analytics to real-world challenges they confront daily in their professional lives. Students will learn to identify the ideal analytic tool for their specific needs; understand valid and reliable ways to collect, analyze, and visualize data; and utilize data in decision making for managing agencies, organizations or clients in their workspace

Course Objectives

- To familiarize the scope, process and advantages of business analytics
- To acquaint the student with the modeling and problem solving skills in business analytics
- To impart the organization and management of business analytics
- To introduce the forecasting models and techniques used in analytics
- To expose the formulation and decision strategies used in business analytics

Unit I **8L**

Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organisation, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview

Learning Outcomes

After the completion of this unit, the student will be able to

- define the scope and process of business analytics (L1)
- choose an organizational structure to implement a business analytics process (L3)
- describe the statistical tools and methods used for data modeling and analysis (L2)
- identify the sampling and estimation requirements for data analysis (L1)

Unit II **8L**

Trendiness and Regression Analysis: Modeling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.

Learning Outcomes

After the completion of this unit, the student will be able to

- identify the relationships and trends in data (L1)
- utilize linear regression methods for identifying data relationships (L4)
- list the types of data and their models used for business analytics (L1)
- describe the methods for visualization and exploration of data (L2)

Unit III **8L**

Organization Structures of Business analytics: Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

Learning Outcomes

After the completion of this unit, the student will be able to

- describe the management issues in the organization structures (L2)

- define the designing information policy and its usage (L1)
- list the methods for ensuring data quality measuring contribution (L1)
- explain the use of data mining methodologies for predictive analytics analysis (L3)
- describe the use of prescriptive analytics methods in business analytics process (L2)

Unit IV **10L**

Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.

Learning Outcomes

After the completion of this unit, the student will be able to

- classify and describe the use of forecasting models (L3)
- model the use of regression forecasting with casual variables (L5)
- identify the appropriate forecasting model for a given data (L5)
- explain the use of monte carlo simulation for forecasting and identify the involved risk (L2)

Unit V **8L**

Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.

Learning Outcomes

After the completion of this unit, the student will be able to

- formulate decision problems (L2)
- list the decision strategies with and without probabilities (L1)
- use the decision trees for analysis (L4)
- describe the value of information, utility and its use in decision making (L4)

Textbook(s):

1. Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Business analytics Principles, Concepts, and Applications Pearson FT Press, 2014.
2. James Evans, Business Analytics, Pearson Education, 2013.

Course Outcomes

Upon successful completion of the course, the student will be able to

- define the scope, process and advantages of business analytics (L1)
- explain the modeling and problem solving skills in business analytics (L2)
- describe the organization and management of business analytics (L3)
- utilize the forecasting models and techniques used in analytics (L4)
- enumerate and utilize the formulation and decision strategies (L2)

19EOE744: INDUSTRIAL SAFETY

L	T	P	C
3	0	0	3

Safety by design or prevention through design is in the core for maintaining engineering systems safe. The students will be equipped with concepts of engineering systems safety, dimensions of engineering systems safety, safety design and analysis mathematics, design for engineering systems safety and control for safety, and integrating safety with other operational goals such as quality and reliability

Course Objectives

- to impart knowledge on different facets and aspects of industrial systems safety
- to familiarize the student with tools, techniques and methodologies needed for prevention of occurrences of unsafe operations and accidents under different industrial settings
- to impart the knowledge of definition, function and types of maintenance activities
- to familiarize the different wear and corrosion mechanisms and their prevention methods
- to expose the students to different faults and their tracing mechanisms
- to impart the art of planning periodic and preventive maintenance mechanisms

Unit I **8L**

Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

Learning Outcomes

After the completion of this unit, the student will be able to

- list the different types of mechanical and electrical hazards in industrial systems(L1)
- enumerate the salient points of factories act 1948(L2)
- describe the health and safety measures to be enforced for industrial safety(L3)
- elaborate the different fire prevention and firefighting arrangements to be made(L2)

Unit II **8L**

Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

Learning Outcomes

After the completion of this unit, the student will be able to

- define the meaning and aim of maintenance engineering(L1)
- elaborate the primary and secondary functions of maintenance department(L2)
- classify the different types and applications of maintenance(L3)
- relate the replacement economy with maintenance cost(L5)
- estimate the service life of equipment from the specifications of individual components(L4)

Unit III **8L**

Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors

affecting the corrosion. Types of corrosion, corrosion prevention methods.

Learning Outcomes

After the completion of this unit, the student will be able to

- explain the different types, causes and effects of Wear(L2)
- elaborate the different methods for reducing wear(L2)
- list the different types of lubricants and mention their applications(L1)
- define the principle and factors affecting corrosion(L1)
- classify the different types of corrosion and identify their prevention methods(L3)

Unit IV **8L**

Fault tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler,vi. Electrical motors, Types of faults in machine tools and their general causes.

Learning Outcomes

After the completion of this unit, the student will be able to

- explain the different types, causes and effects of Wear(L2)
- use the concept of decision tree for fault tracing in machine tools(L4)
- build decision trees for different machine tools including pump, air compressor etc(L4)
- classify the different types of faults in machine tools and their causes(L3)

Unit V **10L**

Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

Learning Outcomes

After the completion of this unit, the student will be able to

- explain the concept of periodic inspection and its need(L2)
- list the common troubles and remedies of electric motor(L1)
- define the need for preventive maintenance and list its steps(L3)
- elaborate the steps/procedure of periodic and preventive maintenance of diesel generating sets, pumps etc(L2)

Text Book(s):

1. Lindley R. Higgins, Lester Coridon Morrow, Maintenance Engineering Handbook, Da Information Services, 1977.
2. H. P. Garg, Maintenance Engineering, S. Chand and Company, 1987.
3. Audels, Pump-hydraulic Compressors, Mc Graw Hill Publication, 1992.
4. Winterkorn, Hans, Foundation Engineering Handbook, Chapman & Hall London, 1975

Course Outcomes

Upon successful completion of the course, the student will be able to

- describe the different facets and aspects of industrial systems safety(L2)
- demonstrate the use of tools, techniques and methodologies needed for prevention of occurrences of unsafe operations and accidents under different industrial settings(L4)
- define the function and list the types of maintenance activities(L1)

- describe the concept of wear and corrosion mechanisms and their prevention methods(L2)
- enumerate the different faults and their tracing mechanisms (L3)
- elaborate the planning periodic and preventive maintenance mechanisms needed for industrial safety(L4)

19EOE746: OPERATIONS RESEARCH

L	T	P	C
3	0	0	3

Optimization problems arise in all walks of human activity- particularly in engineering, business, finance and economics. The simplest optimization problems are linear in nature which may be subject to a set of linear constraints. This course will equip the student with the expertise to mathematically model real life optimization problems as Linear Programming (Optimization) Problems and subsequently educate the student to solve these models with the help of the available methods.

Course Objectives

- to impart knowledge on developing mathematical formulation for linear programming and transportation problem
- to familiarize the student in the construction of the required activities in an efficient manner to complete it on or before a specified time limit and at the minimum cost.
- to expose the development of mathematical model for interactive decision-making situations, where two or more competitors are involved under conditions of conflict and competition.
- to illustrate PERT and CPM techniques for planning and implementing projects.
- To impart the knowledge of formulating and analysis of real life problems using advanced tools and techniques for resource optimization
- to provide frameworks for analyzing waiting lines using advanced queuing theory concepts

Unit I **8L**

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models

Learning Outcomes

After completing this unit, the student will be able to

- identify and develop operational research models from the verbal description of the real system. **(L4)**
- understand the classification systems of effective Inventory control models **(L2)**

Unit II **8L**

Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming

Learning Outcomes

After completing this unit, the student will be able to

- translate a real-world problem, given in words, into a mathematical formulation. **(L2)**
- utilize the mathematical tools that are needed to solve optimization problems. **(L2)**

Unit III **8L**

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

Learning Outcomes

After completing this unit, the student will be able to

- describe the need and origin of the optimization methods **(L2)**
- classify optimization problems to suitably choose the method needed to solve the particular type of problem **(L3)**

Unit IV **8L**

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

Learning Outcomes

After completing this unit, the student will be able to

- choose linear programming problems to suitably choose the method needed to solve the particular type of problem **(L1)**
- identify industrial problems involved in inventory, MRP and scheduling **(L2)**

Unit V **8L**

Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

Learning Outcomes

After completing this unit, the student will be able to

- identify the values, objectives, attributes, decisions, uncertainties, consequences, and trade-offs in a real decision problem **(L2)**
- Apply the models to incorporate rational decision-making process in real life situations.**(L3)**
- Analyze various modeling alternatives & select appropriate modeling techniques for a given situation.. **(L3)**

Text Book(s):

1. H.A. Taha, Operations Research, An Introduction, Prentice Hall of India, 2008
2. H.M. Wagner, Principles of Operations Research, Prentice Hall of India, Delhi, 1982.
3. J.C. Pant, Introduction to Optimization: Operations Research, Jain Brothers, 2008
4. Hitler Libermann Operations Research: McGraw Hill Publishers, 2009
5. Pannerselvam, Operations Research: Prentice Hall of India, 2010
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India, 2010

Course Outcomes

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

- Understand the basic concepts of different advanced models of operations research and their applications. (L2)
- Solve linear programming problems using appropriate techniques and optimization solvers, interpret the results obtained and translate solutions into directives for action. (L4)
- Apply the models to incorporate rational decision-making process in real life situations. (L4)
- Analyze various modeling alternatives & select appropriate modeling techniques for a given situation. (L3)
- Validate output from model to check feasibility of implementations. (L5)
- Create innovative modeling frameworks for a given situation. (L6)
- Conduct and interpret post-optimal and sensitivity analysis and explain the primal-dual relationship. (L3)

19EOE748: COST MANAGEMENT OF ENGINEERING PROJECTS

L	T	P	C
3	0	0	3

This course will equip the student with the expertise to mathematically model engineering projects and use effective methods and techniques to plan and execute engineering activities.

Course Objectives

- to introduce the basic principles of strategic cost management and the related terminology
- to familiarize the project planning and execution process involving technical/nontechnical activities
- to acquaint the student with detailed engineering activities and their cost management analysis
- to impart the knowledge of cost analysis and profit planning of engineering projects
- to familiarize the quantitative techniques for optimization of budget allocation

Unit I **8L**

Introduction and Overview of the Strategic Cost Management Process, Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

Learning Outcomes

After the completion of this unit, the student will be able to

- describe the cost concepts in decision making(L2)
- define the various costs involved in the cost management process(L2)
- list the objectives of cost control(L2)
- identify the different fields of a database for operational control(L2)

Unit II **8L**

Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities.

Learning Outcomes

After the completion of this unit, the student will be able to

- define the meaning of a project and list the different types(L2)
- identify the measures to manage cost overruns(L2)
- describe the various stages of project execution from conception to commissioning(L2)
- plan the proper order of technical/nontechnical activities as part of project execution(L2)

Unit III **8L**

Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process.

Learning Outcomes

After the completion of this unit, the student will be able to

- identify the different clearance norms required in the pre-project execution phase(L2)
- describe the hierarchy of project team and identify the role of each member(L2)
- list the different contents of project contracts(L2)
- present the project cost control and planning through bar charts, network diagrams etc(L2)

Unit IV **8L**

Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis.

Learning Outcomes

After the completion of this unit, the student will be able to

- describe the cost behavior and profit planning(L2)
- distinguish between marginal costing and absorption costing(L2)
- analyze the variance of standard costing(L2)
- analyze the pricing strategies in project costing(L2)
- identify the quality measures satisfying the appropriate constraints(L2)

Unit V **10L**

Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing. Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory

Learning Outcomes

After the completion of this unit, the student will be able to

- define and compare the different budgeting strategies(L2)
- model the cost management as a linear programming problem(L2)
- measure the divisional profitability and decide the appropriate pricing(L2)

Textbook(s):

1. Charles T. Horngren, Srikant M. Datar, George Foster, Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi, 2006.

References:

1. Charles T. Horngren, George Foster, Advanced Management Accounting, Greenwood Publishing, 2001.
2. Robert S Kaplan, Anthony A. Alkinson, Management & Cost Accounting, 1998.
3. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting, Wheeler Publisher, 2004.
4. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book, 2006.

Course Outcomes

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

- list the basic principles of strategic cost management and define the related terminology(L1)
- plan the project execution process involving technical/nontechnical activities(L4)
- describe the detailed engineering activities and their cost management analysis(L2)
- carry out the cost analysis and profit planning of engineering projects(L5)
- utilize quantitative techniques for optimization of budget allocation(L6)

19EOE752: WASTE TO ENERGY

L	T	P	C
3	0	0	3

This course introduces the basic principles and different technologies of converting waste to energy. Student will be able to appropriately identify the methods and build biomass gasification systems of different capacities depending on application requirements.

Course Objectives

- to introduce the classification of waste for its usefulness in preparing different fuels
- to familiarize the biomass pyrolysis process and its yield issues
- to acquaint the student with biomass gasification processes and construction arrangements
- to impart the types and principles of biomass combustors
- to familiarize the calorific values and composition of biogas resources

Unit I **8L**

Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

Learning Outcomes

After the completion of this unit, the student will be able to

- distinguish between different types of waste (L1)
- classify the different types of waste for manufacturing different types of fuel (L3)
- identify the different conversion devices and their applications(L4)

Unit II **8L**

Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

Learning Outcomes

After the completion of this unit, the student will be able to

- classify the different types of pyrolysis methods based on speed(L1)
- describe the different methods of manufacturing charcoal (L2)
- explain the chemical processes involved in the manufacture of pyrolytic oils and gases(L2)

Unit III **8L**

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

Learning Outcomes

After the completion of this unit, the student will be able to

- explain the design, construction and operation of different gasifiers(L2)
- describe the burner arrangement for thermal heating(L2)
- elaborate the gasifier engine arrangement for equilibrium and kinetic considerations(L3)

Unit IV **8L**

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

Learning Outcomes

After the completion of this unit, the student will be able to

- explain the basic principle of biomass combustors(L2)
- classify different combustors based on their capacity and efficiency(L3)
- describe the construction and operation of fixed bed inclined grate, fluidized bed combustors (L2)

Unit V **10L**

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

Learning Outcomes

After the completion of this unit, the student will be able to

- list the properties of biogas(L1)
- elaborate the design, construction and operation of biogas plant(L2)
- classify the different biomass resources and their conversion process(L3)
- distinguish between different biogas plants and identify their applications(L5)

Text Book(s)

1. Non-Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

Course Outcomes

After the successful completion of the course, the student will be able to

- classify different types of waste for their usefulness in preparing different fuels(L3)
- describe the biomass pyrolysis process and its yield issues(L2)
- outline the different biomass gasification processes and their construction arrangements(L3)
- explain the types and principles of biomass combustors(L2)
- analyze the calorific values and composition of biogas resources(L5)

19EOE754: GREEN BUILDINGS

L	T	P	C
3	0	0	3

Green Buildings are the need of the 21st century as the construction industry must contribute towards reducing the effects of climate change. This course is designed to provide basic guidelines for the construction of Green Buildings and it gives an overview of all the processes involved from the start of site construction management to material selection, services management, energy & resources management and managing the indoor environment quality during building operation.

Course Objectives:

- To emphasize the need for energy efficient buildings
- To understand the considerations for an Energy Efficient building design.
- To have an insight into the existing Green Rating Systems in India.
- To illustrate various techniques that can be applied in buildings to make them green.

Unit I **8L**

Introduction to green buildings: Concept of green building design. Need for energy and resource efficient design. Factors affecting the Energy use in Buildings – Pre-Building Stage, Construction Stage & Post Occupancy stages. Building life cycle analysis. Need for Green Building rating Systems. Brief introduction to green rating systems in India.

Learning Outcomes:

Post completion of the unit the student will be able to:

- *Define the concept of Green Buildings. (L1)*
- *Explain the need of resource conservation. (L2)*
- *Illustrate the energy use in buildings as different stages. (L2)*
- *Select appropriate building rating systems. (L3)*

Unit II **8L**

Sustainable site construction and management – Selection of site, preserving and protecting landscape during construction, Top soil conservation, reducing hard paving on site, provide sanitation and safety facilities for construction workers Efficient design of services – water management: water supply and treatment methods, rain water harvesting, water recycling, reuse of water and installation of water efficient fixtures. Waste management: reduction of waste during construction, efficient segregation of waste, resource recovery from waste.

Learning Outcomes:

Post completion of the unit the student will be able to:

- *Choose appropriate methods of construction management. (L1)*
- *Summarise the process of site management. (L2)*
- *Identify the techniques of energy, water and waste management in buildings. (L3)*

Unit III **8L**

Building physics: heat transfer in buildings (conduction, convection and radiation) and importance material selection for building envelope. Specification of materials for walls and roofs in different climates. Building materials and resources: Sustainable Building Materials– Biodegradable & Non- Biodegradable Materials, resource reuse, recyclable materials, recycled content, Regional materials. Energy Efficient Construction Technology – Filler Slab, Rat trap Bond. Technologies developed by CBRI. Contemporary and future trends- Nanotechnology, smart materials.

Learning Outcomes:

Post completion of the unit the student will be able to:

- *Show the process of heat transfer through buildings. (L2)*
- *Examine the performance of building envelopes for heat transfer. (L4)*
- *Identify appropriate building materials. (L3)*

- *Demonstrate various energy efficient construction technologies being developed. (L2)*

Unit IV **8L**

Energy conservation: Optimizing building design to reduce conventional energy demand, reducing material usage and time of construction by adopting efficient technologies, conserving energy through selection energy efficient equipment. Alternative sources of energy: Renewable energy sources, Photo Voltaic Cells, small scale hydro and wind systems, photovoltaic cells.

Learning Outcomes:

Post completion of the unit the student will be able to:

- *Relate the process of building design with energy conservation. (L1)*
- *Outline the process of time & cost reduction in construction projects. (L2)*
- *Identify alternate sources of renewable energy on-site. (L3)*

Unit V **10L**

Indoor environmental quality: Need to improve indoor air quality-sick building syndrome, building related illness, multiple chemical sensitivity. Reducing indoor air pollutants- low-VOC paints / adhesives /sealants, Minimize ozone depleting substances, required levels of indoor ventilation. Indoor and outdoor noise levels. Case Study/Desktop Study: Case study of a live project on Green Buildings or a desktop study of a Green building.

Learning Outcomes:

Post completion of the unit the student will be able to:

- *Explain the need for high indoor air quality. (L2)*
- *List the indoor air pollutants and their sources like VOC, dust, noise, etc. (L1)*
- *Analyse the green aspects of a live project/case study. (L4)*

Text Book(s):

1. Abridged Version reference guide for New Buildings (IGBC rating system)
2. ECBC reference guide.

References:

1. New buildings reference guide
2. Heather L. Venhaus, Designing the Sustainable Site: Integrated Design Strategies for Small Scale Sites and Residential Landscapes
3. Faisal Zia, Vasudevan Rajaram, Solid and liquid waste management,
4. Siddiqui, Sanjeev Agrawal, Mohammed Emran Khan, Introduction to Architectural Science
5. S. V. Szokolay, The Basis of Sustainable Design
6. Sustainable Construction Techniques. From structural design to interior fit-out:
7. Sebastian / John, Viola / Zeumer, Martin Assessing and improving the environmental impact of buildings by El khouli.

Course Outcomes:

- The students will understand the importance of green building design. (L2)
- The students will simultaneously outline efficient techniques of optimizing resource usage in the process of building construction, building operation and post demolition. (L2)
- The students will evaluate effective selection of materials and other equipment.. (L5)
- The students will be able to analyze the sustainability any building and check for green features. (L4)

19EAC741: ENGLISH FOR RESEARCH PAPER WRITING

L	T	P	C
2	0	0	0

This course introduces the student, to the different aspects of research paper writing including planning, preparation, layout, literature review write-up etc. Specifically the perspective and style of writing in different sections of a research paper is highlighted. Students will exposed to English language skills relevant to research paper writing.

Course Objectives:

- To write clearly, concisely and carefully by keeping the structure of the paper in mind.
- To use standard phrases in English and further improve his command over it.
- To write with no redundancy, no ambiguity and increase the readability of the paper.
- To plan and organize his paper by following a logical buildup towards a proper conclusion.
- To decide what to include in various parts of the paper.
- To write a suitable title and an abstract in order to attract the attention of the reader.
- To identify the correct style and correct tense.
- To retain the scientific value of the paper by using minimum number of words.

Unit I **5L**

Planning and Preparation, Word Order, breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.

Learning Outcomes:

After the completion of this unit, the student will be able to

- To know the expectations of various journals and referees (L2)
- To know the typical structure of a paper (L3)
- Learn to put words in a sentence in the correct order (L4)
- To write short and clear sentences from the very beginning of the paper (L4)
- To increase the readability of the paper by making it easy to read and 100% clear (L4)
- Learn to be concise without losing any important content (L4)
- To avoid some typical grammar mistakes made in research papers (L4)

Unit II **5L**

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

Learning Outcomes:

After the completion of this unit, the student will be able to

- Learn to make useful contribution worth recommending for publication (L4)
- Learn good use of language to make readers notice the key findings (L4)
- Learn to anticipate or predict possible objections to the claims made in the paper(L5)
- To understand what is plagiarism, and how to paraphrase other people's work (L4)
- Learn to attract the right kind of readers with a suitable title(L3)
- Learn to sell the abstract to potential readers by attracting their curiosity (L2)

Unit III **6L**

Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check. key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature.

Learning Outcomes:

After the completion of this unit, the student will be able to

- have a deep knowledge about everything that has been previously written on the topic and decide what is important to know in Introduction. (L3)
- Learn to provide the right amount of literature regarding the sequence of events leading up to the current situation in the Literature review(L4)

Unit IV **6L**

Writing Skills: skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions.

Learning Outcomes:

After the completion of this unit, the student will be able to

- Learn to describe the materials used in experiments and/or the methods used to carry out the research (L2)
- The key skill is in reporting the results simply and clearly (L3)
- Learn to structure the Discussion and satisfy the typical requirements of the referees (L4)
- Learn to provide a clear and high-impact take-home message in the conclusion (L5)

Unit V **6L**

Good Paper Writing: Useful phrases, how to ensure paper is as good as it could possibly be the first-time submission.

Learning Outcomes:

After the completion of this unit, the student will be able to

- Learn various lists of frequently used phrases that have a general acceptance in all disciplines and use in specific sections of the paper (L3)
- Learn various kinds of things one should look for when doing the final check (L3)

Text Book (s**):**

1. Goldbort R, Writing for Science, Yale University Press, 2006
2. Day R, How to Write and Publish a Scientific Paper, Cambridge University Press, 2006
3. Highman N, Handbook of Writing for the Mathematical Sciences, SIAM, Highman, 1998.

References:

1. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011.

Course Outcomes:

By the end of the course the students will be able to:

- Frame the structure of the paper precisely. (L2).
- Improve his command over English by using standard phrases. (L3).
- Avoid repetition and mistakes in the paper and increase its readability. (L3).
- Organize the paper logically towards a proper conclusion. (L4).
- Decide on the content to be included in various parts of the paper. (L5).
- Identify whether to use personal or impersonal style in the paper. (L5).
- Express the content in a clear and concise way. (L6).
- Attract the attention of the reader by providing a suitable title and an appropriate abstract. (L6).

19EAC742: DISASTER MANAGEMENT

L	T	P	C
2	0	0	0

This course is intended to provide fundamental understanding of different aspects of Disaster Management. It will expose the students to the concept and functions of Disaster Management and to build competencies of Disaster Management professionals and development practitioners for effective supporting environment as put by the government in legislative manner. It would also provide basic knowledge, skills pertaining to Planning, Organizing and Decision-making process for Disaster Risk Reduction.

Course Objectives

- to provide students an exposure to disasters, their significance, types & Comprehensive understanding on the concurrence of Disasters and its management.
- to ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention, risk reduction and the basic understanding of the research methodology for risk reduction measures.
- equipped with knowledge, concepts, and principles, skills pertaining to Planning, Organizing, Decision-making and Problem solving methods for Disaster Management.
- to develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity.

Unit I **5L**

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

Learning Outcomes

After the completion of this unit, the student will be able to

- define the meaning, list the factors and mention the significance of disaster (L1)
- distinguish between hazard and disaster (L3)
- compare manmade and natural disaster (L3)
- list the types of disaster and describe their magnitude (L2)

Unit II **5L**

Repercussions of Disasters and Hazards: Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.

Learning Outcomes

After the completion of this unit, the student will be able to

- list the different repercussions of disasters and hazards(L1)
- describe the characteristics of natural disasters and the magnitude of their losses(L2)
- describe the characteristics of man-made disasters and the magnitude of their losses(L2)
- elaborate the outbreaks of diseases and epidemics after disasters (L3)

Unit III **6L**

Disaster Prone Areas in India Study of Seismic Zones; Areas Prone to Floods and Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics.

Learning Outcomes

After the completion of this unit, the student will be able to

- describe the seismic zones and their characteristics(L2)
- identify the areas prone to floods and droughts(L1)
- distinguish between landslides and avalanches(L3)
- identify areas prone to cyclonic and costal hazards(L4)
- enumerate the post disaster diseases and epidemics(L2)

Unit IV **6L**

Disaster Preparedness and Management Preparedness: Monitoring of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and Other Agencies, media reports: governmental and Community Preparedness.

Learning Outcomes

After the completion of this unit, the student will be able to

- describe the monitoring of phenomena triggering a disaster/hazard(L2)
- evaluate the risk with the use of remote sensing and meteorological data(L5)
- list the governmental and community measures for disaster preparedness(L2)

Unit V **6L**

Risk Assessment Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival.

Learning Outcomes

After the completion of this unit, the student will be able to

- define and list the elements of disaster risk(L1)
- enumerate the measures for risk reduction(L2)
- apply the techniques of risk assessment (L4)
- identify the means of people's participation in risk assessment(L2)

Text Book(s):

1. R. Nishith, Singh A.K., Disaster Management in India: Perspectives, issues and strategies, New Royal Book Company., 2008.
2. Sahni, Pardeep, Disaster Mitigation Experiences and Reflections, Prentice Hall of India, New Delhi., 2012
3. Goel S. L., Disaster Administration and Management Text and Case Studies", Deep and Deep Publication, 2007.

Course Outcomes

At the end of the course, student will be able to

- Identify management activities in pre, during and post phases of Disasters. (L1)
- Plan disaster management activities and specify measure for risk reduction(L4)
- apply risk assessment techniques in real life disaster scenarios(L4)

19EAC743: SANSKRIT FOR TECHNICAL KNOWLEDGE

L	T	P	C
2	0	0	0

This course is intended to expose the student to the fundamentals of Sanskrit language and its technical utility in forming the core principles of many engineering branches. Students taking this course shall be able to relate the core principles of engineering branches to semantics of Sanskrit language

Course Objectives

- to provide the knowledge of Sanskrit alphabets
- to expose the students to the basic grammar and sentence formation in past/present/future tenses
- to provide a classification of Sanskrit literature and its associated roots
- to demonstrate the relation of core engineering principles to the roots of Sanskrit literature

Unit I **9L**

Alphabets in Sanskrit, Past/Present/Future Tense, Simple Sentences.

Learning Outcomes

After the completion of this unit, the student will be able to

- List the different alphabets in Sanskrit (L1)
- Form sentences in past, present and future tenses (L4)
- Form concise/simple sentences with the right usage of words (L4)

Unit II **9L**

Order, Introduction of roots, Technical information about Sanskrit Literature.

Learning Outcomes

After the completion of this unit, the student will be able to

- classify the different branches of Sanskrit literature (L3)
- describe the order and roots of Sanskrit literature (L2)
- relate the applicability of Sanskrit literature to technical principles (L5)

Unit III **9L**

Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

Learning Outcomes

After the completion of this unit, the student will be able to

- relate the technical concepts of engineering to principles of electrical technology (L2)
- relate the technical concepts of engineering to principles of mechanical engineering (L2)
- apply the use of Sanskrit knowledge to describe the mathematical principles (L4)

Text Book(s):

1. Dr.Vishwas, Abhyaspustakam, Samskrita Bharti Publication, New Delhi, 2005.
2. Vempati Kutumb Shastri, Teach Yourself Sanskrit, Prathama Deeksha, Rashtriya Sanskrit Sansthanam, New Delhi Publication, 2003.
3. Suresh Soni, India's Glorious Scientific Tradition, Ocean books, New Delhi, 2011.

Course Outcomes

After successful completion of the course, the student will be able to

- get a working knowledge in illustrious Sanskrit, the scientific language in the world (L3)
- get a Learning of Sanskrit to improve brain functioning (L4)
- develop the logic in mathematics, science & other subjects with principles of sanskrit(L4)
- explore the huge knowledge from ancient literature with the help of sanskrit(L5)

19EAC744: VALUE EDUCATION

L	T	P	C
2	0	0	0

This course is intended to expose the student to the need for human values and methods to cultivate them for leading an ethical life with good moral conduct. Students taking this course will be able to experience a change in personal and professional behavior with these ethical principles guiding him throughout life

Course Objectives

- to expose the student to need for values, ethics, self-development and standards
- to make the student understand the meaning of different values including duty, devotion, self-reliance etc.
- to imbibe the different behavioral competencies in students for leading an ethical and happy life
- to expose the student to different characteristic attributes and competencies for leading a successful, ethical and happy profession life.

Unit I **7L**

Values and self-development –social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non- moral valuation. Standards and principles. Value judgements

Learning Outcomes

After the completion of this unit, the student will be able to

- define the social values and individual attitudes for self development(L1)
- describe the Indian vision of humanism(L2)
- distinguish between moral and non-moral acts (L3)
- list the standards and value principles for moral conduct (L2)

Unit II **7L**

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.

Learning Outcomes

After the completion of this unit, the student will be able to

- describe the importance of cultivating values(L2)
- list the different traits of self-developed individual(L1)
- explain the need for loving nature/country/humanity(L2)

Unit III **7L**

Personality and Behaviour Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labour. Universal brotherhood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature.

Learning Outcomes

After the completion of this unit, the student will be able to

- describe the benefits of positivie thinking, integrity and discipline(L2)
- list the different methods for avoiding fault finding, anger(L1)
- explain the methods to overcome suffering, religious intolerance, self-destructive habits(L2)

Unit IV **7L**

Character and Competence –Holy books vs Blind faith. Self-management and Good health. Science of reincarnation. Equality, Nonviolence, Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively.

Learning Outcomes

After the completion of this unit, the student will be able to

- describe the science of reincarnation(L2)
- explain the relation between self-management and good health(L1)
- elaborate the role of different religions in reaching the common goal(L3)
- list the different techniques for mind-control to improve personality and studies(L1)

Text Book(s):

1. Chakroborty S.K., "Values and ethics for organizations: Theory and Practice", Oxford University Press, 1998.

Course Outcomes

After successful completion of the course, the student will be able to

- describe the need for human values and methods for self development (L2)
- elaborate the different traits and benefits of a self-developed individual (L1)
- list the different attributes of self-developed individual (L1)
- elaborate the role and scope of books/faith/health/religions in character building and competence development(L3)

19EAC745: CONSTITUTION OF INDIA

L	T	P	C
2	0	0	0

This course is intended to expose the student to the philosophy of Indian constitution. Students will be able to understand their fundamental rights/duties and governance structure. Students also appreciate the role of election commission in establishing a democratic society.

Course Objectives

- to familiarize the student about the need for a constitution
- to make the student understand the role of constitution in a democratic society
- to acquaint the student with key constitutional features and fundamental rights of a citizen
- to impart the organs of governance and local administration hierarchy and their responsibilities
- to familiarize the student with the role, responsibilities and administration hierarchy of election commission

Unit I **5L**

History of Making of the Indian Constitution: History Drafting Committee, (Composition & Working). **Philosophy of the Indian Constitution**: Preamble, Salient Features

Learning Outcomes

After the completion of this unit, the student will be able to

- list the outline of drafting committee and their roles in the making of Indian constitution (L1)
- describe the need and role of a constitution in a democratic society(L2)
- elaborate the salient features of Indian constitution(L3)

Unit II **5L**

Contours of Constitutional Rights & Duties: Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

Learning Outcomes

After the completion of this unit, the student will be able to

- list the fundamental rights of a citizen(L1)
- explain the intricacies in the different rights(L2)
- elaborate the fundamental duties of a citizen(L3)
- describe the principles of state policy(L2)

Unit III **6L**

Organs of Governance: Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions

Learning Outcomes

After the completion of this unit, the student will be able to

- present the hierarchy of governance (L2)
- list the role/responsibilities/powers of different organs of governance(L1)
- elaborate the guidelines for appointment/transfer of judges(L2)

Unit IV **6L**

Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Panchayat 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, Importance of grass root democracy.

Learning Outcomes

After the completion of this unit, the student will be able to

- describe the administrative organizational hierarchy of municipalities and panchayats(L2)
- appreciate the role/responsibilities/powers of mayor, CEO, elected officials(L3)
- appreciate the importance of grass root democracy(L3)

Unit V **6L**

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

Learning Outcomes

After the completion of this unit, the student will be able to

- describe the administrative hierarchy of election commission(L2)
- elaborate the roles/responsibilities/powers of election commissioners at different levels of hierarchy(L3)
- outline the welfare activities of SC/ST/OBC/Women by different bodies(L3)

Text Book(s):

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. S. N. Busi, Dr. B. R. Ambedkar, Framing of Indian Constitution, 1/e, 2015.
3. M. P. Jain, Indian Constitution Law, 7/e, Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

Course Outcomes

After successful completion of the course, the student will be able to

- describe the philosophy and salient features of Indian constitution(L2)
- list the constitutional rights and duties of a citizen(L1)
- elaborate the central and local administrative hierarchy and their roles(L2)
- describe the roles/responsibilities/powers of different governing and administrative bodies(L2)
- explain the structure/functioning and power of election commission(L2)

19EAC746: PEDAGOGY STUDIES

L	T	P	C
2	0	0	0

This course is aimed to familiarizing the student with pedagogical principles, practices and methodologies. This course is intended for students interested in pursuing a career in teaching and research.

Course Objectives

- to familiarize the student about the need for pedagogy studies, background and conceptual framework
- to expose the student to pedagogical practices in formal/informal classrooms
- to acquaint the student with type of curriculum and guidance materials for effective pedagogy
- to familiarize the student with classroom practices and curriculum assessment procedures
- to make the student understand the effect of undertaking research on teaching quality

Unit I **5L**

Introduction and Methodology: Aims and rationale, Policy background, Conceptual framework and terminology, Theories of learning, Curriculum, Teacher education. Conceptual framework, Research questions. Overview of methodology and Searching.

Learning Outcomes

After the completion of this unit, the student will be able to

- define the aim and rationale behind teacher education(L1)
- classify the different theories of learning (L1)
- elaborate the need and role of curriculum, teacher education (L1)

Unit II **5L**

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

Learning Outcomes

After the completion of this unit, the student will be able to

- describe the different pedagogical practices used by teachers in formal and informal classrooms(L1)
- explain the pedagogical practices employed in developing countries (L1)
- enumerate the duties of faculty in terms of teaching, research, consultancy, administration (L1)

Unit III **6L**

Evidence on the effectiveness of pedagogical practices, Methodology for the in depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.

Learning Outcomes

After the completion of this unit, the student will be able to

- list the measures for effective pedagogy(L1)
- identify the different documentation required to formalize curriculum implementation and quality assessment(L1)
- describe the teachers attitudes and beliefs in pedagogic strategies(L2)

Unit IV **6L**

Professional development: alignment with classroom practices and follow-up support, Peer support, Support from the head teacher and the community. Curriculum and assessment, Barriers to learning: limited resources and large class sizes.

Learning Outcomes

After the completion of this unit, the student will be able to

- define the organizational hierarchy in a school administration system(L1)
- list the different barriers to learning(L3)
- enumerate the methods to overcome limited resources and handle large class sizes(L3)
- describe the follow-up support and peer-support in classroom practices(L2)

Unit V **6L**

Research gaps and future directions: Research design, Contexts, Pedagogy, Teacher education, Curriculum and assessment, Dissemination and research impact.

Learning Outcomes

After the completion of this unit, the student will be able to

- explain the need for and role of research in teaching profession(L2)
- list the different research activities to be taken up by teachers(L1)
- describe the impact of research on teaching quality and learning process(L2)

Text Book(s):

1. Ackers J, Hardman F, Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261, 2001
2. Agrawal M, Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379, 2004.
3. Akyeampong K, Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID., 2003.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J, Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282., 2013.
5. Alexander RJ, Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell., 2001.
6. Chavan M, Read India: A mass scale, rapid, ‘Learning to Read’ campaign., 2003.

Course Outcomes

After successful completion of the course, the student will be able to

- describe the theories of learning and conceptual framework of pedagogy(L2)
- explain the pedagogical practices used by teachers in formal and informal classrooms(L2)
- visualize the administrative hierarchy of schools and colleges and define the role(L3)
- appreciate the need for research and define the future direction of teaching career(L3)
- describe the impact of curriculum and assessment on the teaching learning process of a student(L3)

19EAC747: STRESS MANAGEMENT BY YOGA

L	T	P	C
2	0	0	0

This course is aimed to familiarize the student with basic principles of yoga and different physical/mental practices for managing mind and body. This course helps the student in managing stress during education, home and workplace. Further, principles learnt in this course help in building overall personality for a stress-free, happy and independent life.

Course Objectives

- to familiarize the student about eight parts of yoga and their significance
- to expose the student to the importance and meaning of Yam and Niyam
- to make the student understand the meaning and importance of yogic principles including Ahimsa, Satya, Astheya etc
- to introduce the different yogic poses with a knowledge of their benefits for mind and body
- to familiarize the effect of different types of breathing techniques in concept and in activity

Unit I **9L**

Definitions of Eight parts of yoga (Ashtanga).

Learning Outcomes

After the completion of this unit, the student will be able to

- list the eight parts of yoga (L1)
- describe the effects of different parts of yoga on mind and body(L2)
- elaborate the importance of yoga in stress management and personality development(L3)

Unit II **9L**

Yam and Niyam.

Do`s and Don't's in life.

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

Learning Outcomes

After the completion of this unit, the student will be able to

- elaborate the importance of Yam and Niyam(L2)
- describe the meaning and significance of Ahinsa, satya, astheya etc(L2)
- explain the need for shaucha, santosh, tapa, swadhyay in leading a healthy and fruitful life(L3)

Unit III **9L**

Asan and Pranayam

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

Learning Outcomes

After the completion of this unit, the student will be able to

- demonstrate the different physical asanas and explain their physical and phychological effects(L4)
- demonstrate the different breathing techniques and describe their physical and mental effects (L4)
- distinguish between different types of pranayamam(L5)

Text Books

1. Janardan, Yogic Asanas for Group Tarining-Part-I, Swami Yogabhyasi Mandal, Nagpur

2. Swami Vivekananda, “Rajayoga or conquering the Internal Nature”, Advaita Ashrama, Kolkata

Course Outcomes

After successful completion of the course, the student will be able to

- describe the eight parts of yoga and their significance(L1)
- explain the the importance and meaning of Yam and Niyam(L2)
- define the meaning and importance of yogic principles including Ahimsa, Satya, Astheya etc(L1)
- demonstrate the different yogic poses and explain their benefits for mind and body(L4)
- demonstrate the different types of breathing techniques and explain their physical and mental benefits(L5)

19EAC748: PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

L	T	P	C
2	0	0	0

This course is aimed to familiarize the student with life enlightenment skills for personality development. This course helps the student in building his holistic personality through human values, ethics and spiritual attributes.

Course Objectives

- to familiarize the student to good personality traits through moral stories
- to make the student understand the goal of human life and importance of good personality in reaching the goal
- to expose the student to the study of Shrimad-Bhagwad-Geeta for developing his/her personality and achieve the highest goal in life
- to familiarize the student to leadership skills for driving nation and mankind to peace and prosperity
- to expose the role of Neetishatakam for developing versatile personality of students.

Unit I **9L**

Neetisatakam-Holistic development of personality
Verses- 19,20,21,22 (wisdom)
Verses- 29,31,32 (pride & heroism)
Verses- 26,28,63,65 (virtue)
Verses- 52,53,59 (dont's)
Verses- 71,73,75,78 (do's).

Learning Outcomes

After the completion of this unit, the student will be able to

- describe the moral stories illustrating the traits of good personality(L2)
- define the meaning and importance of wisdom, pride, heroism, virtue etc(L1)
- identify do and donts in life from the foundations of human morals/ethics(L5)

Unit II **9L**

Approach to day to day work and duties.
Shrimad BhagwadGeeta: 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.

Learning Outcomes

After the completion of this unit, the student will be able to

- describe the characteristics and principles of bhakti yogam, jnana yogam and karma yogam (L1)
- identify the use of different yogic characteristics in different activities of daily life/duties(L4)
- apply the use of yogic principles for leading a stress-free, happy and fruitful life with good developed personality(L4)

Unit III **9L**

Statements of basic knowledge.
Shrimad BhagwadGeeta: Chapter2-Verses 56, 62, 68
Chapter 12 -Verses 13, 14, 15, 16,17, 18
Personality of Role model. Shrimad BhagwadGeeta:
Chapter2-Verses 17, Chapter 3-Verses 36,37,42,
Chapter 4-Verses 18, 38,39
Chapter18 – Verses 37,38,63

Learning Outcomes

After the completion of this unit, the student will be able to

- list the characteristics of role model proposed by verses of bhagavad gita(L1)
- explain the methods for obtaining life enlightenment through the practice of four yoga appropriately (L2)
- describe the characteristics of karma yogi/jnana yogi for developing leadership personality (L2)

Text Book(s):

1. Swami Swarupananda, "Srimad Bhagavad Gita", Advaita Ashram (Publication Department), Kolkata
2. P. Gopinath, Bhartrihari's Three Satakam (Niti-Sringar-vairagya), Rashtriya Sanskrit Sansthanam, New Delhi.

Course Outcomes

After successful completion of the course, the student will be able to

- List the different parables of neethisathakam and identify their morals(L1)
- enumerate the different traits of human personality for life enlightenment(L2)
- describe the leadership attributes for driving nation and mankind to peace and prosperity(L2)
- explain the applicability of different types of yoga to day-to-day work and duties resulting in responsible personality (L2)

19EAC750: DEVELOPING SOFT SKILLS AND PERSONALITY

L	T	P	C
3	0	0	0

Soft skills comprise pleasant and appealing personality traits as self-confidence, positive attitude, emotional intelligence, social grace, flexibility, friendliness and effective communication skills. The course aims to cause a basic awareness within the students about the significance of soft skills in professional and inter-personal communications and facilitate an all-round development of personality.

Course Objectives

- to familiarize the student to the criteria for self assessment and significance of self-discipline
- to expose the student to attitudes, mindsets, values and beliefs
- to acquaint the student to plan career and goals through constructive thinking
- to enable the student to overcome barriers for active listening and persuasive speaking
- to familiarize the skill of conducting meetings, writing minutes and involving in active group discussions

Unit I **(8L)**

Self-Assessment; Identifying Strength & Limitations; Habits, Will-Power and Drives; Developing Self-Esteem and Building Self-Confidence, Significance of Self-Discipline

Learning Outcomes

After the completion of this unit, the student will be able to

- identify strengths & limitations through self-assessment(L3)
- list the attributes of personalities will good will-power and self-drives(L1)
- describe the reasons for building self-esteem and self-confidence(L2)
- explain the significance of self discipline(L2)

Unit II **(8L)**

Understanding Perceptions, Attitudes, and Personality Types: Mind-Set: Growth and Fixed; Values and Beliefs

Learning Outcomes

After the completion of this unit, the student will be able to

- define the characteristics of different perceptions, attitudes and personality types(L1)
- distinguish between fixed and growing mindsets(L3)
- define the importance and meaning of values and beliefs(L2)

Unit III **(8L)**

Motivation and Achieving Excellence; Self-Actualisation Need; Goal Setting, Life and Career Planning; Constructive Thinking

Learning Outcomes

After the completion of this unit, the student will be able to

- describe the need for having high motivation and achieving excellence(L2)
- define the need for self-actualization(L1)
- plan the life and career goals based on self assessment(L4)
- explain the attributes of constructive thinking(L2)

Unit IV **(8L)**

Communicating Clearly: Understanding and Overcoming barriers; Active Listening; Persuasive Speaking and Presentation Skills.

Learning Outcomes

After the completion of this unit, the student will be able to

- self-assess the barriers for communicating clearly (L4)
- list the attributes of active listening(L1)
- describe the minimal aspects of effective presentation(L2)
- organize ideas resulting a persuasive talk(L3)

Unit V **(8L)**

Conducting Meetings, Writing Minutes, Sending Memos and Notices; Netiquette: Effective E-mail Communication; Telephone Etiquette; Body Language in Group Discussion and Interview.

Learning Outcomes

After the completion of this unit, the student will be able to

- describe the format and structure of writing meeting minutes(L2)
- identify the essential components of memos and notices(L3)
- explain the principles of effective email communication(L2)
- list the basic etiquette of telephone conversation(L1)
- describe the effective body traits during group discussion and interviews(L2)

Text Books

1. Dorch, Patricia. What Are Soft Skills? New York: Execu Dress Publisher, 2013.
2. Kamin, Maxine. Soft Skills Revolution: A Guide for Connecting with Compassion for Trainers, Teams, and Leaders. Washington, DC: Pfeiffer & Company, 2013.
3. Klaus, Peggy, Jane Rohman& Molly Hamaker. The Hard Truth about Soft Skills. London: HarperCollins E-books, 2007.
4. Petes S. J., Francis. Soft Skills and Professional Communication. New Delhi: Tata McGraw-Hill Education, 2011.
5. Stein, Steven J. & Howard E. Book. The EQ Edge: Emotional Intelligence and Your Success. Canada: Wiley & Sons, 2006.

Course Outcomes

After successful completion of the course, the student will be able to

- carry out self assessment and describe the significance of self-discipline(L4)
- define, classify and compare attitudes, mindsets, values and beliefs(L3)
- plan career and goals through constructive thinking and personal assessment(L4)
- overcome barriers for active listening and persuasive speaking (L5)
- conduct meetings, write minutes and involve in active group discussions(L3)

HSMCH102 - UNIVERSAL HUMAN VALUES 2: UNDERSTANDING HARMONY

L	T	P	C
2	1	0	3

Human Values Courses: During the Induction Program, students would get an initial exposure to human values through Universal Human Values – I. This exposure is to be augmented by this compulsory full semester foundation course.

Course Objectives:

1. Development of a holistic perspective based on self- exploration about themselves (human being), family, society and nature/existence.
2. Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence
3. Strengthening of self-reflection.
4. Development of commitment and courage to act.

COURSE TOPICS: The course has 28 lectures and 14 practice sessions in 5 modules:

Module 1: Course Introduction - Need, Basic Guidelines, Content and Process for Value Education

1. Purpose and motivation for the course, recapitulation from Universal Human Values-I.
2. Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration.
3. Continuous Happiness and Prosperity- A look at basic Human Aspirations
4. Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority.
5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario
6. Method to fulfil the above human aspirations: understanding and living in harmony at various levels.

Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking.

Module 2: Understanding Harmony in the Human Being - Harmony in Myself!

1. Understanding human being as a co-existence of the sentient 'I' and the material 'Body'.
2. Understanding the needs of Self ('I') and 'Body' - happiness and physical facility.
3. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer).
4. Understanding the characteristics and activities of 'I' and harmony in 'I'.
5. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail.
6. Programs to ensure Sanyam and Health.

Include practice sessions to discuss the role others have played in making material goods available tome. Identifying from one's own life.
Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease

Module 3: Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship

1. Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship.
2. Understanding the meaning of Trust; Difference between intention and competence.

3. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship
4. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals
5. Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.
Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives.

Module 4: Understanding Harmony in the Nature and Existence - Whole existence as Coexistence

1. Understanding the harmony in the Nature
2. Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature.
3. Understanding Existence as Co-existence of mutually interacting units in all-pervasive space.
4. Holistic perception of harmony at all levels of existence.
5. Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

Module 5: Implications of the above Holistic Understanding of Harmony on Professional Ethics

1. Natural acceptance of human values
2. Definitiveness of Ethical Human Conduct
3. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
4. Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems.
5. Case studies of typical holistic technologies, management models and production systems
6. Strategy for transition from the present state to Universal Human Order:
7. At the level of individual: as socially and ecologically responsible engineers, technologists and managers
8. At the level of society: as mutually enriching institutions and organizations
9. Sum up.

Include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions e.g. To discuss the conduct as an engineer or scientist etc.

READINGS:

Text Book

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010

Reference Books

1. Jeevan Vidya: EkParichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi.

19ECE891: PROJECT WORK I

L	T	P	C
0	0	26	13

Each student is required to submit a report of first part of project work i.e. about the problem definition, literature review and methodology to be adopted including experiments and tests to be performed on topic of project as per the guidelines decided by the department. The project work is to be evaluated through Presentations and Viva-Voce during the semester end.

19ECE892: PROJECT WORK II

L	T	P	C
0	0	26	13

Each student is required to submit a detailed project report about the work on topic of project as per the guidelines decided by the department. The project work is to be evaluated through Presentations and Viva-Voce during the semester and Final evaluation will be done at the end of semester as per the guidelines decided by the department from time to time. The candidate shall present/publish one paper in national/international conference/seminar/journal of repute. However candidate may visit research labs/institutions with the due permission of chairperson on recommendation of supervisor concerned.

GITAM School of Technology

GITAM (Deemed to be Universtiy)

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