ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI

(Autonomous)

(Effective for the students admitted into I year from the AY 2023-24 onwards & LE from 2024-25 onwards)

INDUCTION PROGRAMME

S.No	Course Name	Category	L-T-P-C
1	Physical Activities -- Sports, Yoga and Meditation, Plantation	MC	0-0-6-0
2	Career Counseling	MC	2-0-2-0
3	Orientation to all branches -- career options, tools, etc.	MC	3-0-0-0
4	Orientation on admitted Branch -- corresponding labs, tools and platforms	EC	2-0-3-0
5	Proficiency Modules & Productivity Tools	ES	2-1-2-0
6	Assessment on basic aptitude and mathematical skills	MC	2-0-3-0
7	Remedial Training in Foundation Courses	MC	2-1-2-0
8	Human Values & Professional Ethics	MC	3-0-0-0
9	Communication Skills -- focus on Listening, Speaking, Reading, Writing skills	BS	2-1-2-0
10	Concepts of Programming	ES	2-0-2-0

B.Tech. – I Year I Semester

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits	Scheme of Examination (Max. Marks)		
				L	T/CLC	P	C	CIE	SEE	Total
1	BS	23ABS9903	Engineering Physics	2	1	0	3	30	70	100
2	BS	23ABS9904	Linear Algebra & Calculus	2	1	0	3	30	70	100
3	ES	23AES0201	Basic Electrical & Electronics Engineering	2	1	0	3	30	70	100
4	ES	23AES0301	Engineering Graphics	1	0	4	3	30	70	100
5	ES	23AES0501	Introduction to Programming	2	1	0	3	30	70	100
6	ES	23AES0503	IT Workshop	0	0	2	1	30	70	100
7	BS	23ABS9908	Engineering Physics Lab	0	0	2	1	30	70	100
8	ES	23AES0202	Electrical & Electronics Engineering Workshop	0	0	3	1.5	30	70	100
9	ES	23AES0502	Computer Programming Lab	0	0	3	1.5	30	70	10
10	HM	23AHM9904	NSS/NCC/Scouts & Guides/Community Service	-	-	1	0.5	50	-	50
Total Credits				**9**	**4**	**15**	**20.5**	**320**	**630**	**950**

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI

(Autonomous)

(Effective for the students admitted into I year from the AY 2023-24 onwards & LE from 2024-25 onwards)

B.Tech. – I Year II Semester

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits	Scheme of Examination (Max. Marks)		
				L	T/CL C	P	C	CIE	SEE	Total
1	HM	23AHM9901	Communicative English	2	0	0	2	30	70	100
2	BS	23ABS9902	Engineering Chemistry	2	1	0	3	30	70	100
3	BS	23ABS9905	Differential Equations &Vector Calculus	2	1	0	3	30	70	100
4	ES	23AES0101	Basic Civil & Mechanical Engineering	2	1	0	3	30	70	100
5	PC	23APC0101	Engineering Mechanics	2	1	0	3	30	70	100
6	HM	23AHM9902	Communicative English Lab	0	0	2	1	30	70	100
7	BS	23ABS9907	Engineering Chemistry Lab	0	0	2	1	30	70	100
8	ES	23AES0302	Engineering Workshop	0	0	3	1.5	30	70	100
9	PC	23APC0102	Engineering Mechanics & Building Practices Lab	0	0	3	1.5	30	70	100
10	HM	23AHM9903	Health and wellness, Yoga and Sports	-	-	1	0.5	50	-	50
Total Credits				**10**	**4**	**11**	**19.5**	**320**	**630**	**950**

B.Tech. – II Year I Semester

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits	Scheme of Examination (Max. Marks)		
				L	T/CL C	P	C	CIE	SEE	Total
1	BS	23ABS9909	Numerical and Statistical Methods	2	1	0	3	30	70	100
2	HM	23AHM9905	Universal Human Values–Understanding Harmony and Ethical Human Conduct	2	1	0	3	30	70	100
3	PC	23APC0103	Surveying	2	1	0	3	30	70	100
4	PC	23APC0104	Strength of Materials	2	1	0	3	30	70	100
5	PC	23APC0105	Fluid Mechanics	2	1	0	3	30	70	100
6	PC	23APC0106	Surveying Lab	0	0	3	1.5	30	70	100
7	PC	23APC0107	Strength of Materials Lab	0	0	3	1.5	30	70	100
8	SC	23ASC0101	Building Planning and Drawing	0	1	2	2	30	70	100
Total Credits				**10**	**06**	**08**	**20**	**240**	**560**	**800**

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI

(Autonomous)

(Effective for the students admitted into I year from the AY 2023-24 onwards & LE from 2024-25 onwards)

B.Tech. – II Year II Semester

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits	Scheme of Examination (Max. Marks)		
				L	T/CL C	P	C	CIE	SEE	Total
1	HM	23AHMMB01	Managerial Economics and Financial Analysis	2	0	0	2	30	70	100
2	PC	23APC0108	Engineering Geology	2	1	0	3	30	70	100
3	PC	23APC0109	Concrete Technology	2	1	0	3	30	70	100
4	PC	23APC0110	Structural Analysis	2	1	0	3	30	70	100
5	PC	23APC0111	Hydraulics &Hydraulic Machinery	2	1	0	3	30	70	100
6	PC	23APC0112	Concrete Technology Lab	0	0	3	1.5	30	70	100
7	PC	23APC0113	Engineering Geology lab	0	0	3	1.5	30	70	100
8	SC	23ASC9901	Soft Skills	0	1	2	2	30	70	100
9	ES	23AES0304	Design Thinking & Innovation	1	0	2	2	30	70	100
10	MC	23AMC9901	Environmental Science	2	0	0	-	30	-	30
Total Credits				**13**	**05**	**10**	**21**	**300**	**630**	**930**
Mandatory Community Service Project Internship of 08 weeks duration during summer vacation										

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI

(Autonomous)

(Effective for the students admitted into I year from the AY 2023-24 onwards & LE from 2024-25 onwards)

B.Tech. – III Year I Semester

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits	Scheme of Examination (Max. Marks)		
				L	T/CLC	P	C	CIE	SEE	Total
1	PC	23APC0114	Water Resources Engineering	2	1	0	3	30	70	100
2	PC	23APC0115	Design Of Reinforced Concrete Structures	2	1	0	3	30	70	100
3	PC	23APC0116	Geotechnical Engineering	2	1	0	3	30	70	100
4	ES	23AES0504	Introduction to Quantum Technology & Applications	2	1	0	3	30	70	100
5	PE	23APE0101	Cost Effective Housing Techniques	2	1	0	3	30	70	100
	PE	23APE0102	Experimental Stress Analysis							
	PE	23APE0103	Environmental Impact Assessment							
6	OE		Open Elective – I	2	1	0	3	25	75	100
7	PC	23APC0117	Geotechnical Engineering Lab	0	0	3	1.5	30	70	100
8	PC	23APC0118	Fluid Mechanics Hydraulic Machines Lab	0	0	3	1.5	30	70	100
9	SC	23ASC0102	**Skill oriented course** Estimation, Specifications, Costing & Valuation	0	1	2	2	30	70	100
10	ES	23AES0404	Tinkering Lab	0	0	2	1	30	70	100
11	CSP	23APR0101	Evaluation of Community Service Project	-	-	-	2	100	-	100
Total Credits				**12**	**7**	**10**	**26**	**395**	**705**	**1100**

OPEN ELECTIVE – I

S.No.	Course Code	Course Name	Offered by the Dept.
1	23AOE0201	Electrical Safety Practices and Standards	EEE
2	23AOE0301	Sustainable Energy Technologies	ME
3	23AOE0401	Electronic Circuits	ECE
4	23AOE0501	Java Programming	CSE & ALLIED IT
5	23AOE0502	Introduction to Artificial Intelligence	
6	23AOE0503	Quantum Technologies and Applications	
7	23AOE9901	Mathematics for Machine Learning and AI	MATHEMATICS
8	23AOE9906	Materials Characterization Techniques	PHYSICS
9	23AOE9911	Chemistry of Energy Systems	CHEMISTRY
10	23AOE9915	English for Competitive Examinations	HUMANITIES
11	23AOEMB01	Entrepreneurship and New Venture Creation	

Note:

1. A student is permitted to register for Honors or a Minor in IV semester after the results of III Semester are declared and students may be allowed to take maximum two subjects per semester pertaining to their Minor from V Semester onwards.
2. A student shall not be permitted to take courses as Open Electives/Minor/Honors with content substantially equivalent to the courses pursued in the student's primary major.
3. A student is permitted to select a Minor program only if the institution is already offering a Major degree program in that discipline.

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI

(Autonomous)

(Effective for the students admitted into I year from the AY 2023-24 onwards & LE from 2024-25 onwards)

B.Tech. – III Year II Semester

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits	Scheme of Examination (Max. Marks)		
				L	T/CLC	P	C	CIE	SEE	Total
1	PC	23APC0119	Design of Steel Structures	2	1	0	3	30	70	100
2	PC	23APC0120	Highway Engineering	2	1	0	3	30	70	100
3	PC	23APC0121	Environmental Engineering	2	1	0	3	30	70	100
4	PE	23APE0104	Design of Earthquake Resistant Structures	2	1	0	3	30	70	100
	PE	23APE0105	Open Channel Flow							
	PE	23APE0106	Foundation Engineering							
5	PE	23APE0107	Air Pollution & Control	2	1	0	3	30	70	100
	PE	23APE0108	Watershed Management							
	PE	23APE0109	Advanced Structural Analysis							
6	OE		Open Elective-II	2	1	0	3	25	75	100
7	PC	23APC0122	Highway Engineering Lab	0	0	3	1.5	30	70	100
8	PC	23APC0123	Environmental Engineering Lab	0	0	3	1.5	30	70	100
9	SC	23ASC0103	**Skill oriented course** Building Information Modelling	0	1	2	2	30	70	100
10	MC	23AMC9902	**Mandatory Non Credit course** Technical paper writing & IPR	2	0	0	-	30	-	30
11	SC	23ASC0104	**Workshop**	0	0	0	-	-	-	-
Total Credits				**14**	**7**	**8**	**23**	**295**	**635**	**930**

Note: Workshop can be conducted either III-I or III-II and participation certificate with 90% and above attendance on it shall be submit to department/ Exam Branch before 3-2 regular examination notification is released

OPEN ELECTIVE – II

S.No.	Course Code	Course Name	Offered by the Dept.
1	23AOE0202	Renewable Energy Sources	EEE
2	23APE0322	Automation and Robotics	ME
3	23AOE0402	Digital Electronics	ECE
4	23AOE0504	Operating Systems	CSE & ALLIED? IT
5	23AOE0505	Machine Learning	
6	23AOE9902	Advanced Operation Research	MATHEMATICS
7	23AOE9903	Mathematical Foundation of Quantum Technologies	
8	23AOE9907	Physics Of Electronic Materials And Devices	PHYSICS
9	23AOE9912	Chemistry Of Polymers And Applications	CHEMISTRY
10	23AOE9916	Academic Writing and Public Speaking	HUMANITIES

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI

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(Effective for the students admitted into I year from the AY 2023-24 onwards & LE from 2024-25 onwards)

B.Tech. – IV Year I Semester (Tentative)

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits	Scheme of Examination (Max. Marks)		
				L	T/CLC	P	C	CIE	SEE	Total
1	PC	23APC0124	Finite Element Methods	2	1	0	3	30	70	100
2	HM	23AHMMB02	Business Ethics and Corporate Governance	2	0	0	2	30	70	100
	HM	23AHMMB03	E-Business							
	HM	23AHMMB04	Management Science							
3	PE	23APE0110	Geo-synthetics and Reinforced Earth Structures	2	1	0	3	30	70	100
	PE	23APE0111	Railways, Airports, Docks and Harbour Engineering							
	PE	23APE0112	Prestressed Concrete							
4	PE	23APE0113	Ground Improvement Techniques	2	1	0	3	30	70	100
	PE	23APE0114	Subsurface Investigation and Instrumentation							
	PE	23APE0115	Transportation Economics							
5	OE		Open Elective-III	2	1	0	3	30	70	100
6	OE		Open Elective-IV	2	1	0	3	30	70	100
7	SC	23ASC0104	**Skill oriented course** Skills in Civil Engineering software (STAADPRO/CAD/TEKL)	0	1	2	2	100	-	100
8	AC	23AMC9903	**Audit Course** Gender Sensitization	2	0	0	-	30	-	30
9	PR	23APR0102	Evaluation of Industry Internship (Short Term)	-	-	-	2	100	-	100
Total Credits				**14**	**6**	**2**	**21**	**410**	**420**	**830**

OPEN ELECTIVE – III

S.No.	Course Code	Course Name	Offered by the Dept.
1	23AOE0203	Smart Grid Technologies	EEE
2	23AOE0303	3D Printing Technologies	ME
3	23APC0412	Microprocessors and Microcontrollers	ECE
4	23AOE0506	Data Base Management Systems	CSE & ALLIED? IT
5	23AOE0507	Cyber Security	
6	23AOE9904	Wavelet transforms and its Applications	MATHEMATICS
7	23AOE9908	Smart Materials And Devices	PHYSICS
8	23AOE9909	Introduction to Quantum Mechanics	
9	23AOE9913	Green Chemistry And Catalysis For Sustainable Environment	CHEMISTRY
10	23AOE9917	Employability Skills	HUMANITIES

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI

(Autonomous)

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OPEN ELECTIVE – IV

S.No.	Course Code	Course Name	Offered by the Dept.
1	23AOE0204	Electric Vehicles	EEE
2	23AOE0304	Total Quality Management	ME
3	23AOE0403	Transducers and Sensors	ECE
4	23AOE0508	Computer Networks	CSE & ALLIED? IT
5	23AOE0509	Internet of Things	
6	23AOE0510	Quantum Computing	
7	23AOE9905	Financial Mathematics	MATHEMATICS
8	23AOE9910	Sensors And Actuators For Engineering Applications	PHYSICS
9	23AOE9914	Chemistry of Nanomaterials and Applications	CHEMISTRY
10	23AOE9918	Literary Vibes	HUMANITIES

OPEN ELECTIVE FROM CIVIL

S.No.	Course Code	Course Name	Offered by the Dept.
1	23AOE0101	GREEN BUILDINGS	CIVIL
2	23AOE0102	CONSTRUCTION TECHNOLOGY AND MANAGEMENT	CIVIL
3	23AOE0103	DISASTER MANAGEMENT	CIVIL
4	23A0E0104	SUSTAINABILITY IN ENGINEERING PRACTICES	CIVIL
5	23A0E0105	BUILDING MATERIALS AND SERVICES	CIVIL
6	23APE0103	ENVIRONMENTAL IMPACT ASSESSMENT	CIVIL
7	23AOE0106	GEO-SPATIAL TECHNOLOGIES	CIVIL
8	23AOE0107	SOLID WASTE MANAGEMENT	CIVIL

B.Tech. – IV Year II Semester

Sl. No.	Course Code	Course Title	Hours per week			Credits	Scheme of Examination (Max. Marks)		
			L	T	P	C	CIE	SEE	Total
1	23APR0103	Industry Internship (Long Term)	0	0	0	4	100	-	100
2	23APR0104	Project	0	0	0	8	60	140	200
Total Credits						12	160	140	300

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI

(Autonomous)

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B. Tech with Honors and Minor Degree Program

Eligibility for registrations for Honors and Minor degree program:

- Student should have pass first three semesters with average CGPA of 7.0 without any backlogs in between semester will be considered in the end of IV semester and will be registered.
- Minor Degree 18 credits can be obtained by passing courses listed by the department for 15 credits and a minor project weighing 3 credits

COURSES OFFERED FOR HONORS DEGREE IN CIVIL ENGINEERING

S.No	Course Code	Course Title	Contact Hours per week			Credits
			L	T/CLC	P	
1	23AHN0101	Soil Dynamics and Machine Foundation	2	1	0	3
2	23AHN0102	Industrial Waste and Waste Water Management	2	1	0	3
3	23AHN0103	Repair & Rehabilitation of Structures	2	1	0	3
4	23AHN0104	Design and Drawing of Irrigation Structures	2	1	0	3
5	23AHN0105	Road Safety Engineering	2	1	0	3
6	23AHN0106	NDT Lab	0	0	3	1.5
7	23AHN0107	ETABS/SAP Lab	0	0	3	1.5
Total Credits						**18**

MINOR DEGREE IN CONSTRUCTION MATERIALS TECHNOLOGY TO EEE, ME, ECE, CSE, CSD, CIC, AIDS, AIML BRANCHES OFFERED BY CIVIL ENGINEERING

S.No.	Code	Course Name	Contact Hours per week			Credits
			L	T/CLC	P	
1	23AMN0101	Concrete Technology	2	1	0	3
2	23AMN0102	Basic Construction Materials	2	1	0	3
3	23AMN0103	Modern Construction Materials	2	1	0	3
4	23AMN0104	Building Materials and Composites	2	1	0	3
5	23AMN0105	Development and Applications of Special Concrete	2	1	0	3
6	23AMN0106	Advanced Concrete Technology	2	1	0	3
7	23AMN0107	Maintenance and Repair of Concrete Structures	2	1	0	3
8	23AMN0108	Admixtures and Special Concrete	2	1	0	3
9	23AMN0109	Mini Project	0	0	3	3
Maximum Credits						**18**

- From S.No 1 & 2 Courses are mandatory to obtain 6 credits, from S.No 3 to 8, student can pass any 3 courses to obtain 9 Credits and S.No 9 Mini Project is compulsory to obtain 3 credits

INDUCTION PROGRAMME

S.No	Course Name	Category	L-T-P-C
1	Physical Activities -- Sports, Yoga and Meditation, Plantation	MC	0-0-6-0
2	Career Counseling	MC	2-0-2-0
3	Orientation to all branches -- career options, tools, etc.	MC	3-0-0-0
4	Orientation on admitted Branch -- corresponding labs, tools and platforms	EC	2-0-3-0
5	Proficiency Modules & Productivity Tools	ES	2-1-2-0
6	Assessment on basic aptitude and mathematical skills	MC	2-0-3-0
7	Remedial Training in Foundation Courses	MC	2-1-2-0
8	Human Values & Professional Ethics	MC	3-0-0-0
9	Communication Skills -- focus on Listening, Speaking, Reading, Writing skills	BS	2-1-2-0
10	Concepts of Programming	ES	2-0-2-0

B.Tech. – I Year I Semester

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits	Scheme of Examination (Max. Marks)		
				L	T/CLC	P	C	CIE	SEE	Total
1	BS	23ABS9903	Engineering Physics	2	1	0	3	30	70	100
2	BS	23ABS9904	Linear Algebra & Calculus	2	1	0	3	30	70	100
3	ES	23AES0201	Basic Electrical & Electronics Engineering	2	1	0	3	30	70	100
4	ES	23AES0301	Engineering Graphics	1	0	4	3	30	70	100
5	ES	23AES0501	Introduction to Programming	2	1	0	3	30	70	100
6	ES	23AES0503	IT Workshop	0	0	2	1	30	70	100
7	BS	23ABS9908	Engineering Physics Lab	0	0	2	1	30	70	100
8	ES	23AES0202	Electrical & Electronics Engineering Workshop	0	0	3	1.5	30	70	100
9	ES	23AES0502	Computer Programming Lab	0	0	3	1.5	30	70	10
10	HM	23AHM9904	NSS/NCC/Scouts & Guides/Community Service	-	-	1	0.5	50	-	50
Total Credits				**9**	**4**	**15**	**20.5**	**320**	**630**	**950**

B.Tech. – I Year II Semester

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits	Scheme of Examination (Max. Marks)		
				L	T/CLC	P	C	CIE	SEE	Total
1	HM	23AHM9901	Communicative English	2	0	0	2	30	70	100
2	BS	23ABS9902	Engineering Chemistry	2	1	0	3	30	70	100
3	BS	23ABS9905	Differential Equations &Vector Calculus	2	1	0	3	30	70	100
4	ES	23AES0101	Basic Civil& Mechanical Engineering	2	1	0	3	30	70	100
5	PC	23APC0101	Engineering Mechanics	2	1	0	3	30	70	100
6	HM	23AHM9902	Communicative English Lab	0	0	2	1	30	70	100
7	BS	23ABS9907	Engineering Chemistry Lab	0	0	2	1	30	70	100
8	ES	23AES0302	Engineering Workshop	0	0	3	1.5	30	70	100
9	PC	23APC0102	Engineering Mechanics & Building Practices Lab	0	0	3	1.5	30	70	100
10	HM	23AHM9903	Health and wellness, Yoga and Sports	-	-	1	0.5	50	-	50
Total Credits				**10**	**4**	**11**	**19.5**	**320**	**630**	**950**

B.Tech. – II Year I Semester

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits	Scheme of Examination (Max. Marks)		
				L	T/CLC	P	C	CIE	SEE	Total
1	BS	23ABS9909	Numerical and Statistical Methods	2	1	0	3	30	70	100
2	HM	23AHM9905	Universal Human Values–Understanding Harmony and Ethical Human Conduct	2	1	0	3	30	70	100
3	PC	23APC0103	Surveying	2	1	0	3	30	70	100
4	PC	23APC0104	Strength of Materials	2	1	0	3	30	70	100
5	PC	23APC0105	Fluid Mechanics	2	1	0	3	30	70	100
6	PC	23APC0106	Surveying Lab	0	0	3	1.5	30	70	100
7	PC	23APC0107	Strength of Materials Lab	0	0	3	1.5	30	70	100
8	SC	23ASC0101	Building Planning and Drawing	0	1	2	2	30	70	100
Total Credits				**10**	**06**	**08**	**20**	**240**	**560**	**800**

B.Tech. – II Year II Semester

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits	Scheme of Examination (Max. Marks)		
				L	T/CLC	P	C	CIE	SEE	Total
1	HM	23AHMMB01	Managerial Economics and Financial Analysis	2	0	0	2	30	70	100
2	PC	23APC0108	Engineering Geology	2	1	0	3	30	70	100
3	PC	23APC0109	Concrete Technology	2	1	0	3	30	70	100
4	PC	23APC0110	Structural Analysis	2	1	0	3	30	70	100
5	PC	23APC0111	Hydraulics &Hydraulic Machinery	2	1	0	3	30	70	100
6	PC	23APC0112	Concrete Technology Lab	0	0	3	1.5	30	70	100
7	PC	23APC0113	Engineering Geology lab	0	0	3	1.5	30	70	100
8	SC	23ASC9901	Soft Skills	0	1	2	2	30	70	100
9	ES	23AES0304	Design Thinking & Innovation	1	0	2	2	30	70	100
10	MC	23AMC9901	Environmental Science	2	0	0	-	30	-	30
Total Credits				**13**	**05**	**10**	**21**	**300**	**630**	**930**
Mandatory Community Service Project Internship of 08 weeks duration during summer vacation										

B.Tech. – III Year I Semester

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits	Scheme of Examination (Max. Marks)		
				L	T/CLC	P	C	CIE	SEE	Total
1	PC	23APC0114	Water Resources Engineering	2	1	0	3	30	70	100
2	PC	23APC0115	Design Of Reinforced Concrete Structures	2	1	0	3	30	70	100
3	PC	23APC0116	Geotechnical Engineering	2	1	0	3	30	70	100
4	ES	23AES0504	Introduction to Quantum Technology & Applications	2	1	0	3	30	70	100
5	PE	23APE0101	Cost Effective Housing Techniques	2	1	0	3	30	70	100
	PE	23APE0102	Experimental Stress Analysis							
	PE	23APE0103	Environmental Impact Assessment							
6	OE		Open Elective – I	2	1	0	3	25	75	100
7	PC	23APC0117	Geotechnical Engineering Lab	0	0	3	1.5	30	70	100
8	PC	23APC0118	Fluid Mechanics Hydraulic Machines Lab	0	0	3	1.5	30	70	100
9	SC	23ASC0102	**Skill oriented course** Estimation, Specifications, Costing & Valuation	0	1	2	2	30	70	100
10	ES	23AES0404	Tinkering Lab	0	0	2	1	30	70	100
11	CSP	23APR0101	Evaluation of Community Service Project	-	-	-	2	100	-	100
Total Credits				**12**	**07**	**10**	**26**	**395**	**705**	**1100**

OPEN ELECTIVE – I

S.No.	Course Code	Course Name	Offered by the Dept.
1	23AOE0201	Electrical Safety Practices and Standards	EEE
2	23AOE0301	Sustainable Energy Technologies	ME
3	23AOE0401	Electronic Circuits	ECE
4	23AOE0501	Java Programming	CSE & ALLIED IT
5	23AOE0502	Introduction to Artificial Intelligence	
6	23AOE0503	Quantum Technologies and Applications	
7	23AOE9901	Mathematics for Machine Learning and AI	MATHEMATICS
8	23AOE9906	Materials Characterization Techniques	PHYSICS
9	23AOE9911	Chemistry of Energy Systems	CHEMISTRY
10	23AOE9915	English for Competitive Examinations	HUMANITIES
11	23AOEMB01	Entrepreneurship and New Venture Creation	

Note:

1. A student is permitted to register for Honors or a Minor in IV semester after the results of III Semester are declared and students may be allowed to take maximum two subjects per semester pertaining to their Minor from V Semester onwards.
2. A student shall not be permitted to take courses as Open Electives/Minor/Honors with content substantially equivalent to the courses pursued in the student's primary major.
3. A student is permitted to select a Minor program only if the institution is already offering a Major degree program in that discipline.

B.Tech. – III Year II Semester

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits	Scheme of Examination (Max. Marks)		
				L	T/CLC	P	C	CIE	SEE	Total
1	PC	23APC0119	Design of Steel Structures	2	1	0	3	30	70	100
2	PC	23APC0120	Highway Engineering	2	1	0	3	30	70	100
3	PC	23APC0121	Environmental Engineering	2	1	0	3	30	70	100
4	PE	23APE0104	Design of Earthquake Resistant Structures	2	1	0	3	30	70	100
	PE	23APE0105	Open Channel Flow							
	PE	23APE0106	Foundation Engineering							
5	PE	23APE0107	Air Pollution & Control	2	1	0	3	30	70	100
	PE	23APE0108	Watershed Management							
	PE	23APE0109	Advanced Structural Analysis							
6	OE		Open Elective-II	2	1	0	3	25	75	100
7	PC	23APC0122	Highway Engineering Lab	0	0	3	1.5	30	70	100
8	PC	23APC0123	Environmental Engineering Lab	0	0	3	1.5	30	70	100
9	SC	23ASC0103	**Skill oriented course** Building Information Modelling	0	1	2	2	30	70	100
10	MC	23AMC9902	**Mandatory Non Credit course** Technical paper writing & IPR	2	0	0	-	30	-	30
11	SC	23ASC0104	**Workshop**	0	0	0	-	-	-	-
Total Credits				**14**	**07**	**8**	**23**	**295**	**635**	**930**

Note: Workshop can be conducted either III-I or III-II and participation certificate with 90% and above attendance on it shall be submit to department/ Exam Branch before 3-2 regular examination notification is released

OPEN ELECTIVE – II

S.No.	Course Code	Course Name	Offered by the Dept.
1	23AOE0202	Renewable Energy Sources	EEE
2	23APE0322	Automation and Robotics	ME
3	23AOE0402	Digital Electronics	ECE
4	23AOE0504	Operating Systems	CSE & ALLIED? IT
5	23AOE0505	Machine Learning	
6	23AOE9902	Advanced Operation Research	MATHEMATICS
7	23AOE9903	Mathematical Foundation of Quantum Technologies	
8	23AOE9907	Physics Of Electronic Materials And Devices	PHYSICS
9	23AOE9912	Chemistry Of Polymers And Applications	CHEMISTRY
10	23AOE9916	Academic Writing and Public Speaking	HUMANITIES

B.Tech. – IV Year I Semester (Tentative)

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits	Scheme of Examination (Max. Marks)		
				L	T/CLC	P	C	CIE	SEE	Total
1	PC	23APC0124	Finite Element Methods	2	1	0	3	30	70	100
2	HM	23AHMMB02	Business Ethics and Corporate Governance	2	0	0	2	30	70	100
	HM	23AHMMB03	E-Business							
	HM	23AHMMB04	Management Science							
3	PE	23APE0110	Geo-synthetics and Reinforced Earth Structures	2	1	0	3	30	70	100
	PE	23APE0111	Railways, Airports, Docks and Harbour Engineering							
	PE	23APE0112	Prestressed Concrete							
4	PE	23APE0113	Ground Improvement Techniques	2	1	0	3	30	70	100
	PE	23APE0114	Subsurface Investigation and Instrumentation							
	PE	23APE0115	Transportation Economics							
5	OE		Open Elective-III	2	1	0	3	30	70	100
6	OE		Open Elective-IV	2	1	0	3	30	70	100
7	SC	23ASC0104	**Skill oriented course** Skills in Civil Engineering software (STAADPRO/CAD/TEKL)	0	1	2	2	30	70	100
8	AMC	23AMC9903	**Audit Course** Gender Sensitization	2	0	0	-	30	-	30
9	PR	23APR0102	Evaluation of Industry Internship (Short Term)	-	-	-	2	100	-	100
Total Credits				**14**	**06**	**02**	**21**	**340**	**490**	**830**

OPEN ELECTIVE – III

S.No.	Course Code	Course Name	Offered by the Dept.
1	23AOE0203	Smart Grid Technologies	EEE
2	23AOE0303	3D Printing Technologies	ME
3	23APC0412	Microprocessors and Microcontrollers	ECE
4	23AOE0506	Data Base Management Systems	CSE & ALLIED? IT
5	23AOE0507	Cyber Security	
6	23AOE9904	Wavelet transforms and its Applications	MATHEMATICS
7	23AOE9908	Smart Materials And Devices	PHYSICS
8	23AOE9909	Introduction to Quantum Mechanics	
9	23AOE9913	Green Chemistry And Catalysis For Sustainable Environment	CHEMISTRY
10	23AOE9917	Employability Skills	HUMANITIES

OPEN ELECTIVE – IV

S.No.	Course Code	Course Name	Offered by the Dept.
1	23AOE0204	Electric Vehicles	EEE
2	23AOE0304	Total Quality Management	ME
3	23AOE0403	Transducers and Sensors	ECE
4	23AOE0508	Computer Networks	CSE & ALLIED? IT
5	23AOE0509	Internet of Things	
6	23AOE0510	Quantum Computing	
7	23AOE9905	Financial Mathematics	MATHEMATICS
8	23AOE9910	Sensors And Actuators For Engineering Applications	PHYSICS
9	23AOE9914	Chemistry Of Nanomaterials and Applications	CHEMISTRY
10	23AOE9918	Literary Vibes	HUMANITIES

OPEN ELECTIVE FROM CIVIL

S.No.	Course Code	Course Name	Offered by the Dept.
1	23AOE0101	GREEN BUILDINGS	CIVIL
2	23AOE0102	CONSTRUCTION TECHNOLOGY AND MANAGEMENT	CIVIL
3	23AOE0103	DISASTER MANAGEMENT	CIVIL
4	23A0E0104	SUSTAINABILITY IN ENGINEERING PRACTICES	CIVIL
5	23A0E0105	BUILDING MATERIALS AND SERVICES	CIVIL
6	23APE0103	ENVIRONMENTAL IMPACT ASSESSMENT	CIVIL
7	23AOE0106	GEO-SPATIAL TECHNOLOGIES	CIVIL
8	23AOE0107	SOLID WASTE MANAGEMENT	CIVIL

B.Tech. – IV Year II Semester (Tentative)

Sl. No.	Course Code	Course Title	Hours per week			Credits	Scheme of Examination (Max. Marks)		
			L	T/CLC	P	C	CIE	SEE	Total
1	23APR0103	Industry Internship (Long Term)	0	0	0	4	100	-	100
2	23APR0104	Project	0	0	0	8	60	140	200
Total Credits			0	0	0	12	160	140	300

B.Tech with Honors and Minor Degree Program

Eligibility for registrations for Honors and Minor degree program:

- Student should have pass first three semesters with average CGPA of 7.0 without any backlogs in between semester will be considered in the end of IV semester and will be registered.
- Minor Degree 18 credits can be obtained by passing courses listed by the department for 15 credits and a minor project weighing 3 credits

COURSES OFFERED FOR HONORS DEGREE IN CIVIL ENGINEERING

S.No	Course Code	Course Title	Contact Hours per week			Credits
			L	T/CLC	P	
1	23AHN0101	Soil Dynamics and Machine Foundation	2	1	0	3
2	23AHN0102	Industrial Waste and Waste Water Management	2	1	0	3
3	23AHN0103	Repair & Rehabilitation of Structures	2	1	0	3
4	23AHN0104	Design and Drawing of Irrigation Structures	2	1	0	3
5	23AHN0105	Road Safety Engineering	2	1	0	3
6	23AHN0106	NDT Lab	0	0	3	1.5
7	23AHN0107	ETABS/SAP Lab	0	0	3	1.5
Total Credits						**18**

MINOR DEGREE IN CONSTRUCTION MATERIALS TECHNOLOGY TO EEE, ME, ECE, CSE, CSD, CIC, AIDS, AIML BRANCHES OFFERED BY CIVIL ENGINEERING

S.No.	Code	Course Name	Contact Hours per week			Credits
			L	T/CLC	P	
1	23AMN0101	Concrete Technology	2	1	0	3
2	23AMN0102	Basic Construction Materials	2	1	0	3
3	23AMN0103	Modern Construction Materials	2	1	0	3
4	23AMN0104	Building Materials and Composites	2	1	0	3
5	23AMN0105	Development and Applications of Special Concrete	2	1	0	3
6	23AMN0106	Advanced Concrete Technology	2	1	0	3
7	23AMN0107	Maintenance and Repair of Concrete Structures	2	1	0	3
8	23AMN0108	Admixtures and Special Concrete	2	1	0	3
9	23AMN0109	Mini Project	0	0	3	3
Maximum Credits						**18**

- From S.No 1 & 2 Courses are mandatory to obtain 6 credits, from S.No 3 to 8, student can pass any 3 courses to obtain 9 credits and S.No 9 Mini Project is compulsory to obtain 3 credits

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI (Autonomous)

(Effective for the students admitted into I year from the AY 2023-24 onwards & LE from 2024-25 onwards)

B.Tech. – I Year I Semester

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits	Scheme of Examination (Max. Marks)		
				L	T/CLC	P	C	CIE	SEE	Total
1	BS	23ABS9903	Engineering Physics	2	1	0	3	30	70	100
2	BS	23ABS9904	Linear Algebra & Calculus	2	1	0	3	30	70	100
3	ES	23AES0201	Basic Electrical & Electronics Engineering	2	1	0	3	30	70	100
4	ES	23AES0301	Engineering Graphics	1	0	4	3	30	70	100
5	ES	23AES0501	Introduction to Programming	2	1	0	3	30	70	100
6	ES	23AES0503	IT Workshop	0	0	2	1	30	70	100
7	BS	23ABS9908	Engineering Physics Lab	0	0	2	1	30	70	100
8	ES	23AES0202	Electrical & Electronics Engineering Workshop	0	0	3	1.5	30	70	100
9	ES	23AES0502	Computer Programming Lab	0	0	3	1.5	30	70	10
10	HM	23AHM9904	NSS/NCC/Scouts & Guides/Community Service	-	-	1	0.5	50	-	50
Total Credits				**9**	**4**	**15**	**20.5**	**320**	**630**	**950**

I YEAR I SEMESTER

Subject Code	Subject Name	L	T/CLC	P	CREDITS
23ABS9903	ENGINEERING PHYSICS	2	1	0	3

Course Outcomes: After studying the course, students will be able to

CO1	Understand the intensity variation of light due to interference, diffraction, and polarization
CO2	Analyze the fundamentals of crystallography and X-ray diffraction.
CO3	Apply the basic concepts of dielectric and magnetic materials for engineering applications.
CO4	Analyze the fundamentals of Quantum mechanics and interpret the nanomaterials for engineering problems.
CO5	Analyze the charge carrier dynamics in semiconductors by implementing the equations of state.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Understand	The intensity variation of light due to interference, diffraction, and polarization.			L2
2	Analyze	The fundamentals of crystallography and Xray diffraction.			L4
3	Apply	The basic concepts of dielectric and magnetic materials		for engineering applications	L3
4	Analyze	The fundamentals of Quantum mechanics and interpret the nanomaterials		or engineering problems	L4
5	Analyze	The charge carrier dynamics in semiconductors.	By implementing the equations of state.		L4

UNIT-I (WAVE OPTICS)

Interference: Introduction - Principle of superposition –Interference of light - Interference in thin films (Reflection Geometry) & applications - Newton's Rings, Determination of wavelength and refractive index.

Diffraction: Introduction - Fresnel and Fraunhofer diffractions - Fraunhofer diffraction due to single slit, double slit (Qualitative) – Diffraction Grating.

Polarization: Introduction -Types of polarization - Polarization by reflection, refraction and Double refraction - Nicol's Prism -Half wave and Quarter wave plates.

UNIT-II (CRYSTALLOGRAPHY AND X – RAY DIFFRACTION)

Crystallography: Space lattice, Basis, Unit Cell and lattice parameters – Bravais Lattices – crystal systems (3D) – coordination number - packing fraction of SC, BCC & FCC - Miller indices – separation between successive (hkl) planes.

X-ray diffraction: Bragg's law - X-ray Diffractometer – crystal structure determination byLaue's and powder methods.

UNIT-III (DIELECTRIC AND MAGNETIC MATERIALS)

Dielectric Materials: Introduction - Dielectric polarization - Dielectric polarizability, Susceptibility, Dielectric constant and Displacement Vector – Relation between the electric vectors - Types of polarizations- Electronic (Quantitative), Ionic (Quantitative) and Orientation polarizations (Qualitative) - Lorentz internal field - Clausius- Mossotti equation - Frequency dependence of polarization Applications of Dielectric materials.

Magnetic Materials: Introduction - Magnetic dipole moment - Magnetization-Magnetic susceptibility and permeability – Atomic origin of magnetism - Classification of magnetic materials: Dia, para, Ferro, anti-ferro & Ferri magnetic materials - Domain concept for Ferromagnetism & Domain walls (Qualitative) - Hysteresis - soft and hard magnetic materials - Applications of magnetic materials.

UNIT-IV (QUANTUM MECHANICS AND NANOMATERIALS)

Quantum Mechanics: Dual nature of matter – Heisenberg's Uncertainty Principle – Significance and properties of wave function – Schrodinger's time independent and dependent wave equations– Particle in a one-dimensional infinite potential well.

Nanomaterials: Introduction to Nanomaterials–Significance of nanoscale - Physical, Mechanical, Magnetic, and optical properties of nanomaterials –Synthesis of nanomaterials: Ball Milling, Applications of Nanomaterials.

UNIT-V (SEMICONDUCTORS)

Semiconductors: Formation of energy bands – classification of crystalline solids - Intrinsic semiconductors: Density of charge carriers – Electrical conductivity – Fermi level – Extrinsic semiconductors: density of charge carriers – dependence of Fermi energy on carrier concentration and temperature - Drift and diffusion currents – Einstein's equation – Hall effect and its applications – Applications of semiconductors.

TEXTBOOKS:

1. A Text book of Engineering Physics, M. N. Avadhanulu, P.G. Kshirsagar & TVS Arun Murthy, S. Chand Publications, 11th Edition 2019.
2. K.Thyagarajan "Engineering Physics",-Mc Graw Hill Publishing Company Ltd, 2016.
3. Engineering Physics - D.K.Bhattacharya and Poonam Tandon, Oxford press (2015)

REFERENCES:

1. Engineering Physics - B.K. Pandey and S. Chaturvedi, Cengage Learning 2021.
2. Engineering Physics - Shatendra Sharma, Jyotsna Sharma, Pearson Education, 2018.
3. Engineering Physics" - Sanjay D. Jain, D. Sahasrabudhe and Girish, University Press.2010
4. Engineering Physics - M.R. Srinivasan, New Age international publishers (2009).

WEB RESOURCES:

1. https://www.loc.gov/rr/scitech/selected-internet/physics.html

CORRELATION OF COS WITH THE POS & PSOS:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3												
CO2	3												
CO3	3			3									
CO4	3												
CO5	3			3									

CO-PO MAPPING JUSTIFICATION:

Unit No	Course Outcomes					Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
	Lesson Plan Hrs	%	Correlation	CO's Action Verb	BTL			
1	**15**	**22.3**	**3**	**Understand**	L2	PO1	Apply (L3)	2
2	11	16.4	2	**Analyze**	L4	PO1	Apply (L3)	3
3	12	17.9	2	**Apply**	**L3**	PO1 PO4	Apply (L3) Apply (L3)	3 3
4	13	19.4	2	**Analyze**	**L4**	PO1	Apply (L3)	3
5	16	23.8	3	**Analyze**	L4	PO1 PO4	Apply (L3) Apply (L3)	3 3
	67							

JUSTIFICATION STATEMENTS:

CO1: The intensity variation of light due to interference, diffraction, and polarization.
Action Verb: Understand (L2)
PO1 Verbs: Apply (L3)
CO1 Action Verb is lesser than PO1 verb by one level; Therefore, correlation is moderate (2).

CO2: The fundamentals of crystallography.
Action Verb: Analyze (L4)
PO1 Verbs: Apply (L3)
CO2 Action Verb is greater than PO1 verb; Therefore, correlation is high (3).

CO3: Apply the basic concepts of dielectric and magnetic materials for engineering applications.
Action Verb: Apply (L3)
PO1 and PO4 Verbs: Apply (L3)
CO3 Action Verb level is equal to PO1 and PO4 verb; Therefore, correlation is high (3).

CO4: The fundamentals of Quantum mechanics and interpret the nanomaterials for engineering problems.
Action Verb: Analyze (L4)
PO1 Verb: Apply (L3)
CO4 Action Verb is greater than PO1 verb by one level; Therefore, correlation is high (3).

CO5: The charge carrier dynamics in semiconductors by implementing the equations of state.
Action Verb: Analyze (L4)
PO1 and PO4 Verb: Apply (L3)
CO5 Action verb is greater than PO1 verb; Therefore, the correlation is high (3).

I YEAR I SEMESTER

Subject Code	Subject Name	L	T/CLC	P	CREDITS
23ABS9904	Linear Algebra and Calculus	2	1	0	3

Course Outcomes: After studying the course, students will be able to

CO1	Analyze the matrix algebraic techniques for engineering applications.
CO2	Understand the concept of Eigen values, Eigen vectors and quadratic forms.
CO3	Analyze the mean value theorems for real time applications.
CO4	Apply the concepts of partial differentiation to functions of several variables.
CO5	Apply the multivariable integral calculus for computation of Area and Volume.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	**Analyze**	**the matrix algebraic techniques**	**For engineering applications.**		L4
2	**Understand**	**the concept of eigen values, eigen vectors and quadratic forms.**			L2
3	**Analyze**	**the mean value theorems**	**for real time applications.**		L4
4	**Apply**	**the concept of Maxima and Minima**	**to functions of several variables.**		L3
5	**Apply**	**the multivariable integral calculus**	**for computation of Area and volume.**		L3

UNIT-I (MATRICES)
Rank of a matrix by Echelon form, Normal form, Cauchy-Binet formula (without proof).Inverse of Non-singular matrices by Gauss-Jordan method, system of linear equations: solving system of Homogeneous and Nonhomogeneous equations by Gauss Elimination method, Jacobi and Gauss Seidel Iteration methods.
UNIT-II (EIGEN VALUES, EIGEN VECTORS AND ORTHOGONAL TRANSFORMATION)
Eigen values, Eigen vectors and their properties, Diagonalization of a matrix, Cayley-Hamilton theorem (without proof), finding inverse and power of a matrix by Cayley-Hamilton theorem, Quadratic forms and Nature of the Quadratic forms, Reduction of quadratic form to canonical forms by Orthogonal Transformation.
UNIT-III (CALCULUS)
Mean Value Theorems: Rolle's theorem, Lagrange's mean value theorem with their geometrical interpretation, Cauchy's mean value theorem, Taylor's and Maclaurin's theorems with remainders (without proof), problems and applications on the above theorems.
UNIT-IV (PARTIAL DIFFERENTIATION AND APPLICATIONS (MULTI VARIABLE CALCULUS))

Functions of several variables: Continuity and Differentiability, Partial derivatives, total derivatives, chain rule, Directional derivative, Taylor's and Maclaurin's series expansion of functions of two variables, Jacobians, Functional dependence, Maxima and Minima of functions of two variables, method of Lagrange multipliers.
UNIT-V (MULTIPLE INTEGRALS)
Double integrals, triple integrals change of order of integration, change of Variables to polar, Cylindrical and Spherical coordinates, Finding areas(by double integrals) and volumes (by double integrals and triple integrals).

TEXTBOOKS:

1. B. S. Grewal, Higher Engineering Mathematics, 44/e, Khanna Publishers, 2017.
2. 2. Erwin Kreyszig, Advanced Engineering Mathematics, 10/e, John Wiley & Sons, 2011

REFERENCES:

1. Thomas Calculus, George B. Thomas, Maurice D. Weir and Joel Hass, Pearson Publishers, 2018, 14th Edition.

2. Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Alpha Science International Ltd., 25th Edition (9th reprint).

3. Advanced Modern Engineering Mathematics, Glyn James, Pearson publishers, 2018, 5th Edition.

4. Advanced Engineering Mathematics, Micheael Greenberg, , Pearson publishers, 9th edition.

5. Higher Engineering Mathematics, H. K Das, Er. Rajnish Verma, S. Chand Publications,2014, Third Edition (Reprint 2021)

CORRELATION OF COS WITH THE POS & PSOS:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1		3											
CO2		2											
CO3		3											
CO4	3												
CO5	3												

CO-PO MAPPING JUSTIFICATION:

Unit No	Course Outcomes					Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
	Lesson Plan Hrs	%	Correlation	CO's Action Verb	BTL			
1	**10**	14	2	**Analyze**	**L4**	PO2	**Analyze**	3
2	**15**	21.4	3	**Understand**	**L2**	PO2	**Apply**	2
3	**15**	21.4	**3**	**Analyze**	**L4**	PO2	**Analyze**	3
4	**16**	22.8	**3**	**Apply**	**L3**	PO1	**Apply**	3
5	**14**	20	**3**	**Apply**	**L3**	PO1	**Apply**	3
	70							

JUSTIFICATION STATEMENTS:

CO1: Analyze the matrix algebraic techniques that are needed for engineering applications.
Action Verb: Analyze(L4)
PO2 Verbs: Analyze (L4)
CO1 Action Verb is equal toPO2 verb; Therefore, correlation is high (3).

CO2: Understand the concept of eigen values, eigen vectors and quadratic forms.
Action Verb: Understand (L2)
PO1 Verbs: Apply (L3)
CO2 Action Verb is low level to PO1 verb by one level; Therefore, correlation is moderate (2).

CO3: Analyze the mean value theorems for real life problems.
Action Verb: Analyze (L4)
PO1 Verb: Analyze (L4)
CO3 Action Verb level is equal to PO2 verb; Therefore, correlation is high (3).

CO4: Apply the concept of Maxima and Minima of functions of several variables.
Action Verb: Apply (L3)
PO2 Verb: Apply (L3)
CO4 Action Verb level is equal to PO1 verb; Therefore, correlation is high (3).

CO5: Apply the multivariable integral calculus for computation of area and volume.
Action Verb: Apply (L3)
PO1 Verb: Apply (L3)
CO5 Action verb is high level to PO1 verb; Therefore, the correlation is high (3).

I YEAR I SEMESTER

Subject Code	Subject Name	L	T/CLC	P	CREDITS
23AES0201	BASIC ELECTRICAL & ELECTRONICS ENGINEERING	2	1	0	3

Course Outcomes: After studying the course, students will be able to

CO1	Understand the fundamental laws of A. C circuits and D. C circuits.
CO2	Understand operating principles of motors, generators and measuring instruments.
CO3	Understand the fundamentals of power generation, costing and safety measures.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Understand	The fundamentals laws		of A. C circuits and D. C circuits	L2
2	Understand	Operating principles of motors, generators and measuring instruments.			L2
3	Understand	The fundamentals of Power generation, costing and safety measures.			L2

PART-A
BASIC ELECTRICAL ENGINEERING

UNIT-I (DC & AC CIRCUITS)

DC Circuits: Electrical circuit elements (R, L and C), Ohm's Law and its limitations, KCL & KVL, series, parallel, series-parallel circuits, Super Position theorem, Simple numerical problems.

AC Circuits: A.C. Fundamentals: Equation of AC Voltage and current, waveform, time period, frequency, amplitude, phase, phase difference, average value, RMS value, form factor, peak factor, Voltage and current relationship with phasor diagrams in R, L, and C circuits, Concept of Impedance, Active power, reactive power and apparent power, Concept of power factor (Simple Numerical problems)

UNIT-II (MACHINES AND MEASURING INSTRUMENTS)

Machines: Construction, principle and operation of (i) DC Motor, (ii) DC Generator, (iii) Single Phase Transformer, (iv) Three Phase Induction Motor and (v) Alternator, Applications of electrical machines.

Measuring Instruments: Construction and working principle of Permanent Magnet Moving Coil (PMMC), Moving Iron (MI) Instruments and Wheat Stone Bridge.

UNIT-III (ENERGY RESOURCES, ELECTRICITY BILL & SAFETY MEASURES)

Energy Resources: Conventional and non-conventional energy resources; Layout and operation of various Power Generation systems: Hydel, Nuclear, Solar & Wind power generation.

Electricity bill: Power rating of household appliances including air conditioners, PCs, Laptops, Printers, etc. Definition of "unit" used for consumption of electrical energy, two-part electricity tariff, calculation of electricity bill for domestic consumers.

Equipment Safety Measures: Working principle of Fuse and Miniature circuit breaker (MCB), merits and demerits. Personal safety measures: Electric Shock, Earthing and its types, Safety Precautions to avoid shock.

TEXTBOOKS:

1. Basic Electrical Engineering, D. C. Kulshreshtha, Tata McGraw Hill, 2019, First Edition
2. Power System Engineering, P.V. Gupta, M.L. Soni, U.S. Bhatnagar and A. Chakrabarti, Dhanpat Rai & Co, 2013.
3. Fundamentals of Electrical Engineering, Rajendra Prasad, PHI publishers, 2014, Third Edition

REFERENCES:

1. Basic Electrical Engineering, D. P. Kothari and I. J. Nagrath, Mc Graw Hill, 2019, Fourth Edition.
2. Principles of Power Systems, V.K. Mehtha, S. Chand Technical Publishers, 2020.
3. Basic Electrical Engineering, T. K. Nagsarkar and M. S. Sukhija, Oxford University Press, 2017.
4. Basic Electrical and Electronics Engineering, S. K. Bhatacharya, Person Publications, 2018, Second Edition.

WEB RESOURCES:

1. https://nptel.ac.in/courses/108105053
2. https://nptel.ac.in/courses/108108076

PART B
BASICS OF ELECTRONICS ENGINEERING

Course Outcomes: After studying the course, students will be able to

CO4	Understand the fundamental concepts of diodes, transistors and its applications.
CO5	Analyze the concepts of rectifiers, power supplies and amplifiers in electronics.
CO6	Analyze the concepts of Number Systems, Boolean Functions, Logic Gates and Digital Circuits.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
4	Understand	fundamental concepts of diodes, transistors and its applications			L2
5	Analyze	concepts of rectifiers, power supplies and amplifiers in electronics			L4
6	Analyze	concepts of Number Systems, Boolean Functions, Logic Gates and Digital Circuits			L4

UNIT-I (SEMICONDUCTOR DEVICES)
Introduction - Evolution of electronics – Vacuum tubes to nano electronics - Characteristics of PN Junction Diode — Zener Effect — Zener Diode and its Characteristics. Bipolar Junction Transistor — CB, CE, CC Configurations and Characteristics — Elementary Treatment of Small Signal CE Amp
UNIT-II (BASIC ELECTRONIC CIRCUITS AND INSTRUMENTTAION)
Rectifiers and power supplies: Block diagram description of a DC power supply, working of a full wave bridge rectifier, capacitor filter (no analysis), working of simple Zener voltage regulator. Amplifiers: Block diagram of Public Address system, Circuit diagram and working of common

emitter (RC coupled) amplifier with its frequency response. Electronic Instrumentation: Block diagram of an electronic instrumentation system.

UNIT-III (DIGITAL ELECTRONICS)

Overview of Number Systems, Logic gates including Universal Gates, BCD codes, Excess-3 code, Gray code, Hamming code. Boolean Algebra, Basic Theorems and properties of Boolean Algebra, Truth Tables and Functionality of Logic Gates – NOT, OR, AND, NOR, NAND, XOR and XNOR. Simple combinational circuits– Half and Full Adder, Introduction to sequential circuits, Flip flops, Registers and counters (Elementary Treatment only)

TEXTBOOKS:

1. R. L. Boylestad & Louis Nashlesky, Electronic Devices & Circuit Theory, Pearson Education, 2021.
2. R. P. Jain, Modern Digital Electronics, 4th Edition, Tata Mc Graw Hill, 2009

REFERENCES:

1. R. S. Sedha, A Textbook of Electronic Devices and Circuits, S. Chand & Co, 2010.
2. Santiram Kal, Basic Electronics- Devices, Circuits and IT Fundamentals, Prentice Hall, India, 2002.
3. R. T. Paynter, Introductory Electronic Devices & Circuits – Conventional Flow Version, Pearson Education, 2009.

CORRELATION OF COS WITH THE POS & PSOS:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2				1						2	
CO2	2	1				1						1	
CO3	2	1				2						1	2
CO4	2	3											
CO5	3	3											
CO6	3	3											

CO-PO MAPPING JUSTIFICATION:

Unit No	Course Outcomes					Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
	Lesson Plan Hrs	%	Correlation	CO's Action Verb	BTL			
1	8	30	3	Understand	L2	PO1 PO2 PO6	Apply (L3) Identify (L3) Thumb Rule	2 2 1
2	8	30	3	Understand	L2	PO1 PO2 PO6	Apply (L3) Identify (L3) Thumb Rule	2 1 1
3	10	38	3	Understand	L2	PO1 PO2 PO6	Apply (L3) Identify (L3) Thumb Rule	2 1 2
4	8	30	3	**Understand**	L2	PO1 PO2	Apply (L3) Review (L2)	2 3
5	8	30	3	**Analyze**	L4	PO1 PO2	Apply (L3) Review (L2)	3 3
6	10	38	3	**Analyze**	L4	PO1 PO2	Apply (L3) Review (L2)	3 3

JUSTIFICATION STATEMENTS:

CO1: Understand the fundamental laws of AC and DC circuits.
Action Verb: Understand (L2) PO1: Apply (L3)
CO1 Action Verb is Less than PO1 verb by one level; Therefore, correlation is moderate (2). PO2: Identify (L3)
CO1 Action Verb is Less than PO2 verb by one level; Therefore, correlation is moderate (2). PO6: Using thumb rule, CO1 correlates PO6 as low (1).

CO2: Understand operating principles of motors, generators, MC and MI instruments.
Action Verb: Understand (L2) PO1: Apply (L3)
CO2 Action Verb is Less than PO1 verb by one level; Therefore, correlation is moderate (2). PO2: Analyze (L4)
CO2 Action Verb is Less than PO2 verb by two level; Therefore, correlation is low (1). PO6: Using thumb rule, CO2 correlates PO6 as low (1).

CO3: Understand the fundamentals of power generation, costing and safety measures.
Action Verb: Understand (L2) PO1: Apply (L3)
CO3 Action Verb is Less than PO1 verb by one level; Therefore, correlation is moderate (2). PO2: Analyze (L4)
CO3 Action Verb is Less than PO2 verb by two level; Therefore, correlation is low (1). PO6: Using thumb rule, CO3 correlates PO6 as medium (2).

CO4: Understand the fundamental concepts of diodes, transistors and its applications
Action Verb: Understand (L2)
PO1 Verbs: Apply (L3) CO4 Action Verb is less than PO1 verb by one level; Therefore, correlation is moderate (2).
PO2 Verbs: Review (L2) CO4 Action Verb is equal to PO2 verb; Therefore, correlation is high (3).

CO5: Analyze the concepts of rectifiers, power supplies and amplifiers in electronics.
Action Verb: Analyze (L4)
PO1 Verbs: Apply (L3) CO5 Action Verb is greater than PO1 verb by one level; Therefore, correlation is high (3).
PO2 Verbs: Review (L2) CO5 Action Verb is equal to PO2 verb; Therefore, correlation is high (3).

CO6: Analyze the concepts of Number Systems, Boolean Functions, Logic Gates and Digital Circuits.
Action Verb: Analyze (L4)
PO1 Verbs: Apply (L3) CO6 Action Verb is greater than PO1 verb by one level; Therefore, correlation is high (3).
PO2 Verbs: Review (L2) CO6 Action Verb is equal to PO2 verb; Therefore, correlation is high (3).

I YEAR I SEMESTER

Subject Code	Subject Name	L	T/CLC	P	CREDITS
23AES0301	ENGINEERING GRAPHICS	1	0	4	3

Course Outcomes: After studying the course, students will be able to

CO1	Apply the concepts of engineering curves and scales for technical drawing.
CO2	Understand the quadrant system to locate the position of points, lines and planes.
CO3	Analyze the projection of solids located in quadrant system.
CO4	Analyze the sectional views and development of surfaces of regular solids.
CO5	Apply orthographic and isometric projections concepts to construct the given object

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Apply	the concepts of engineering curves and scales	for technical drawing		L3
2	Understand	the quadrant system to locate the position of points, lines and planes			L2
3	Analyze	the projection of solids	located in quadrant system		L4
4	Analyze	the sectional views and development of surfaces	of regular solids		L4
5	Apply	orthographic and isometric projections concepts to construct the given object			L3

UNIT-I

Introduction: Lines, Lettering and Dimensioning, Geometrical Constructions and Constructing regular polygons by general methods.
Curves: construction of ellipse, parabola and hyperbola by general, Cycloids, Involutes, Normal and tangent to Curves.
Scales: Plain scales, diagonal scales and vernier scales.

UNIT-II

Orthographic Projections: Reference plane, importance of reference lines or Plane, Projections of a point situated in any one of the four quadrants.
Projections of Straight Lines: Projections of straight lines parallel to both reference planes, perpendicular to one reference plane and parallel to other reference plane, inclined to one reference plane and parallel to the other reference plane. Projections of Straight Line Inclined to both the reference planes
Projections of Planes: regular planes Perpendicular to both reference planes, parallel to one reference plane and inclined to the other reference plane; plane inclined to both the reference planes.

UNIT-III

Projections of Solids: Types of solids: Polyhedra and Solids of revolution. Projections of solids in simple positions: Axis perpendicular to horizontal plane, Axis perpendicular to vertical plane and

Axis parallel to both the reference planes, Projection of Solids with axis inclined to one reference plane and parallel to another plane.
UNIT-IV
Sections of Solids: Perpendicular and inclined section planes, Sectional views and True shape of section, Sections of solids in simple position only. **Development of Surfaces**: Methods of Development: Parallel line development and radial line development. Development of a cube, prism, cylinder, pyramid and cone**.**
UNIT-V
Conversion of Views: Conversion of isometric views to orthographic views; Conversion of orthographic views to isometric views. **Computer graphics:** Creating 2D&3D drawings of objects including PCB and Transformations using Auto CAD (*Not for end examination*).

TEXTBOOKS:

1. K. L. Narayana & P. Kannaiah, Engineering Drawing, 3/e, Scitech Publishers
2. N. D. Bhatt, Engineering Drawing, 53/e, Charotar Publishers

REFERENCES:

1. Engineering Drawing, K.L. Narayana and P. Kannaiah, Tata McGraw Hill, 2013.
2. Engineering Drawing, M.B. Shah and B.C. Rana, Pearson Education Inc,2009.
3. Engineering Drawing with an Introduction to AutoCAD, Dhananjay Jolhe, Tata McGraw Hill, 2017.

CORRELATION OF COS WITH THE POS & PSOS:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3								3		2	2
CO2	2	2								3		2	2
CO3	2	2								3		2	2
CO4	3	3								3		2	2
CO5	3	3								3		2	2

CO-PO MAPPING JUSTIFICATION:

Unit No	Course Outcomes					Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
	Lesson Plan Hrs	%	Correlation	CO's Action Verb	BTL			
1	18	24	3	Apply	L3	PO1 PO2 PO10	Apply (L3) Develop (L3) Thumb Rule	3 3 3
2	15	20	2	Understand	L2	PO1 PO2 PO10	Apply (L3) Develop (L3) Thumb Rule	3 3 3
3	15	20	2	Analyze	L4	PO1 PO2 PO10	Apply (L3) Develop (L3) Thumb Rule	3 3 3
4	15	20	2	Analyze	L4	PO1 PO2 PO10	Apply (L3) Develop (L3) Thumb Rule	3 3 3

5	12	16	2	Apply	L3	PO1 PO2 PO10	Apply (L3) Develop (L3) Thumb Rule	3 3 3

JUSTIFICATION STATEMENTS:

CO1: Apply the concepts of engineering curves and scales for technical drawing.
Action Verb: Apply (L3)
PO1 Verb: Apply (L3)
CO1 Action verb is same level as PO1 verb. Therefore, the correlation is high (3) PO2 Verb: Develop (L3)
CO1 Action verb is same level as PO2 verb. Therefore, the correlation is high (3) PO10 Verb: Thumb Rule (TR)
CO1: Engineering graphics involves creating visual representations and technical drawings to communicate design ideas, concepts and specifications. Therefore, the correlation is high (3)

CO2: Understand the quadrant system to locate the position of points, lines and planes.
Action Verb: Understand (L2)
PO1 Verb: Apply (L3)
CO2: Action verb is less than PO1 verb by one level. Therefore, the correlation is medium (2) PO2 Verb: **Develop (L3)**
CO2: Action verb is less than PO2 verb by one level. Therefore, the correlation is medium (2) PO10 Verb: Thumb Rule (TR)
CO2: Engineering graphics involves creating visual representations and technical drawings to communicate design ideas, concepts and specifications. Therefore, the correlation is high (3)

CO3: Analyze the projection of solids located in quadrant system.
Action Verb: Analyze (L4)
PO1 Verb: Apply (L3)
CO3: Action verb is same level as PO1 verb. Therefore, the correlation is high (3) PO2 Verb: Develop (L3)
CO3: Action verb is same level as PO2 verb. Therefore, the correlation is high (3) PO10 Verb: Thumb Rule (TR)
CO3: Engineering graphics involves creating visual representations and technical drawings to communicate design ideas, concepts and specifications. Therefore, the correlation is high (3)

CO4: Analyze the sectional views and development of surfaces of regular solids
Action Verb: Analyze (L4)
PO1 Verb: Apply (L3)
CO4: Action verb is same level as PO1 verb. Therefore, the correlation is high (3) PO2 Verb: Develop (L3)
CO4: Action verb is same level as PO2 verb. Therefore, the correlation is high (3) PO10 Verb: Thumb Rule (TR)
CO4: Engineering graphics involves creating visual representations and technical drawings to communicate design ideas, concepts and specifications. Therefore, the correlation is high (3)

CO5: Apply orthographic and isometric projections concepts to construct the given object.
Action Verb: Apply (L3) PO1 Verb: Apply (L3)
CO5: Action verb is same level as PO1 verb. Therefore, the correlation is high (3) PO2 Verb: Develop (L3)
CO5: Action verb is same level as PO2 verb. Therefore, the correlation is high (3) PO10 Verb: Thumb Rule (TR)
CO5: Engineering graphics involves creating visual representations and technical drawings to communicate design ideas, concepts and specifications. Therefore, the correlation is high (3)

I YEAR I SEMESTER

Subject Code	Subject Name	L	T/CLC	P	CREDITS
23AES0501	INTRODUCTION TO PROGRAMMING	2	1	0	3

Course Outcomes: After studying the course, students will be able to

CO1	Understand the computer Programming concepts and Algorithms.
CO2	Analyze the control structures to implement basic programs.
CO3	Understand the concept of Arrays and string to manipulate the stored data.
CO4	Create the dynamic memory allocation using pointers and structures.
CO5	Create the user defined functions and files for modifying stored data.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Understand	the computer Programming concepts and Algorithms.			L2
2	Analyze	the control structures		to implement basic programs.	L4
3	Understand	the concept of Arrays and string		to manipulate the stored data	L2
4	Create	the dynamic memory allocation	using pointers and structures.		L6
5	Create	user defined functions and files		for modifying stored data.	L6

UNIT-I (INTRODUCTION TO PROGRAMMING AND PROBLEM SOLVING)
History of Computers, Basic organization of a computer: ALU, input-output units, memory, program counter, Introduction to Programming Languages, Basics of a Computer Program- Algorithms, flowcharts (Using Dia Tool), pseudo code. Introduction to Compilation and Execution, Primitive Data Types, Variables, and Constants, Basic Input and Output, Operations, Type Conversion, and Casting. **Problem solving techniques:** Algorithmic approach, characteristics of algorithm, Problem solving strategies: Top-down approach, Bottom-up approach, Time and space complexities of algorithms.
UNIT-II (CONTROL STRUCTURES)
Simple sequential programs Conditional Statements (if, if-else, switch), Loops (for, while, do-while) Break and Continue.
UNIT-III (ARRAYS AND STRINGS)
Arrays indexing, memory model, programs with array of integers, two dimensional arrays, Introduction to Strings.
UNIT-IV (POINTERS & USER DEFINED DATA TYPES)
Pointers, dereferencing and address operators, pointer and address arithmetic, array manipulation using pointers, User-defined data types-Structures and Unions
UNIT-V (FUNCTIONS & FILE HANDLING)
Introduction to Functions, Function Declaration and Definition, Function call Return Types and Arguments, modifying parameters inside functions using pointers, arrays as parameters. Scope and Lifetime of Variables, Basics of File Handling

TEXTBOOKS:

1. "The C Programming Language", Brian W. Kernighan and Dennis M. Ritchie, Prentice- Hall, 1988
2. Schaum's Outline of Programming with C, Byron S Gottfried, McGraw-Hill Education, 1996.

REFERENCES:

1. Computing fundamentals and C Programming, Balagurusamy, E., McGraw-Hill Education, 2008.
2. Programming in C, Rema Theraja, Oxford, 2016, 2nd edition
3. C Programming, A Problem-Solving Approach, Forouzan, Gilberg, Prasad, CENGAGE, 3rd edition

CORRELATION OF COS WITH THE POS & PSOS:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	3	2									3	
CO2	3	3	3								2	2	
CO3	2	3									2	2	
CO4	3	3	3								2	2	
CO5	3	3	3								3	2	2

CO-PO MAPPING JUSTIFICATION:

Unit No	Course Outcomes					Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
	Lesson Plan Hrs	%	Correlation	CO's Action Verb	BTL			
1	19	25%	3	Understand	L2	PO1 PO2 PO3	Apply(L3) Review(L2) Develop(L3)	2 3 2
2	10	14%	2	Analyze	L4	PO1 PO2 PO3 PO11	Apply(L3) Analyze (L4) Develop(L3) Thumb rule	3 3 3 2
3	19	25%	3	Understand	L2	PO1 PO2 PO11	Apply(L3) Review (L2) Thumb rule	2 3 2
4	15	20%	2	Create	L6	PO1 PO2 PO3 PO11	Apply(L3) Review (L2) Develop(L3) Thumb rule	3 3 3 2
5	12	16%	2	Create	L6	PO1 PO2 PO3 PO11	Apply(L3) Review(L2) Develop(L3) Thumb rule	3 3 3 3

JUSTIFICATION STATEMENTS:

CO1: Understand the computer Programming concepts and Algorithms.
Action Verb: Understand (L2)
PO1 Verb: Apply (L3)
CO1 Action verb is less than PO1 verb by one level. Therefore, the correlation is moderate (2)
PO2 Verb: Review (L2)

CO1 Action verb is same as than as PO2 verb by two level. Therefore, the correlation is High (3)
PO3 Verb: Develop (L3)
CO1 Action verb is less than as PO2 verb by one level. Therefore, the correlation is moderate (2)

CO2: Analyze the control structures to implement basic programs.
Action Verb: Analyze (L4) PO1: Apply (L3)
CO2 Action verb is greater than as PO1 verb. Therefore, the correlation is high (3)
PO2: Analyze (L4)
CO2 Action verb is equal to PO2 verb. Therefore, the correlation is high (3)
PO3: Develop (L3)
CO2 Action verb is greater than PO3 verb. Therefore, the correlation is high (3)
PO11: Thumb rule Some of the flow of control statements knowledge are used to solve various problems. Therefore, the correlation is moderate (2)

CO3: Understand the concept of Arrays and string to manipulate the stored data.
Action Verb: Understand (L2)
PO1: Apply (L3)
CO3 Action verb is less than PO1 verb by one level. Therefore, the correlation is moderate (2)
PO2: Review (L2)
CO3 Action verb is Same as PO2 verb. Therefore, the correlation is High (3)
PO11: Thumb rule
For some matrix operations array and string concepts were used Therefore, the correlation is moderate (2)

CO4: Create the dynamic memory allocation using pointers and structures.
Action Verb: Create (L6) PO1: Apply (L3)
CO4 Action verb is greater than PO1 verb by two levels. Therefore, the correlation is high (3)
PO2: Review (L2)
CO4 Action verb is greater than as PO2 verb. Therefore, the correlation is high (3)
PO3: Develop (L3)
CO4 Action verb is greater than PO3 verb. Therefore, the correlation is high (3)
PO11: Thumb rule
For some mathematical operations Pointers and structures are used to manipulate the memory references. Therefore, the correlation is moderate (2)

CO5: Create the user defined functions and files for modifying stored data.
Action Verb: Create (L6)
PO1: Apply (L3)
CO5 Action verb is greater than PO1 verb by two levels. Therefore, the correlation is high (3)
PO2: Review (L2)
CO5 Action verb is greater than as PO2 verb. Therefore, the correlation is high (3)
PO3: Develop (L3)
CO5 Action verb is greater than as PO3 verb. Therefore, the correlation is high (3)
PO11: Thumb rule
In today's world file handling techniques were used in most of the areas. Therefore, the correlation is high (3)

I YEAR I SEMESTER

Subject Code	Subject Name	L	T/CLC	P	CREDITS
23AES0503	IT WORKSHOP	0	0	2	1

Course Outcomes: After studying the course, students will be able to

CO1	Understand The Process of Software Installation & Hardware troubleshooting.
CO2	Analyze the network configurations for customizing web pages and search engines.
CO3	Apply the basic editing function, formatting text & objects on a required content
CO4	Apply the formulas, functions and visualizations to manage the data.
CO5	Understand the libraries and models of chatGPT to generate information.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Understand	The Process of Software Installation & Hardware troubleshooting.			L2
2	Analyze	the network configurations		for customizing web pages and search engines	L4
3	Apply	The basic editing function, formatting text & objects		on a required content	L3
4	Apply	the formulas, functions and visualizations		to manage the data	L3
5	Understand	The libraries and models of chatGPT		to generate information	L2

LIST OF EXPERIMENTS

PC HARDWARE & SOFTWARE INSTALLATION

Task 1: Identify the peripherals of a computer, components in a CPU and its functions. Draw the block diagram of the CPU along with the configuration of each peripheral and submit to your instructor.[CO1]

Task 2: Every student should disassemble and assemble the PC back to working condition. Lab instructors should verify the work and follow it up with a Viva. Also students need to go through the video which shows the process of assembling a PC. A video would be given as part of the course content.[CO1]

Task 3: Every student should individually install MS windows on the personal computer. Lab instructor should verify the installation and follow it up with a Viva.[CO1]

Task 4: Every student should install Linux on the computer. This computer should have windows installed. The system should be configured as dual boot (VMWare) with both Windows and Linux. Lab instructors should verify the installation and follow it up with a Viva.[CO1]

Task 5: Every student should install BOSS on the computer. The system should be configured as dual boot (VMWare) with both Windows and BOSS. Lab instructors should verify the installation and follow it up with a Viva.[CO1]

INTERNET & WORLD WIDE WEB

Task1: Orientation & Connectivity Boot Camp: Students should get connected to their Local Area Network and access the Internet. In the process they configure the TCP/IP setting. Finally students should demonstrate, to the instructor, how to access the websites and email. If there isno internet connectivity preparations need to be made by the instructors to simulate the WWW on the LAN.[CO2]

Task 2: Web Browsers, Surfing the Web: Students customize their web browsers with the LAN proxy settings, bookmarks, search toolbars and pop up blockers. Also, plug-ins like Macromedia Flash and JRE for applets should be configured.[CO2]

Task 3: Search Engines & Netiquette: Students should know what search engines are and how to use the search engines. A few topics would be given to the students for which they need to search on Google. This should be demonstrated to the instructors by the student. [CO2]

Task 4: Cyber Hygiene: Students would be exposed to the various threats on the internet and would be asked to configure their computer to be safe on the internet. They need to customize their browsers to block pop ups, block active x downloads to avoid viruses and/or worms. [CO2]

LATEX AND WORD

Task 1 – Word Orientation: The mentor needs to give an overview of La TeX and Microsoft (MS) office or equivalent (FOSS) tool word: Importance of La TeX and MS office or equivalent (FOSS) tool Word as word Processors, Details of the four tasks and features that would be covered in each, Using La TeXand word – Accessing, overview of toolbars, saving files, Using help and resources, rulers, format painter in word. [CO3]

Task 2: Using La TeX and Word to create a project certificate. Features to be covered:- Formatting Fonts in word, Drop Cap in word, Applying Text effects, Using Character Spacing, Borders and Colors, Inserting Header and Footer, Using Date and Time option in both La TeX and Word. [CO3]

Task 3: Creating project abstract Features to be covered:-Formatting Styles, Inserting table, Bullets and Numbering, Changing Text Direction, Cell alignment, Footnote, Hyperlink, Symbols, Spell Check, Track Changes. [CO3]

Task 4: Creating a Newsletter: Features to be covered:- Table of Content, Newspaper columns, Images from files and clipart, Drawing toolbar and Word Art, Formatting Images, Textboxes, Paragraphs and Mail Merge in word. [CO3]

EXCEL

Excel Orientation: The mentor needs to tell the importance of MS office or equivalent (FOSS) tool Excel as a Spreadsheet tool, give the details of the four tasks and features that would be covered in each. Using Excel – Accessing, overview of toolbars, saving excel files, Using help and resources. [CO4]

Task 1: Creating a Scheduler - Features to be covered: Gridlines, Format Cells, Summation, auto fill, Formatting Text [CO4]

Task 2: Calculating GPA -. Features to be covered: - Cell Referencing, Formulae in excel – average, std. deviation, Charts, Renaming and Inserting worksheets, Hyper linking, Count function, [CO4]

LOOKUP/VLOOKUP

Task 3: Split cells, freeze panes, group and outline, Sorting, Boolean and logical operators, Conditional formatting [CO4]

POWER POINT

Task 1: Students will be working on basic power point utilities and tools which help them create basic power point presentations. PPT Orientation, Slide Layouts, Inserting Text, Word Art, Formatting Text, Bullets and Numbering, Auto Shapes, Lines and Arrows in PowerPoint. [CO4]

Task 2: Interactive presentations - Hyperlinks, Inserting –Images, Clip Art, Audio, Video, Objects, Tables and Charts. [CO4]

Task 3: Master Layouts (slide, template, and notes), Types of views (basic, presentation, slide slotter, notes etc), and Inserting – Background, textures, Design Templates, Hidden slides. [CO4]

AI TOOLS – ChatGPT

Task 1: Prompt Engineering: Experiment with different types of prompts to see how the model responds. Try asking questions, starting conversations, or even providing incomplete sentences to see how the model completes them. [CO5]

• Ex: Prompt: "You are a knowledgeable AI. Please answer the following question: What is the capital of France?"

Task 2: Creative Writing: Use the model as a writing assistant. Provide the beginning of a story or a description of a scene, and let the model generate the rest of the content. This can be a fun way to brainstorm creative ideas[CO5]

• Ex: Prompt: "In a world where gravity suddenly stopped working, people started floating upwards. Write a story about how society adapted to this new reality."

Task 3: Language Translation: Experiment with translation tasks by providing a sentence in one language and asking the model to translate it into another language. Compare the output to see how accurate and fluent the translations are. [CO5]

• Ex: Prompt: "Translate the following English sentence to French: 'Hello, how are you doing today?'"

REFERENCES:

1. Comdex Information Technology course tool kit, Vikas Gupta, WILEY Dream tech, 2003
2. The Complete Computer upgrade and repair book, Cheryl A Schmidt, WILEY Dream tech, 2013, 3rd edition
3. 3Introduction to Information Technology, ITL Education Solutions limited, Pearson Education, 2012, 2nd edition
4. PC Hardware - A Handbook, Kate J. Chase, PHI (Microsoft)
5. LaTeX Companion, Leslie Lamport, PHI/Pearson.
6. IT Essentials PC Hardware and Software Companion Guide, David Anfins on and Ken Quamme. – CISCO Press, Pearson Education, 3rd edition
7. IT Essentials PC Hardware and Software Labs and Study Guide, Patrick Regan– CISCO Press, Pearson Education, 3rd edition.

CORRELATION OF COS WITH THE POS & PSOS:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	3										1	
CO2	3	3	3	3	3								
CO3	3	3	3	2	3						3	2	
CO4	3	3	3	2	3						3		2
CO5	2	2											1

CO-PO MAPPING JUSTIFICATION:

CO	CO		Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
	Verb	BTL			
1	Understand	L2	PO1 PO2	Apply(L3) Review(L2)	2 3
2	Analyze	L4	PO1 PO2 PO3 PO4 PO5	Apply(L3) Identify (L3) Develop(L3) Analyze (L4) Apply (L3)	3 3 3 3 3
3	Apply	L3	PO1 PO2 PO3 PO4 PO5 PO11	Apply(L3) Review (L2) Develop(L3) Analyze (L4) Apply (L3) Thumb rule	3 3 3 2 3 3
4	Apply	L3	PO1 PO2 PO3 PO4 PO5 PO11	Apply(L3) Review (L2) Develop(L3) Analyze (L4) Apply (L3) Thumb rule	3 3 3 2 3 3
5	Understand	L2	PO1 PO2	Apply(L3) Identify (L3)	2 2

JUSTIFICATION STATEMENTS:

CO1: Understand The Process of Software Installation & Hardware troubleshooting

Action Verb: Understand (L2)
PO1 Verb: Apply (L3)
CO1 Action verb is less than PO1 verb by one level. Therefore, the correlation is moderate (2)
PO2 Verb: Review(L2)
CO1 Action verb is same as PO2 verb. Therefore, the correlation is high (3)

CO2: Analyze the network configurations for customizing web pages and search engines
Action Verb: Analyze (L4)
PO1: Apply (L3)
CO2 Action verb is greater than as PO1 verb. Therefore, the correlation is high (3)
PO2: Identify(L3)
CO2 Action verb is greater than as PO2 verb. Therefore, the correlation is high (3)
PO3: Develop (L3)
CO2 Action verb is greater than as PO3 verb. Therefore, the correlation is high (3)
PO4: Analyze (L4)
CO2 Action verb is same as PO4 verb. Therefore, the correlation is high (3)
PO5: Apply (L3)
CO2 Action verb is greater than as PO5 verb. Therefore, the correlation is high (3)

CO 3: Apply The basic editing function, formatting text & objects on a required content. Action Verb: Apply (L3)
PO1: Apply (L3)
CO3 Action verb is greater than as PO1 verb. Therefore, the correlation is high (3)
PO2: Review(L2)
CO3 Action verb is less than as PO2 verb. Therefore, the correlation is high(3)
PO3: Develop(L3)
CO3 Action verb is same as PO3 verb. Therefore, the correlation is high (3)
PO4: Analyze (L4)
CO3 Action verb is less than as PO4 verb. Therefore, the correlation is moderate (2)
PO5: Apply (L3)
CO3 Action verb is same as PO5 verb. Therefore, the correlation is high (3)
PO11: Thumb rule
Documentation and presentation is learning process to find the solution better manner the correlation is high (3)
CO 4: Apply the formulas, functions and visualizations to manage the data.
Action Verb: Apply (L3)
PO1: Apply (L3)
CO4 Action verb is greater than as PO1 verb. Therefore, the correlation is high (3)
PO2: Identify(L3)
CO4 Action verb is greater than as PO2 verb. Therefore, the correlation is high (3)
PO3: Develop (L3)
CO4 Action verb is same as PO3 verb. Therefore, the correlation is high (3)
PO4: Analyze (L4)
CO4 Action verb is less than as PO4 verb by one level. Therefore, the correlation is moderate (2)
PO5: Apply (L3)
CO4 Action verb is greater than as PO5 verb. Therefore, the correlation is high (3)
PO11: Thumb rule
Spread sheets in Excel is the trending approach in the current days Therefore, the correlation is high (3)
CO 5: Understand the libraries and models of chatGPT to generate information.
Action Verb: Understand (L2)
PO1 Verb: Apply (L3)
CO1 Action verb is less than PO1 verb by one level. Therefore, the correlation is moderate (2)
PO2 Verb: Identify(L3)
CO1 Action verb is same as PO2 verb. Therefore, the correlation is moderate (2)

Subject Code	Subject Name	L	T/CLC	P	CREDITS
23ABS9908	ENGINEERING PHYSICS LAB	0	0	2	1

Course Outcomes: After studying the course, students will be able to

CO1	Analyze the properties of light for engineering problems.
CO2	Evaluate the crystallite size using X-ray diffraction.
CO3	Analyze the basic properties of dielectric and magnetic behavior of the given material.
CO4	Determine the mechanical behavior of a given material.
CO5	Evaluate the basic parameters of a given semiconductor material.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Analyze	The properties of light		for engineering problems.	L4
2	Evaluate	The crystallite size using X-ray diffraction.			L5
3	Analyze	The basic properties of dielectric and magnetic behavior of the given material			L4
4	Determine	The mechanical behavior of a given material.			L5
5	Evaluate	The basic parameters of a given semiconductor material.			L5

LIST OF EXPERIMENTS:

1. Determination of radius of curvature of a given Plano-convex lens by Newton's rings – CO1.

2. Determination of wavelengths of different spectral lines in mercury spectrum using diffraction grating in normal incidence configuration – CO1.

3. Study the variation of B versus H by magnetizing the magnetic material (B-H curve) – CO3.

4. Determination of wavelength of Laser light using diffraction grating – CO1.

5. Magnetic field along the axis of a current carrying circular coil by Stewart Gee's Method – CO3.

6. Determination of energy gap of a semiconductor using p-n junction diode – CO5.

7. Determination of the resistivity of semiconductors by four probe methods – CO5.

8. Determination of the crystallite size using X-Ray Diffraction spectra – CO2.

9. Determination of the numerical aperture of a given optical fiber and angle of acceptance – CO1.

10. Verification of Brewster's law – CO1.

11. Determination of acceleration due to gravity and radius of Gyration by using a compound pendulum – CO4.

12. Determination of rigidity modulus of the material of the given wire using Torsional pendulum – CO4.

13. Determination of temperature coefficients of a thermistor – CO5.

14. Determination of dielectric constant using charging and discharging method – CO3.

15. Determination of Hall voltage and Hall coefficient of a given semiconductor using Hall Effect – CO5.

16. Sonometer: Verification of laws of stretched string – CO4.

17. Determination of magnetic susceptibility by Kundt's tube method – CO3.

18. Determination of Frequency of electrically maintained tuning fork by Melde's experiment – CO4.

Note: Any TEN of the listed experiments are to be conducted. Out of which any TWO Experiments may be conducted in virtual mode.

REFERENCES:

1. A Textbook of Practical Physics - S. Balasubramanian, M. N. Srinivasan, S. Chand Publishers, 2017.

WEB RESOURCES:

1. www.vlab.co.in

CORRELATION OF COS WITH THE POS & PSOS:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3			3									
CO2	3			3									
CO3	3			3									
CO4	3			3									
CO5	3			3									

CO-PO MAPPING JUSTIFICATION:

Unit No	Course Outcomes					Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
	Lesson Plan Hrs	%	Correlation	CO's Action Verb	BTL			
1	9	25	3	Analyze	L4	PO1 PO4	Apply (L3) Analyze (L4)	3 3
2	6	16	2	Evaluate	L5	PO1 PO4	Apply (L3) Analyze (L4)	3 3

3	9	25	3	Analyze	L4	PO1 PO4	Apply (L3) Analyze (L4)	3 3
4	6	16	2	Determine	L5	PO1 PO4	Apply (L3) Analyze (L4)	3 3
5	6	16	2	Evaluate	L5	PO1 PO4	Apply (L3) Analyze (L4)	3 3

JUSTIFICATION STATEMENTS:

CO1: Analyze the properties of light for solving engineering problems.
Action Verb: Analyze (L4)
PO1 Verbs: Apply (L3)
PO4 Verb: Analyze (L4)
CO1 Action Verb is greater than PO1 verb by one level; Therefore, correlation is high (3).
CO1 Action Verb is equal to PO4 verb; Therefore, correlation is high (3).

CO2: Evaluate the crystallite size using X-ray diffraction.
Action Verb: Evaluate (L5)
PO1 Verbs: Apply (L3)
PO4 Verb: Analyze (L4)
CO2 Action Verb is greater than PO1 verb by two levels; Therefore, correlation is high (3).
CO2 Action Verb is greater than PO1 verb by one level; Therefore, correlation is high (3).

CO3: Analyze the basic properties of dielectric and magnetic behavior of the given material.
Action Verb: Analyze (L4)
PO1 Verbs: Apply (L3)
PO4 Verb: Analyze (L4)
CO3 Action Verb level is greater than PO1 action verb by one level; Therefore, correlation is high (3).
CO3 Action Verb level is equal to PO4 action verb; Therefore, correlation is high (3).

CO4: Determine the mechanical behavior of a given material using dynamic methods.
Action Verb: Determine (L5)
PO1 Verbs: Apply (L3)
PO4 Verb: Analyze (L4)
CO4 Action Verb is greater than PO1 verb by two levels; Therefore, correlation is high (3).
CO4 Action Verb is greater than PO4 verb by one level; Therefore, correlation is high (3).

CO5: Evaluate the basic parameters of a given semiconductor material.
Action Verb: Evaluate (L5)
PO1 and PO4 Verb: Apply (L3)
CO5 Action Verb is greater than PO1 verb by two levels; Therefore, correlation is high (3).
CO5 Action Verb is greater than PO1 verb by one level; Therefore, correlation is high (3).

I YEAR I SEMESTER

Subject Code	Subject Name	L	T/CLC	P	CREDITS
23AES0202	ELECTRICAL & ELECTRONICS ENGINEERING WORKSHOP	0	0	3	1.5

Course Outcomes: After studying the course, students will be able to

CO1	Understand the Electrical circuit design, measurement of resistance, power, and power factor.
CO2	Apply suitable methods to measure Resistance, power, energy and power factor.
CO3	Design suitable methods for magnetization characteristics of D. C shunt generator.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	**Understand**	**Electrical circuit design; measurement of resistance, power, power factor**			L2
2	**Apply**	Suitable methods to measure Resistance, power, energy and power factor.			L3
3	Design	Suitable methods for magnetization characteristics of D. C shunt generator			L6

PART A
ELECTRICAL ENGINEERING LAB

LIST OF EXPERIMENTS

1. Verification of Kirchhoff's current law and Voltage law-(CO1).
2. Verification of Superposition theorem-(CO1).
3. Measurement of Resistance using Wheat stone bridge-(CO1).
4. Measurement of Power and Power factor using Single-phase watt-meter-(CO2).
5. Measurement of Earth Resistance using Megger-(CO2).
6. Calculation of Electrical Energy for Domestic Premises-(CO2).
7. Magnetization Characteristics of DC shunt Generator-(CO3).

Note: Minimum Six Experiments to be performed.

REFERENCES:

1. Basic Electrical Engineering, D. C. Kulshreshtha, Tata McGraw Hill, 2019, First Edition
2. Power System Engineering, P.V. Gupta, M.L. Soni, U.S. Bhatnagar and A. Chakrabarti, Dhanpat Rai & Co, 2013
3. Fundamentals of Electrical Engineering, Rajendra Prasad, PHI publishers, 2014, Third Edition
Jain -Laxmi Publications (P) ltd., New Delhi 17th 2022.

PART B
ELECTRONICS ENGINEERING LAB

Course Outcomes: After studying the course, students will be able to

CO4	Understand the V-I Characteristics of diodes and its applications.
CO5	Analyze the input and output characteristics of BJT and its applications.
CO6	Analyze the truth tables of all logic gates and f/f's using IC's.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	**Understand**	V-I Characteristics of diodes and its applications.			L2
2	Analyze	input and output characteristics of BJT and its applications			L4
3	Analyze	Truth tables of all logic gates and f/f's using IC's.			L4

LIST OF EXPERIMENTS

1. Plot V-I characteristics of PN Junction diode A) Forward bias B) Reverse bias. (CO4)
2. Plot VI characteristics of Zener Diode and its application as voltage Regulator. (CO4)
3. Implementation of half wave and full wave rectifiers (CO4)
4. Plot Input & Output characteristics of BJT in CE and CB configurations (CO5)
5. Frequency response of CE amplifier. (CO5)
6. Simulation of RC coupled amplifier with the design supplied. (CO5)
7. Verification of Truth Table of AND, OR, NOT, NAND, NOR, Ex-OR, Ex-NOR gates using ICs. (CO6)
8. Verification of Truth Tables of S-R, J-K& D flip flops using respective ICs. (CO6)

Tools Equipment Required: DC Power supplies, Multi meters, DC Ammeters, DC Voltmeters, AC Voltmeters, CROS, and all the required active devices.
Note: Minimum Six Experiments to be performed. All the experiments shall be implemented using both Hardware and Software

REFERENCES:

1. R. L. Boylestad & Louis Nashlesky, Electronic Devices & Circuit Theory, Pearson Education, 2021.
2. R. P. Jain, Modern Digital Electronics, 4th Edition, Tata Mc Graw Hill, 2009
3. R. T. Paynter, Introductory Electronic Devices & Circuits - Conventional Flow Version, Pearson Education, 2009.

CORRELATION OF COS WITH THE POS & PSOS:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	1		1					1			2	
CO2	3	2		2					1			2	
CO3		3		3					1			2	1

CO4	2	3											
CO5	3	3											
CO6	3	3											

CO-PO MAPPING JUSTIFICATION:

CO	CO		Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
	Verb	BTL			
1	**Understand**	L2	PO1 PO2 PO4 PO9	Apply (L3) Analyze (L4) Analyze (L4) Thumb Rule	2 1 1 1
2	**Apply**	L3	PO1 PO2 PO4 PO9	Apply (L3) Analyze (L4) Analyze (L4) Thumb Rule	3 2 2 1
3	Design	L6	PO2 PO4 PO9	Analyze(L4) Design (L6) Thumb Rule	3 3 1
4	**Understand**	L2	PO1 PO2	Apply (L3) Review (L2)	2 3
5	Analyze	L4	PO1 PO2	Apply (L3) Review (L2)	3 3
6	Analyze	L4	PO1 PO2	Apply (L3) Review (L2)	3 3

JUSTIFICATION STATEMENTS:

CO1: Understand the Electrical circuit design, measurement of resistance, power, and power factor.
Action Verb: Understand (L2)
PO1: Apply (L3)
CO1 Action Verb is Less than PO1 verb by one level; Therefore, correlation is moderate (2).
PO2: Analyze (L4)
CO1 Action Verb is Less than PO2 verb by two level; Therefore, correlation is low (1).
PO4: Analyze (L4)
CO1 Action Verb is Less than PO4 verb by two level; Therefore, correlation is low (1).
PO9: Using Thumb Rule, CO1 correlates to PO9 as low (1).

CO2: Apply suitable methods to measure Resistance, power, energy and power factor.
Action Verb: Apply (L3)
PO1: Apply (L3)
CO2 Action Verb is same as PO1 verb; Therefore, correlation is high (3).
PO2: Analyze (L4)
CO2 Action Verb is Less than PO2 verb by one level; Therefore, correlation is moderate (2).
PO4: Analyze (L4)
CO2 Action Verb is Less than PO4 verb by one level; Therefore, correlation is moderate (2).
PO9: Using Thumb Rule, CO2 correlates to PO9 as low (1).

CO3: Design suitable methods for magnetization characteristics of D. C shunt generator.
Action Verb: Design (L6)

PO2: Analyze (L4)
CO3 Action Verb is greater than PO2 verb by two level; Therefore, correlation is high (3).
PO4: Design (L6)
CO3 Action Verb is same as PO4 verb; Therefore, correlation is high (3).
PO9: Using Thumb Rule, CO3 correlates to PO9 as low (1).

CO4: Understand the V-I Characteristics of diodes and its applications.
Action Verb: Understand (L2)
PO1 Verbs: Apply (L3)
CO4 Action Verb is less than PO1 verb by one level; Therefore, correlation is moderate (2)
PO2 Verbs: Review (L2)
CO4 Action Verb is equal to PO2 verb; Therefore, correlation is high (3).

CO5: Analyze the input and output characteristics of BJT and its applications.
Action Verb: Analyze (L4)
PO1 Verbs: Apply (L3)
CO5 Action Verb is greater than PO1 verb by one level; Therefore, correlation is high (3).
PO2 Verbs: Review (L2)
CO5 Action Verb is equal to PO2 verb; Therefore, correlation is high (3).

CO6: Analyze the truth tables of all logic gates and f/f's using IC's.
Action Verb: Analyze (L4)
PO1 Verbs: Apply (L3)
CO6 Action Verb is greater than PO1 verb by one level; Therefore, correlation is high (3).
PO2 Verbs: Review (L2)
CO6 Action Verb is equal to PO2 verb; Therefore, correlation is high (3).

I YEAR I SEMESTER

Subject Code	Subject Name	L	T/CLC	P	CREDITS
23AES0502	COMPUTER PROGRAMMING LAB	0	0	3	1.5

Course Outcomes: After studying the course, students will be able to

CO1	Understand the basic syntax of C program to build applications.
CO2	Create the control structure for solving complex problems.
CO3	Apply the concepts of arrays, functions, basic concepts of pointers to organize the data.
CO4	Apply the concepts of structures, unions and linked list to manage heterogeneous data .
CO5	Create the file applications for storing and accessing data.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Understand	the basic syntax of C program		to build applications	L2
2	Create	the control structure		for solving complex problems	L6
3	Apply	the concepts of arrays, functions, basic concepts of pointers		to organize the data	L3
4	Apply	the concepts of structures, unions and linked list		to manage heterogeneous data	L3
5	Create	the file applications		for storing and accessing data	L6

LIST OF EXPERIMENTS

Exercise 1: Problem-solving using Computers [CO1]
i) Basic Linux environment and its editors like Vi, Vim & Emacs etc.
ii) Exposure to Turbo C, gcc
iii) Writing simple programs using printf(), scanf()

Exercise 2: Problem-solving using Algorithms and Flow charts. [CO1]
i) Sum and average of 3 numbers
ii) Conversion of Fahrenheit to Celsius and vice versa
iii) Simple interest calculation

Exercise 3: Variable types and type conversions [CO2]
i) Finding the square root of a given number
ii) Finding compound interest
iii) Area of a triangle using heron's formulae
iv) Distance travelled by an object

Exercise 4: Operators and the precedence and as associativity [CO2]
i) Evaluate the following expressions.
a. A+B*C+(D*E) + F*G
b. A/B*C-B+A*D/3
c. A+++B---A
d. J= (i++) + (++i)
ii) Find the maximum of three numbers using conditional operator
iii) Take marks of 5 subjects in integers, and find the total, average in float

list and perform insertion, deletion, and traversal.
Exercise 5: Branching and logical expressions [CO2] i) Write a C program to find the max and min of four numbers using if-else. ii) Write a C program to generate electricity bill. iii) Find the roots of the quadratic equation. iv) Write a C program to simulate a calculator using switch case. v) Write a C program to find the given year is a leap year or not.
Exercise 6: Loops, while and for loops [CO2] i) Find the factorial of given number using any loop. ii) Find the given number is a prime or not. iii) Compute sine and cos series iv) Checking a number palindrome v) Construct a pyramid of numbers.
Exercise 7: 1 D Arrays: searching [CO3] i) Find the min and max of a 1-D integer array. ii) Perform linear search on1D array. iii) The reverse of a 1D integer array iv) Find 2's complement of the given binary number. v) Eliminate duplicate elements in an array
Exercise 8: 2 D arrays, sorting and Strings [CO3] i) Addition of two matrices ii) Multiplication two matrices iii) Sort array elements using bubble sort iv) Concatenate two strings without built-in functions v) Reverse a string using built-in and without built-in string functions
Exercise 9: Pointers, structures and dynamic memory allocation [CO3] i) Write a C program to find the sum of a 1D array using malloc() ii) Write a C program to find the total, average of n students using structures iii) Enter n students data using calloc() and display failed students list iv) Read student name and marks from the command line and display the student details along with the total. v) Write a C program to implement realloc()
Exercise 10: Bitfields, Self-Referential Structures, Linked lists [CO4] i) Create and display a singly linked list using self-referential structure. ii) Demonstrate the differences between structures and unions using a C program. iii) Write a C program to shift/rotate using bitfields. iv) Write a C program to copy one structure variable to another structure of the same type.
Exercise 11: Functions, call by value, scope and extent [CO2] i) Write a C function to calculate NCR value. ii) Write a C function to find the length of a string. iii) Write a C function to transpose of a matrix. iv) Write a C function to demonstrate numerical integration of differential equations using Euler's method
Exercise 12: Recursion, the structure of recursive calls [CO4] i) Write a recursive function to generate Fibonacci series. ii) Write a recursive function to find the lcm of two numbers. iii) Write a recursive function to find the factorial of a number. iv) Write a C Program to implement Ackermann function using recursion. v) Write a recursive function to find the sum of series.

Exercise 13: Call by reference, dangling pointers [CO4] i) Write a C program to swap two numbers using call by reference. ii) Demonstrate Dangling pointer problem using a C program. iii) Write a C program to copy one string into another using pointer. v) Write a C program to find no of lowercase, uppercase, digits and other characters using pointers.
Exercise 14: File handling [CO5] i) Write a C program to write and read text into a file. ii) Write a C program to write and read text into a binary file using fread() and fwrite() iii) Copy the contents of one file to another file. iv) Write a C program to merge two files into the third file using command-line arguments. v) Find no. of lines, words and characters in a file vi) Write a C program to print last n characters of a given file.

TEXTBOOKS:

1. Ajay Mittal, Programming in C: A practical approach, Pearson.
2. Byron Gottfried, Schaum' s Outline of Programming with C, McGraw Hill

REFERENCES:

1. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice- Hall of India

2. C Programming, A Problem-Solving Approach, Forouzan, Gilberg, Prasad, CENGAGE

CORRELATION OF COS WITH THE POS & PSOS:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	3	2	2								2	
CO2	3	3		3							2	2	
CO3	3	3		2	3						3	2	
CO4	3	3	3	2							2	2	
CO5	3	3	3	3							3	2	

CO-PO MAPPING JUSTIFICATION:

CO	CO		Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
	Verb	BTL			
1	Understand	L2	PO1 PO2 PO3 PO4	Apply (L3) Review (L2) Develop (L3) Analyze (L4)	2 3 2 2
2	Create	L6	PO1 PO2 PO4 PO11	Apply (L3) Review (L2) Analyze (L4) Thumb Rule	3 3 3 2
3	Apply	L3	PO1 PO2 PO4 PO5 PO11	Apply(L3) Review (L3) Analyze (L4) Apply(L3) Thumb rule	3 3 2 3 3
4	Apply	L3	PO1 PO2	Apply(L3) Review (L2)	3 3

			PO3 PO4 PO11	Develop(L3) Analyze (L4) Thumb rule	3 2 2
5	Create	L6	PO1 PO2 PO3 PO4 PO11	Apply(L3) Review(L2) Develop(L3) Analyze (L4) Thumb rule	3 3 3 3 3

JUSTIFICATION STATEMENTS:

CO1: Understand the basic syntax of C program to build applications.
Action Verb: Understand (L2)
PO1 Verb: Apply (L3)
CO1 Action verb is less than PO1 verb by one level. Therefore, the correlation is moderate (2)
PO2 Verb: Review(L2)
CO1 Action verb is greater than PO2 verb. Therefore, the correlation is high (3)
PO3: Develop(L3)
CO1 Action verb is less than PO3 verb by one level. Therefore, the correlation is moderate (2)
PO4: Analyze(L4)
CO1 Action verb is less than PO1 verb by one level. Therefore, the correlation is moderate is (2)

CO2: Create the control structure for solving complex problems.
Action Verb: Create (L6)
PO1: Apply (L3)
CO2 Action verb is greater than as PO1 verb. Therefore, the correlation is high (3)
PO2: Review (L3)
CO2 Action verb is same level PO2 verb. Therefore, the correlation is high (3)
PO4: Analyze (L4)
CO2 Action verb is same as PO4 verb. Therefore, the correlation is high (3)
PO5: Apply (L3)
CO2 Action verb is same as PO5 verb. Therefore, the correlation is high (3)
PO11: Thumb rule
For some of Linear Data Structure applications, Linked lists concepts are used to write programs store the data. Therefore, the correlation is high (2)

CO3: Apply the concepts of arrays, functions, basic concepts of pointers to organize the data.
Action Verb: Apply (L3)
PO1: Apply (L3)
CO3 Action verb is greater than as PO1 verb. Therefore, the correlation is high (3)
PO2: Review (L3)
CO3 Action verb is same level PO2 verb. Therefore, the correlation is high (3)
PO4: Analyze (L4)
CO3 Action verb is less than PO4 verb by one level. Therefore, the correlation is moderate (2)
PO5: Apply(L3)
CO3 Action verb is same as PO5 verb. Therefore, the correlation is high (3)
PO11: Thumb rule
For some of Linear Data Structure applications, Linked lists concepts are used to write programs store the data. Therefore, the correlation is high (3)

CO4: Apply the concepts of structures, unions and linked list to manage heterogeneous data.
Action Verb: Apply (L3)
PO1: Apply (L3)
CO4 Action verb is greater than as PO1 verb. Therefore, the correlation is high (3)
PO2: Review (L3)
CO4 Action verb is same level PO2 verb. Therefore, the correlation is high (3)

PO4: Analyze (L4)
CO4 Action verb is less than PO4 verb by one level. Therefore, the correlation is moderate (2)
PO5: Apply(L3)
CO4 Action verb is same as PO5 verb. Therefore, the correlation is high (3)
PO11: Thumb rule
For some of Linear Data Structure applications, Linked lists concepts are used to write programs store the data. Therefore, the correlation is high (2)

CO5: Create the file applications for storing and accessing data.
Action Verb: Create (L6)
PO1: Apply (L3)
CO5 Action verb is greater than as PO1 verb. Therefore, the correlation is high (3)
PO2: Review (L3)
CO5 Action verb is same level PO2 verb. Therefore, the correlation is high (3)
PO4: Analyze (L4)
CO5 Action verb is same as PO4 verb. Therefore, the correlation is high (3)
PO5: Apply(L3)
CO5 Action verb is same as PO5 verb. Therefore, the correlation is high (3)
PO11: Thumb rule
For some of Linear Data Structure applications, Linked lists concepts are used to write programs store the data. Therefore, the correlation is high (3)

I YEAR I SEMESTER

Subject Code	Subject Name	L	T/CLC	P	CREDITS
23AHM9904	NSS/NCC/SCOUTS&GUIDES/ COMMUNITY SERVICE	0	0	1	0.5

Course Outcomes: After studying the course, students will be able to

CO1	Understand the importance of discipline, character and service motto of community.
CO2	Analyze the activities need to be done for nature protection
CO3	Analyze the social issues in a community and address it through the base camps.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Understand	the importance of discipline, character and service motto		of community	L2
2	Analyze	the activities need to be done for nature protection			L4
3	Analyze	the social issues in a community and address it through the base camps			L4

UNIT-I

ORIENTATION

General Orientation on NSS/NCC/ Scouts & Guides/Community Service activities, career guidance.

Activities:

i) Conducting –ice breaking sessions-expectations from the course-knowing personal talents and skills

ii) Conducting orientations programs for the students –future plans-activities-releasing road map etc.

iii) Displaying success stories-motivational biopics- award winning movies on societal issues etc.

iv) Conducting talent show in singing patriotic songs-paintings- any other contribution

UNIT-II

NATURE & CARE

Activities:

i) Best out of waste competition.

ii) Poster and signs making competition to spread environmental awareness.

iii) Recycling and environmental pollution article writing competition.

iv) Organizing Zero-waste day.

v) Digital Environmental awareness activity via various social media platforms.

vi) Virtual demonstration of different eco-friendly approaches for sustainable living.

vii) Write a summary on any book related to environmental issues.

UNIT-III

COMMUNITY SERVICE

Activities:

i) Conducting One Day Special Camp in a village contacting village-area leaders- Survey in the village, identification of problems- helping them to solve via media- authorities- experts-etc.

ii) Mental health, Spiritual Health, HIV/AIDS,

iii) Conducting consumer Awareness. Explaining various legal provisions etc.

iv) Women Empowerment Programmes- Sexual Abuse, Adolescent Health and Population Education.

v) Any other programmes in collaboration with local charities, NGOs etc.

vi) Conducting awareness programs on Health-related issues such as General Health,

CORRELATION OF COS WITH THE POS & PSOS:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2								2			2
CO2	2	3								3			2
CO3	2	3								3			2

CO-PO MAPPING JUSTIFICATION:

CO	CO		Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
	Verb	BTL			
1	Understand	L2	PO1 PO2 PO10	Apply(L3) Analyze(L4) Thumb Rule	2 3 3
2	Analyze	L4	PO1 PO2 PO10	Apply(L3) Analyze(L4) Thumb Rule	2 3 3
3	Analyze	L4	PO1 PO2 PO10	Apply(L3) Analyze(L4) Thumb Rule	2 3 3

JUSTIFICATION STATEMENTS:

CO1: Understand the importance of discipline, character and service motto of community.
Action Verb: Understand (L2)
PO1: Apply(L3)
CO Action Verb is less than PO1 verb by one level; Therefore, correlation is moderate (2).
PO2: Analyze (L4)
CO Action Verb is less than PO2 verb by one level; Therefore, correlation is moderate (2).
CO Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO10 as moderate (2).

CO2: Analyze the activities need to be done for nature protection
Action Verb: Analyze (L4)
PO1: Apply(L3)
CO Action verb is greater than PO1 verb. Therefore, the correlation is moderate (3)
PO2: Analyze (L4)
CO Action verb is equal to PO2 verb. Therefore, the correlation is high (3)
PO 4: Analysis (L4)
CO Action Verb is equal to PO4; Therefore, correlation is high (3)
CO Action Verb Analyze is of BTL 4. Using Thumb rule, L4 correlates PO10 as moderate (3).

CO3: Analyze the social issues in a community and address it through the base camps.
Action Verb: Analyze (L4)
PO1: Apply(L3)
CO Action verb is greater than PO1 verb. Therefore, the correlation is moderate (3)
PO2: Analyze (L4)
CO Action verb is equal to PO2 verb. Therefore, the correlation is high (3)
PO 4: Analysis (L4)
CO Action Verb is equal to PO4; Therefore, correlation is high (3)
CO Action Verb Analyze is of BTL 4. Using Thumb rule, L4 correlates PO10 as moderate (3).

B.Tech. – I Year II Semester

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits	Scheme of Examination (Max. Marks)		
				L	T/CLC	P	C	CIE	SEE	Total
1	HM	23AHM9901	Communicative English	2	0	0	2	30	70	100
2	BS	23ABS9902	Engineering Chemistry	2	1	0	3	30	70	100
3	BS	23ABS9905	Differential Equations &Vector Calculus	2	1	0	3	30	70	100
4	ES	23AES0101	Basic Civil & Mechanical Engineering	2	1	0	3	30	70	100
5	PC	23APC0101	Engineering Mechanics	2	1	0	3	30	70	100
6	HM	23AHM9902	Communicative English Lab	0	0	2	1	30	70	100
7	BS	23ABS9907	Engineering Chemistry Lab	0	0	2	1	30	70	100
8	ES	23AES0302	Engineering Workshop	0	0	3	1.5	30	70	100
9	PC	23APC0102	Engineering Mechanics & Building Practices Lab	0	0	3	1.5	30	70	100
10	HM	23AHM9903	Health and wellness, Yoga and Sports	-	-	1	0.5	50	-	50
Total Credits				**10**	**4**	**11**	**19.5**	**320**	**630**	**950**

I YEAR II SEMESTER

Subject Code	Subject Name	L	T/CLC	P	CREDITS
23AHM9901	COMMUNICATIVE ENGLISH	2	0	0	2

Course Outcomes: After studying the course, students will be able to

CO1	Understand reading / listening texts and to write summaries based on global comprehension of these texts**. (Listening & Reading)**
CO2	Apply grammatical structures to formulate sentences and correct word forms**. (Grammar)**
CO3	Analyze discourse markers to speak clearly on a specific topic in formal and informal conversations. (**Speaking)**
CO4	Analyze a coherent paragraph interpreting graphic elements, figure/graph/chart/table **(Read & Write)**
CO5	Create a coherent essay, letter writing, report writing and design a resume**. (Writing)**

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Understand	reading / listening texts and to write summaries based on global comprehension of these texts.			L2
2	Apply	grammatical structures to formulate sentences and correct word forms			L3
3	Analyze	discourse markers to speak clearly on a specific topic in formal and informal conversations			L4
4	Analyze	coherent paragraph interpreting a graphic element.			L4
5	Create	coherent essay, letter writing, report writing and design a resume			L6

UNIT-I

Lesson: HUMAN VALUES: Gift of Magi **(Short Story)**
Listening: Identifying the topic, the context and specific pieces of information by listening to short audio texts and answering a series of questions.
Speaking: Asking and answering general questions on familiar topics such as home, family, work, studies and interests; introducing oneself and others.
Reading: Skimming to get the main idea of a text; scanning to look for specific pieces of information.
Writing: Mechanics of Writing-Capitalization, Spellings, Punctuation-Parts of Sentences.
Grammar: Parts of Speech, Basic Sentence Structures-forming questions
Vocabulary: Synonyms, Antonyms, Affixes (Prefixes/Suffixes), Root words.

UNIT-II

Lesson: NATURE: The Brook by Alfred Tennyson (Poem)
Listening: Answering a series of questions about main ideas and supporting ideas after listening to audio texts.
Speaking: Discussion in pairs/small groups on specific topics followed by short structure talks.
Reading: Identifying sequence of ideas; recognizing verbal techniques that help to link the ideas in a paragraph together.
Writing: Structure of a paragraph - Paragraph writing (specific topics)
Grammar: Cohesive devices - linkers, use of articles and zero article; prepositions.

Vocabulary: Homonyms, Homophones, Homographs.

UNIT-III

Lesson: BIOGRAPHY: Elon Musk
Listening: Listening for global comprehension and summarizing what is listened to.
Speaking: Discussing specific topics in pairs or small groups and reporting what is discussed
Reading: Reading a text in detail by making basic inferences - recognizing and interpreting specific context clues; strategies to use text clues for comprehension.
Writing: Summarizing, Note-making, paraphrasing
Grammar: Verbs - tenses; subject-verb agreement**.**
Vocabulary: Compound words, Collocations

UNIT-IV

Lesson: INSPIRATION: The Toys of Peace by Saki
Listening: Making predictions while listening to conversations/ transactional dialogues without video; listening with video.
Speaking: Role plays for practice of conversational English in academic contexts (formal and informal) - asking for and giving information/directions.
Reading: Studying the use of graphic elements in texts to convey information, reveal trends/patterns/relationships, communicate processes or display complicated data.
Writing: Letter Writing: Official Letters, Resumes, Cover letters
Grammar: Reporting verbs, Direct & Indirect speech, Active & Passive Voice
Vocabulary: Words often confused, Jargons

UNIT-V

Lesson: MOTIVATION: The Power of Intrapersonal Communication (An Essay)
Listening: Identifying key terms, understanding concepts and answering a series of relevant questions that test comprehension.
Speaking: Formal oral presentations on topics from academic contexts
Reading: Reading comprehension.
Writing: Writing structured essays on specific topics.
Grammar: Editing short texts –identifying and correcting common errors in grammar and usage (articles, prepositions, tenses, subject verb agreement)
Vocabulary: Idiom and phrases & Phrasal verbs

TEXTBOOKS:

1. Pathfinder: Communicative English for Undergraduate Students, 1st Edition, Orient Black Swan, 2023 (Units 1,2 & 3)
2. Empowering with Language by Cengage Publications, 2023 (Units 4 & 5)

REFERENCES:

1. Dubey, Sham Ji& Co. English for Engineers, Vikas Publishers, 2020
2. Bailey, Stephen. Academic writing: A Handbook for International Students. Routledge, 2014.
3. Murphy, Raymond. English Grammar in Use, Fourth Edition, Cambridge University Press, 2019.
4.Lewis, Norman. Word Power Made Easy- The Complete Handbook for Building a Superior Vocabulary. Anchor, 2014.

WEB RESOURCES:
GRAMMAR:
1. www.bbc.co.uk/learningenglish

2. https://dictionary.cambridge.org/grammar/british-grammar/
3. www.eslpod.com/index.html
4. https://www.learngrammar.net/
5. https://english4today.com/english-grammar-online-with-quizzes/
6. https://www.talkenglish.com/grammar/grammar.aspx

VOCABULARY:

1. https://www.youtube.com/c/DailyVideoVocabulary/videos
2. https://www.youtube.com/channel/UC4cmBAit8i_NJZE8qK8sfpA

CORRELATION OF COS WITH THE POS & PSOS:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1										2			
CO2									2	2			
CO3										3			
CO4										3			
CO5										3			

CO-PO MAPPING JUSTIFICATION:

Unit No	Course Outcomes					Program Outcome (PO)	PO(s): Action Verb and BTL(for PO1 to PO11)	Level of Correlation (0-3)
	Lesson Plan Hrs	%	Correlation	CO's Action Verb	BTL			
1	12	22	3	Understand	L2	PO10	Thumb Rule	2
2	12	22	3	Apply	L3	PO9 PO10	Thumb Rule	2 2
3	10	18	2	Analyze	L4	PO10	Thumb Rule	3
4	10	18	2	Analyze	L4	PO10	Thumb Rule	3
5	10	18	2	Create	L6	PO10	Thumb Rule	3

JUSTIFICATION STATEMENTS:

CO1: Understand reading / listening text and to write summaries based on global comprehension of these texts.
Action Verb: Understand (L2)
CO1 Action Verb Understand is of BTL 2. Using Thumb rule, L2 correlates PO6 to PO11 as moderate (2).

CO2: Apply grammatical structures to formulate sentences and correct word forms.
Action Verb: Apply (L3)
CO2 Action Verb Apply is of BTL 3. Using Thumb rule, L3 correlates PO6 to PO11 as moderate (2) & (2)

CO3: Analyze discourse markers to speak clearly on a specific topic in Formal and informal Conversations.
Action Verb: Analyze (L4)
CO3 Action Verb Analyze is of BTL 4. Using Thumb rule, L4 correlates PO6 to PO11 as high (3).

CO4: Analyze a coherent paragraph interpreting graphic elements, figure/graph/chart/table (Read & Write)
Action Verb: Analyze (L4)
CO4 Action Verb Analyze is of BTL 4. Using Thumb rule, L6 correlates PO6 to PO11 as high (3).

CO5: Create a coherent essay, letter writing, report writing and design a resume. (Writing)
Action Verb: Create(L6)
CO5 Action Verb Create is of BTL 6. Using Thumb rule, L5 correlates PO6 to PO11 as high (3).

I YEAR II SEMESTER

Subject Code	Subject Name	L	T/CLC	P	CREDITS
23ABS9902	ENGINEERING CHEMISTRY	2	1	0	3

Course Outcomes: After studying the course, students will be able to

CO1	Understand the purification techniques to remove hardness of water
CO2	Apply the electrochemical principles to the energy storage devices and corrosion prevention techniques
CO3	Analyze the preparation of polymers, elastomers and fuels
CO4	Analyze the properties of lubricants, Refractories, composites and cement.
CO5	Analyze the properties of colloids and nano materials

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Understand	Purification techniques		to remove hardness of water	L2
2	Apply	electrochemical principles to the energy storage devices and corrosion prevention techniques			L3
3	Analyze	preparation of polymers, elastomers and fuels			L4
4	Analyze	properties of lubricants, Refractories, composites and cement			L4
5	Analyze	Properties of colloids and nano materials			L4

UNIT-I (WATER TECHNOLOGY)

Soft and hard water, Estimation of hardness of water by EDTA Method, Estimation of dissolved Oxygen - Boiler troubles –Priming, foaming**,** scale and sludge, Caustic embrittlement, Industrial water treatment – Specifications for drinking water, Bureau of Indian Standards (BIS) and World health organization (WHO) standards, Ion-exchange processes - desalination of brackish water, reverse osmosis (RO) and electrodialysis.

UNIT-II (ELECTROCHEMISTRY AND APPLICATIONS)

Electrodes –electrochemical cell, Nernst equation, cell potential calculations. Primary cells – Zinc-air battery, Secondary cells – Nickel-Cadmium (NiCad), and lithium-ion batteries- working principle of the batteries including cell reactions; Fuel cells-Basic Concepts, the principle and working of hydrogen-oxygen Fuel cell.

Corrosion: Introduction to corrosion, electrochemical theory of corrosion, differential aeration cell corrosion, galvanic corrosion, metal oxide formation by dry corrosion, Pilling Bedworth ratios and uses, Factors affecting the corrosion**,** cathodic and anodic protection, electroplating and electro less plating (Nickel and Copper).

UNIT-III (POLYMERS AND FUEL CHEMISTRY)

Introduction to polymers, functionality of monomers, Mechanism of chain growth, step growth polymerization. Thermoplastics and Thermo-setting plastics-: Preparation, properties and applications of poly styrene. PVC Nylon 6,6 and Bakelite.

Elastomers – Preparation, properties and applications of Buna S, Buna N, Thiokol rubbers.

Fuels – Types of fuels, calorific value of fuels, numerical problems based on calorific value; Analysis of coal (Proximate and Ultimate analysis), Liquid Fuels, refining of petroleum, Octane and Cetane number- alternative fuels propane, methanol, ethanol and bio fuel-bio diesel.

UNIT-IV (MODERN ENGINEERING MATERIALS)

Composites- Definition, Constituents, Classification- Particle, Fibre and Structural reinforced composites,
properties and Engineering applications.
Refractories- Classification, Properties, Factors affecting the refractory materials and Applications.
Lubricants- Classification, Functions of lubricants, Mechanism, Properties of lubricating oils – Viscosity, Viscosity Index, Flash point, Fire point, Cloud point, saponification and Applications.
Building materials- Portland Cement, constituents, Setting and Hardening of cement.

UNIT-V (SURFACE CHEMISTRY AND NANOMATERIALS)

Introduction to surface chemistry, colloids, nanometals and nanometal oxides, micelle formation, synthesis of colloids (Braggs Method), chemical and biological methods of preparation of nanometals and metal oxides, stabilization of colloids and nanomaterials by stabilizing agents, adsorption isotherm (Freundlich and Longmuir), BET equation (no derivation) applications of colloids and nanomaterials – catalysis, medicine, sensors, etc.

TEXTBOOKS:

1. Jain and Jain, Engineering Chemistry, 16/e, DhanpatRai, 2013.
2. Peter Atkins, Julio de Paula and James Keeler, Atkins' Physical Chemistry, 10/e, Oxford University Press, 2010.

REFERENCES:

1. H.F.W. Taylor, Cement Chemistry, 2/e, Thomas Telford Publications, 1997.
2. D.J.Shaw, Introduction to Colloids and Surface Chemistry, Butterworth-Heineman, 1992. Textbook of Polymer Science, Fred W. Billmayer Jr, 3rd Edition.

CORRELATION OF COS WITH THE POS & PSOS:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2												
CO2	3												
CO3		3											
CO4		3											
CO5		3											

CO-PO MAPPING JUSTIFICATION:

Unit No	Course Outcomes					Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
	Lesson Plan Hrs	%	Correlation	CO's Action Verb	BTL			
1	12	18.4	3	Understand	L2	PO1	Apply (L3)	2

2	22	33.8	3	Apply	L3	PO1	Apply (L#)	3
3	12	18.4	3	Analyze	L4	PO2	Analyze (L)	3
4	6	9.2	1	Analyze	L4	PO2	Analyze (L)	3
5	13	20	3	Analyze	L4	PO2	Analyze (L5)	3

JUSTIFICATION STATEMENTS:

CO1: Understand the purification techniques to remove hardness of water
Action Verb: Understand (L2)
PO1 Verbs: Apply (L3)
CO1 Action Verb is less than PO1 verb by one level; Therefore, correlation is moderate (2).

CO2: Apply the electrochemical principles to the energy storage devices and corrosion prevention techniques
Action Verb: Apply (L3)
PO1 Verbs: Apply (L3)
CO2 Action Verb is equal to PO1 verb; Therefore, correlation is high (3).

CO3: Analyze the preparation of polymers and fuels
Action Verb: Analyze (L4)
PO2 Verb: Analyze (L4)
CO3 Action Verb level is equal to PO2 verb; Therefore, correlation is high (3).

CO4: Analyse the properties of lubricants, Refractories, composites and cement.
Action Verb: Analyze (L4)
PO2 Verb: Analyze (L4)
CO4 Action Verb level is equal to PO2 verb; Therefore, correlation is high (3).

CO5: Analyze the Properties of colloids and nano materials
Action Verb: Analyze (L4)
PO1 Verb: Analyze (L4)
CO5 Action verb is equal to PO2 verb; Therefore, the correlation is high (3).

I YEAR II SEMESTER

Subject Code	Subject Name	L	T/CLC	P	CREDITS
23ABS9905	DIFFERENTIAL EQATIONS AND VECTOR CALCULUS	2	1	0	3

Course Outcomes: After studying the course, students will be able to

CO1	Apply the concepts of ordinary differential equations of first order and first degree.
CO2	Apply the methods of linear differential equations related to various engineering problems.
CO3	Analyze the solutions of partial differential equations using Lagrange's method.
CO4	Understand the different operators and identities in the vector calculus.
CO5	Evaluate the surface integral and volume integral in the vector calculus using various theorems

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Apply	The concepts of ordinary differential equations.		of first order and first degree	L3
2	Apply	The methods of linear differential equations related to various engineering problems			L3
3	Analyze	The solutions of partial differential equations	Using Lagrange's method		L4
4	Understand	different operators and identities in he vector calculus.			L2
5	Evaluate	the surface integral and volume integral in the vector calculus	Using various theorems		L5

UNIT-I (LINEAR DIFFERENTIAL EQUATIONS OF FIRST ORDER AND FIRST DEGREE)
Linear differential equations-Bernoulli's equations-Exat equations and equations reducible to exact form. Applications: Newton's Law of cooling-Law of natural growth and decay-Electrical circuits.
UNIT-II (EQUATIONS REDUCIBLE TO LINEAR DIFFERENTIAL EQUATIONS & APPLICATIONS)
Definitions, homogeneous and non-homogeneous, complimentary function, general solution, particular integral, Wronskian, Method of variation of parameters. Simultaneous linear equations, Applications to L-C- R circuit problems and simple harmonic motion.
UNIT-III (PARTIAL DIFFERENTIAL EQUATIONS)
Introduction and formation of partial differential Equations by elimination of arbitrary constants and arbitrary functions, solutions of first order linear equations using Lagrange's method. Homogeneous Linear Partial differential equations with constant coefficients.
UNIT-IV (VECTOR DIFFERENTIATION)
Scalar and vector point functions, vector operator del, del applies to scalar point functions-Gradient, Directional derivative, del applied to vector point functions-Divergence and Curl, vector identities.
UNIT-V (VECTOR INTEGRATION)

Line integral-circulation-work done, surface integral-flux, Green's theorem in the plane (without proof), Stoke's theorem (without proof), volume integral, Divergence theorem (without proof) and applications of these theorems.

TEXTBOOKS:

1. B. S. Grewal, Higher Engineering Mathematics, 44th Edition, Khanna publishers, 2017.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, John Wiley & Sons, 2011.

REFERENCES:

1. Dr.T.K.V.Iyengar, Engineering Mathematics-I,S.Chand publishers
2. R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, 3/e, Alpha Science International Ltd., 2002
3. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi publication,2008
4. B. V. Ramana, Higher Engineering Mathematics, McGraw Hill Education.

CORRELATION OF COS WITH THE POS & PSOS:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3												
CO2	3												
CO3		3											
CO4	2												
CO5		3											

CO-PO MAPPING JUSTIFICATION:

Unit No	Course Outcomes					Program Outcome (PO)	PO(s): Action Verb and BTL(for PO1 to PO11)	Level of Correlation (0-3)
	Lesson Plan Hrs	%	Correlation	CO's Action Verb	BTL			
1	14	20.8	3	Apply	L3	PO1	Apply	3
2	15	22.3	3	Apply	L3	PO1	Apply	3
3	14	20.8	3	Analyze	L4	PO2	Analyze	3
4	9	13.4	2	Understand	L2	PO1	Apply	2
5	15	22.3	3	Evaluate	L5	PO2	Analyze	3

JUSTIFICATION STATEMENTS:

CO1: Apply the concepts of ordinary differential equations of first order and first degree.
Action Verb: Apply(L3)
PO1 Verbs: Apply(L3)
CO1 Action Verb is equal to PO1 verb Therefore correlation is high (3).

CO2: Apply the methods of linear differential equations related to various engineering problems.
Action Verb: Apply (L3)
PO1 Verbs: Apply (L3)
CO2 Action Verb is equal to PO1 verb; Therefore, correlation is high (3).

CO3: Analyze the solutions of partial differential equations.
Action Verb: Analyze(L4)

PO2 Verb: Analyze (L4)
CO3 Action Verb level is equal to PO2 verb; Therefore, correlation is high (3).

CO4: Understand the different operators and identities in the vector calculus.
Action Verb: Understand(L2)
PO1 Verb: Apply(L3)
CO4 Action Verb is low level to PO1 to one level; Therefore, correlation is moderate (2).

CO5: Evaluate the surface integral and volume integral in the vector calculus.
Action Verb: Evaluate(L5)
PO2 Verb: Analyze (L4)
CO5 Action verb is high level to PO2 verb; therefore, the correlation is high (3).

I YEAR II SEMESTER

Subject Code	Subject Name	L	T/CL C	P	CREDITS
23AES0101	BASIC CIVIL & MECHANICAL ENGINEERING	2	1	0	3

Course Outcomes: After studying the course, students will be able to

CO1	Understand various sub-divisions of Civil Engineering and to appreciate their role in ensuring better society
CO2	Apply the methods of surveying in finding the measurements on Earth surface
CO3	Understand the importance of transportation, water resources and environmental engineering

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Understand	Various sub-divisions of Civil Engineering		Role in ensuring better society	L2
2	Apply	Methods of surveying	Finding the measurements	On Earth surface	L2
3	Understand	Importance of transportation, water resources and environmental engineering			L2

PART-A
BASIC CIVIL ENGINEERING

UNIT-I (BASICS OF CIVIL ENGINEERING)

Role of Civil Engineers in Society- Various Disciplines of Civil Engineering- Structural Engineering- Geotechnical Engineering- Transportation Engineering Hydraulics and Water Resources Engineering - Environmental Engineering-Scope of each discipline - Building Construction and Planning- Construction Materials-Cement - Aggregate - Bricks- Cement concrete- Steel. Introduction to Prefabricated construction Techniques.

UNIT-II (SURVEYING)

Objectives of Surveying- Horizontal Measurements- Angular Measurements- Introduction to Bearings Levelling instruments used for levelling -Simple problems on levelling and bearings- Contour mapping.

UNIT-III (TRANSPORTATION, WATER RESOURCES AND ENVIRONMENTAL ENGINEERING)

Transportation Engineering: Importance of Transportation in Nation's economic development- Types of Highway Pavements- Flexible Pavements and Rigid Pavements - Simple Differences. Basics of Harbour, Tunnel, Airport, and Railway Engineering.

Water Resources and Environmental Engineering: Introduction, Sources of water- Quality of water- Specifications- Introduction to Hydrology–Rainwater Harvesting-Water Storage and Conveyance Structures (Simple introduction to Dams and Reservoirs).

TEXTBOOKS:

1. Basic Civil Engineering, M.S.Palanisamy, , Tata Mcgraw Hill publications (India) Pvt. Ltd. Fourth Edition.

2. Introduction to Civil Engineering, S.S. Bhavikatti, New Age International Publishers. 2022. First Edition.
3. Basic Civil Engineering, Satheesh Gopi, Pearson Publications, 2009, First Edition

REFERENCES:

1. Surveying, Vol- I and Vol-II, S.K. Duggal, Tata McGraw Hill Publishers 2019. Fifth Edition
2. Hydrology and Water Resources Engineering, Santosh Kumar Garg, Khanna Publishers, Delhi. 2016
3. Irrigation Engineering and Hydraulic Structures - Santosh Kumar Garg, Khanna Publishers, Delhi 2023. 38th Edition
4. Highway Engineering, S.K.Khanna, C.E.G. Justo and Veeraraghavan, Nemchand and Brothers Publications 2019. 10th Edition
5. Indian Standard DRINKING WATER — SPECIFICATION IS 10500-2012

PART B
BASICS OF MECHANICAL ENGINEERING

Course Outcomes: After studying the course, students will be able to

CO4	Understand the applications and role of various materials in Mechanical Engineering.
CO5	Understand the different manufacturing processes and the basics of thermal engineering with its applications.
CO6	Understand the working of different mechanical power transmission systems, power plants and applications of robotics.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
4	**Understand**	applications and role of various materials in Mechanical Engineering			L2
5	**Understand**	different manufacturing processes and the basics of thermal engineering with its applications			L2
6	**Understand**	working of different mechanical power transmission systems, power plants and applications of robotics			L2

UNIT-I
Introduction to Mechanical Engineering: Role of Mechanical Engineering in Industries and Society- Technologies in different sectors such as Energy, Manufacturing, Automotive, Aerospace, and Marine sectors. **Engineering Materials -** Metals-Ferrous and Non-ferrous, Ceramics, Composites, Smart materials.
UNIT-II
Manufacturing Processes: Principles of Casting**,** Forming, joining processes, Machining, Introduction to CNC machines, 3D printing, and Smart manufacturing. **Thermal Engineering** – working principle of Boilers, Otto cycle, Diesel cycle, Refrigeration and air-conditioning cycles, IC engines, 2-Stroke and 4-Stroke engines, SI/CI Engines, Components of Electric and Hybrid Vehicles.

UNIT-III
Power plants – working principle of Steam, Diesel, Hydro, Nuclear power plants. **Mechanical Power Transmission -** Belt Drives, Chain, Rope drives, Gear Drives and their applications. **Introduction to Robotics -** Joints & links, configurations, and applications of robotics. (Note: The subject covers only the basic principles of Civil and Mechanical Engineering systems. The evaluation shall be intended to test only the fundamentals of the subject)

TEXTBOOKS:

1. Internal Combustion Engines by V.Ganesan, By Tata McGraw Hill publications (India) Pvt. Ltd.
2. A Tear book of Theory of Machines by S.S. Rattan, Tata McGraw Hill Publications, (India) Pvt. Ltd.
3. An introduction to Mechanical Engg by Jonathan Wicker and Kemper Lewis, Cengage learning India Pvt. Ltd.

REFERENCES:

1. Appuu Kuttan KK, Robotics, I.K. International Publishing House Pvt. Ltd. Volume-I
2. 3D printing & Additive Manufacturing Technology- L. Jyothish Kumar, Pulak M Pandey, Springer publications
3. Thermal Engineering by Mahesh M Rathore Tata McGraw Hill publications (India) Pvt. Ltd.
4. G. Shanmugam and M.S.Palanisamy, Basic Civil and the Mechanical Engineering, Tata McGraw Hill publications (India) Pvt. Ltd.

CORRELATION OF COS WITH THE POS & PSOS:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2				2							
CO2	3	2				2							
CO3	2	2				2							
CO4	2					2							
CO5	2					2							
CO6	2				2	2							

CO-PO MAPPING JUSTIFICATION:

Unit No	Course Outcomes					Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
	Lesson Plan Hrs	%	Correlation	CO's Action Verb	BTL			
1	11	33	2	Understand	L2	PO1 PO2 PO6	Apply (L3) Analyze (L3) Thumb Rule	2 2 2
2	12	34	3	Apply	L3	PO1 PO2 PO6	Apply (L3) Analyze (L3) Thumb Rule	3 2 2
3	11	33	2	Understand	L2	PO1 PO2 PO6	Apply (L3) Analyze (L3) Thumb Rule	2 2 2

4	9	30	3	**Understand**	L2	PO1 PO6	Identify-L3 Thumb Rule	2 2
5	12	40	3	**Understand**	L2	PO1 PO6	Identify-L3 Thumb Rule	2 2
6	9	30	3	**Understand**	L2	PO1 PO5 PO6	Apply - L3 Apply-L3 Thumb Rule	2 2 2

JUSTIFICATION STATEMENTS:

CO1: Understand various sub-divisions of Civil Engineering and to appreciate their role in ensuring better society.
Action Verb: Understand (L2)
PO1 Verb: Apply (L3)
CO1 Action verb is not same level as PO1 verb. Therefore, the correlation is medium (2)
PO2 Verb: Analyze(L4)
CO1 Action verb is not same level as PO2 verb. Therefore, the correlation is medium (2)
PO7 Verb: Thumb Rule
CO1 correlates medium with PO6. Therefore, the correlation is medium (2)

CO2: Apply the methods of surveying in finding the measurements on Earth surface.
Action Verb: Apply (L3)
PO1 Verb: Apply (L3)
CO2 Action verb is same level as PO1 verb. Therefore, the correlation is high (3)
PO2 Verb: Analyze(L4)
CO2 Action verb is not same level as PO2 verb. Therefore, the correlation is medium (2)
PO6 Verb: Thumb Rule
CO2 correlates medium with PO6. Therefore, the correlation is medium (2)

CO3: Understand the importance of transportation, water resources and environmental engineering.
Action Verb: Understand (L2)
PO1 Verb: Apply (L3)
CO3 Action verb is not same level as PO1 verb. Therefore, the correlation is medium (2)
PO2 Verb: Analyze(L4)
CO3 Action verb is not same level as PO2 verb. Therefore, the correlation is medium (2)
PO7 Verb: Thumb Rule
CO3 correlates medium with PO7. Therefore, the correlation is medium (2)

CO4: Understand the applications and role of various materials in Mechanical Engineering.
Action Verb: Understand (L2)
PO1 Verb: Apply (L3)
CO4 Action verb is less than PO1 verb by one level. Therefore, the correlation is medium (2)
PO3 Verb: Review-L2
CO4 Action verb is same level as PO2 verb. Therefore, the correlation is high (3)
PO7 Verb: Thumb Rule
CO4 correlates moderately with PO6. Therefore, the correlation is medium (2).

CO5: Understand the different manufacturing processes and the basics of thermal engineering with its applications.
Action Verb: Understand (L2)
PO1 Verb: Apply (L3)
CO5 Action verb is less than PO1 verb by one level. Therefore, the correlation is medium (2)
PO3 Verb: Review-L2

CO5 Action verb is same level as PO2 verb. Therefore, the correlation is high (3)
PO7 Verb: Thumb Rule
CO5 correlates moderately with PO6. Therefore, the correlation is medium (2).

CO6: Understand the working of different mechanical power transmission systems, power plants and applications of robotics.
Action Verb: Understand (L2)
PO1 Verb: Apply (L3)
CO5 Action verb is less than PO1 verb by one level. Therefore, the correlation is medium (2)
PO3 Verb: Review-L2
CO5 Action verb is same level as PO2 verb. Therefore, the correlation is high (3)
PO7 Verb: Thumb Rule
CO5 correlates moderately with PO6. Therefore, the correlation is medium (2).

I YEAR II SEMESTER

Subject Code	Subject Name	L	T/CL C	P	CREDITS
23APC0101	ENGINEERING MECHANICS	2	1	0	3

Course Outcomes: After studying the course, students will be able to

CO1	Apply the concepts of system of forces and frictional forces for contact bodies
CO2	Analyze the different force systems to calculate their resultant forces and moments.
CO3	Apply the concepts of centroid and moment of inertia for different cross-sections.
CO4	Apply the principles of work-energy and impulse-momentum of rectilinear and curvilinear motion of a particle.
CO5	Apply the principles of work-energy and impulse-momentum of rigid body motion of a particle

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Apply	Concepts of system of forces and frictional forces	for contact bodies		L3
2	Analyze	To calculate their resultant forces and moments of different force systems			L4
3	Apply	Concepts of centroid and moment of inertia	For different cross-sections		L3
4	Apply	Principles of work-energy and impulse-momentum	Rectilinear and curvilinear motion for a particle		L3
5	Apply	Principles of work-energy and impulse-momentum	Rigid body motion for a particle		L3

UNIT-I
Introduction to Engineering Mechanics– Basic Concepts. Scope and Applications **Systems of Forces:** Coplanar Concurrent Forces– Components in Space–Resultant–Moment of Force and its Application –Couples and Resultant of Force Systems. **Friction:** Introduction**,** limiting friction and impending motion, Coulomb's laws of dry friction, coefficient of friction, Cone of Static friction.
UNIT-II
Equilibrium of Systems of Forces: Free Body Diagrams, Lami's Theorem, Equations of Equilibrium of Coplanar Systems, Graphical method for the equilibrium, Triangle law of forces, converse of the law of polygon of forces condition of equilibrium, Equations of Equilibrium for Spatial System of forces, Numerical examples on spatial system of forces using vector approach, Analysis of plane trusses. Principle of virtual work with simple examples.
UNIT-III
Centroid: Centroids of simple figures (from basic principles)–Centroids of Composite Figures.

Centre of Gravity: Centre of gravity of simple body (from basic principles), Centre of gravity of composite bodies, Pappus theorems. **Area Moments of Inertia:** Definition– Polar Moment of Inertia, Transfer Theorem, Moments of Inertia of Composite Figures, Products of Inertia, Transfer Formula for Product of Inertia. **Mass Moment of Inertia:** Moment of Inertia of Masses, Transfer Formula for Mass Moments of Inertia, Mass Moment of Inertia of composite bodies
UNIT-IV
Rectilinear and Curvilinear motion of a particle: Kinematics and Kinetics –D'Alembert's Principle Work Energy method and applications to particle motion-Impulse Momentum method.
UNIT-V
Rigid body Motion: Kinematics and Kinetics of translation, Rotation about fixed axis and plane motion, Work Energy method and Impulse Momentum method.

TEXTBOOKS:

1. Engineering Mechanics, S. Timoshenko, D. H. Young, J.V. Rao, S. Pati., , McGraw Hill Education 2017. 5th Edition.
2. Engineering Mechanics, P.C.Dumir- S.Sengupta and Srinivas V veeravalli , University press. 2020. First Edition.
3. A Textbook of Engineering Mechanics, S.S Bhavikatti. New age international publications 2018. 4th Edition.

REFERENCES:

1. Engineering Mechanics, Statics and Dynamics, Rogers and M A. Nelson., McGraw Hill Education. 2017. First Edition.
2. Engineering Mechanics, Statics and Dynamics, I.H. Shames., PHI, 2002. 4th Edition.
3. Engineering Mechanics, Volume-I: Statics, Volume-II: Dynamics, J. L. Meriam and L. G. Kraige., John Wiley, 2008. 6th Edition.
4. Introduction to Statics and Dynamics, Basudev Battachatia, Oxford University Press, 2014. Second Edition
5. Engineering Mechanics: Statics and Dynamics, Hibbeler R.C., Pearson Education, Inc., New Delhi, 2022, 14th Edition

WEB RESOURCES:

1. https://koha.srmap.edu.in/cgi-bin/koha/opac detail.pl?biblionumber=11522&shelfbrowse_itemnumber=2306

CORRELATION OF COS WITH THE POS & PSOS:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2				2							
CO2	2	3		3		3							
CO3	3	2				2							
CO4	3	2				2							
CO5	3	2				2							

CO-PO MAPPING JUSTIFICATION:

	Course Outcomes	Program		Level of

Unit No	Lesson Plan Hrs	%	Correlation	CO's Action Verb	BTL	Outcome (PO)	PO(s): Action Verb and BTL(for PO1 to PO11)	Correlation (0-3)
1	15	20	3	Apply	L3	PO1 PO2 PO6	Apply (L3) Analyze (L4) Thumb Rule	3 2 2
2	15	20	3	Analyze	L4	PO1 PO2 PO4 PO6	Apply (L3) Analyze (L3) Analyze (L4) Thumb Rule	3 3 3 3
3	15	20	3	Apply	L3	PO1 PO2 PO6	Apply (L3) Analyze (L4) Thumb Rule	3 2 2
4	15	20	3	Apply	L3	PO1 PO2 PO6	Apply (L3) Analyze (L4) Thumb Rule	3 2 2
5	15	20	3	Apply	L3	PO1 PO2 PO6	Apply (L3) Analyze (L4) Thumb Rule	3 2 2

JUSTIFICATION STATEMENTS:

CO1: Apply the concepts of system of forces and frictional forces for contact bodies
Action Verb: Apply (L3)
PO1 Verb: Apply (L3)
CO1 Action verb is equal to the level of PO1 verb. Therefore, the correlation is high (3)
PO2 Verb: Analyze (L4)
CO1 Action verb is above the level of PO2 verb. Therefore, the correlation is medium (2)
PO6 Verb: Thumb Rule
CO1 correlates highly with PO6. Therefore, the correlation is high (3)

CO2: Analyze the different force systems to calculate their resultant forces and moments.
Action Verb: Analyze (L4)
PO1 Verb: Apply (L3)
CO2 Action verb is above the level of PO1 verb. Therefore, the correlation is high (3)
PO2 Verb: Analyze(L4)
CO2 Action verb is above the level of PO2 verb. Therefore, the correlation is high (3)
PO4 Verb: Analyze(L4)
CO2 Action verb is above the level of PO4 verb. Therefore, the correlation is high (3)
PO6 Verb: Thumb Rule
CO2 correlates highly with PO6. Therefore, the correlation is high (3)

CO3: **Apply the concepts of centroid and moment of inertia for different cross-sections.**
Action Verb: Apply (L3)
PO1 Verb: Apply (L3)
CO3 Action verb is equal to the level of PO1 verb. Therefore, the correlation is high (3)
PO2 Verb: Analyze (L4)
CO3 Action verb is above the level of PO2 verb. Therefore, the correlation is medium (2)
PO6 Verb: Thumb Rule
CO3 correlates highly with PO6. Therefore, the correlation is high (3)

CO4: Apply the principles of work-energy and impulse-momentum of rectilinear and curvilinear motion of a particle.

Action Verb: Apply (L3)
PO1 Verb: Apply (L3)
CO4 Action verb is equal to the level of PO1 verb. Therefore, the correlation is high (3)
PO2 Verb: Analyze (L4)
CO4 Action verb is above the level of PO2 verb. Therefore, the correlation is medium (2)
PO6 Verb: Thumb Rule
CO4 correlates highly with PO6. Therefore, the correlation is high (3)

CO5: Apply the principles of work-energy and impulse-momentum of rigid body motion of a particle.
Action Verb: Apply (L3)
PO1 Verb: Apply (L3)
CO5 Action verb is equal to the level of PO1 verb. Therefore, the correlation is high (3)
PO2 Verb: Analyze (L4)
CO5 Action verb is above the level of PO2 verb. Therefore, the correlation is medium (2)
PO6 Verb: Thumb Rule
CO5 correlates highly with PO6. Therefore, the correlation is high (3)

I YEAR I SEMESTER

Subject Code	Subject Name	L	T/CL C	P	CREDITS
23AHM9902	COMMUNICATIVE ENGLISH LAB	0	0	2	1

Course Outcomes: After studying the course, students will be able to

CO1	Understand the different aspects of the English language proficiency with emphasis on LSRW skills.
CO2	Apply communication skills through various language learning activities.
CO3	Analyze the English speech sounds, for better listening and speaking.
CO4	Evaluate and exhibit professionalism in participating in debates and group discussions.
CO5	Analyze themselves to face interviews in future.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Understand	the different aspects of the English language proficiency with emphasis on LSRW skills.			L2
2	Apply	communication skills through various language learning activities.			L3
3	Analyze	the English speech sounds, for better listening and speaking.			L4
4	Evaluate	and exhibit professionalism in participating in debates and group discussions			L5
5	Analyze	themselves to face interviews in future			L5

LIST OF EXPERIMENTS

1. Vowels & Consonants (CO3)
2. Non Verbal Communication (CO2)
3. Communication Skills(CO2)
4. Role Play or Conversational Practice (CO1, CO2)
5. E-mail Writing (CO1)
6. Just A Minute (CO1, CO2)
7. Group Discussions-methods & practice (CO4)
8. Debates-Methods & Practice (CO4)
9. PPT Presentations/ Poster Presentation (CO2)
10. Interviews Skills (CO5)

SUGGESTED SOFTWARE:

- WaldenInfotech
- YoungIndiaFilms

REFERENCES:

1. Raman Meenakshi, Sangeeta-Sharma. *Technical Communication*. OxfordPress.2018.
2. Taylor Grant: *English Conversation Practice*, TataMcGraw-HillEducationIndia,2016
3. Hewing's, Martin. Cambridge *Academic English* (B2). CUP, 2012.
4. J.Sethi & P.V.Dhamija.*A Course in Phonetics and Spoken English*,(2ndEd),Kindle,2013.

WEB RESOURCES:

Spoken English:

1. www.esl-lab.com
2. www.englishmedialab.com
3. www.englishinteractive.net
4. https://www.britishcouncil.in/english/online
5. http://www.letstalkpodcast.com/
6. https://www.youtube.com/c/mmmEnglish_Emma/featured
7. https://www.youtube.com/c/ArnelsEverydayEnglish/featured
8. https://www.youtube.com/c/engvidAdam/featured
9. https://www.youtube.com/c/EnglishClass101/featured
10. https://www.youtube.com/c/SpeakEnglishWithTiffani/playlists
11. https://www.youtube.com/channel/UCV1h_cBE0Drdx19qkTM0WNw

Voice & Accent:

1. https://www.youtube.com/user/letstalkaccent/videos
2. https://www.youtube.com/c/EngLanguageClub/featured
3. https://www.youtube.com/channel/UC_OskgZBoS4dAnVUgJVexc
4. https://www.youtube.com/channel/UCNfm92h83W2i2ijc5Xwp_IA

CORRELATION OF COS WITH THE POS & PSOS:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1										2			
CO2									2	2			
CO3										3			
CO4									3	3			
CO5										3			

CO-PO MAPPING JUSTIFICATION:

CO	CO		Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
	Verb	BTL			
1	Understand	L2	PO10	Thumb Rule	2
2	Apply	L3	PO9 PO10	Thumb Rule Thumb Rule	2 2
3	Analyze	L4	PO10	Thumb Rule	3
4	Evaluate	L5	PO9 PO10	Thumb Rule Thumb Rule	3 3
5	Analyze	L5	PO10	Thumb Rule	3

JUSTIFICATION STATEMENTS:

CO1: Understand the different aspects of the English language proficiency with emphasis on LSRW skills
Action Verb: Understand (L2)
CO1 Action Verb is understand of BTL 2. Using Thumb rule, L2 correlates PO6 to PO11 as moderate (2).

CO2: Apply communication skills through various language learning activities.
Action Verb: Apply (L3)
CO2 Action Verb is Apply of BTL 3. Using Thumb rule, L3 correlates PO6 to PO11 as moderate (2).

CO3: Analyze the English speech sounds, for better listening and speaking.
Action Verb: Analyze (L4)
CO3 Action Verb is Analyze of BTL 4. Using Thumb rule, L4 correlates PO6 to PO11 as high (3).

CO4: Evaluate and exhibit professionalism in participating in debates and group discussions.
Action Verb: Evaluate (L5)
CO4 Action Verb is Evaluate of BTL 5. Using Thumb rule, L5 correlates PO6 to PO11 as high (3).

CO5: Analyze themselves to face interviews in future.
Action Verb: Develop (L4)
CO5 Action Verb is Analyze of BTL 4. Using Thumb rule, L4 correlates PO6 to PO11 as high (3).

I YEAR II SEMESTER

Subject Code	Subject Name	L	T/CL C	P	CREDITS
23ABS9907	ENGINEERING CHEMISTRY LAB	0	0	2	1

Course Outcomes: After studying the course, students will be able to

CO1	Estimate the hardness of water.
CO2	Prepare advanced polymer materials.
CO3	Measure the strength of an acid present in secondary batteries.
CO4	Estimate the Iron and Calcium in cement.
CO5	Determine the physical properties like surface tension, adsorption and viscosity.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Estimate	Hardness of water			L5
2	Prepare	Advanced polymer Bakelite materials			L4
3	Measure	Strength of an acid present in secondary batteries.			L4
4	Estimate	Iron and Calcium in cement			L5
5	Determine	Physical properties like surface tension, adsorption and viscosity			L4

LIST OF EXPERIMENTS

1. Determination of Hardness of a groundwater sample (CO1)
2. Estimation of Dissolved Oxygen by Winkler's method (CO3)
3. Determination of Strength of an acid in Pb-Acid battery (CO3)
4. Preparation of a polymer (Bakelite) (CO2)
5. Determination of percentage of Iron in Cement sample by colorimetry (CO4)
6. Estimation of Calcium in port land Cement (CO4)
7. Preparation of nanomaterials by precipitation method (CO5)
8. Adsorption of acetic acid by charcoal (CO4)
9. Determination of percentage Moisture content in a coal sample (CO4)
10. Determination of Viscosity of lubricating oil by Redwood Viscometer 1(CO5)
11. Determination of Viscosity of lubricating oil by Redwood Viscometer 2 (CO5)
12. Estimation of copper by Iodometry (CO3)

Note: Any TEN of the listed experiments are to be conducted. Out of which any TWO Experiments may be conducted in virtual mode.

REFERENCES:

1. Vogel's Quantitative Chemical Analysis 6th Edition 6th Edition

CORRELATION OF COS WITH THE POS & PSOS:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1				3									
CO2				3									
CO3				3									
CO4				3									
CO5				3									

CO-PO MAPPING JUSTIFICATION:

CO	CO		Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
	Verb	BTL			
1	Estimate	L5	PO4	Analyze (L4)	3
2	Prepare	L4	PO4	Analyze (L4)	3
3	Measure	L4	PO4	Analyze (L4)	3
4	Estimate	L5	PO4	Analyze (L4)	3
5	Determine	L4	PO4	Analyze (L4)	3

JUSTIFICATION STATEMENTS:

CO1: Estimate the hardness of water.
Action Verb: Estimate (L5)
PO4 Verb: Analyze (L4)
CO1 Action Verb is greater than PO4; Therefore, correlation is high (3)

CO2: Prepare advanced polymer Bakelite materials.
Action Verb: Prepare (L4)
PO4 Verb: Analyze (L4)
CO2 Action Verb is equal to PO4 verb; Therefore, correlation is high (3)

CO3: Measure the strength of an acid present in secondary batteries.
Action Verb: Measure (L4)
PO4 Verb: Analyze (L4)
CO3 Action Verb is equal to PO4 verb; Therefore, correlation is high (3)
CO4: Estimate the Iron and Calcium in cement.
Action Verb: Estimate (L5)
PO4 Verb: Analyze (L4)
CO4 Action Verb is greater than PO4; Therefore, correlation is high (3)
CO5: Determine the physical properties like surface tension, adsorption and viscosity.
Action Verb: Determine (L4)
PO4 Verb: Analyze (L4)
CO5 Action Verb is equal to PO4 verb; Therefore, correlation is high (3)

I YEAR II SEMESTER

Subject Code	Subject Name	L	T/CL C	P	CREDITS
23AES0302	ENGINEERING WORKSHOP	0	0	3	1.5

Course Outcomes: After studying the course, students will be able to

CO1	Apply the wood working skills to prepare different joints.
CO2	Analyze the sheet metal and fitting operations to prepare various components
CO3	Apply the basic electrical engineering knowledge for house wiring practice.
CO4	Apply the Welding process for Lap and Butt Joints.
CO5	Understand the various plumbing pipe joints

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Apply	the wood working skills to prepare different joints			L3
2	Analyze	the sheet metal and fitting operations to prepare various components			L4
3	Apply	the basic electrical engineering knowledge for house wiring practice			L3
4	Apply	the Welding process for Lap and Butt joints			L3
5	Understand	the various plumbing pipe joints			L2

LIST OF EXPERIMENTS

1. Demonstration: Safety practices and precautions to be observed in workshop.
2. Wood Working: Familiarity with different types of woods and tools used in wood working and make following joints.

a) Half – Lap joint b) Mortise and Tenon joint c) Corner Dovetail joint or Bridle joint

3. Sheet Metal Working: Familiarity with different types of tools used in sheet metal working, Developments of following sheet metal job from GI sheets.

a) Tapered tray b) Conical funnel c) Elbow pipe d) Brazing

4. Fitting: Familiarity with different types of tools used in fitting and do the following fitting exercises.

a) V-fit b) Dovetail fit c) Semi-circular fit d) Bicycle tire puncture and change of two-wheeler tyre

5. Electrical Wiring: Familiarity with different types of basic electrical circuits and make the following connections.

a) Parallel and series b) Two-way switch c) Godown lighting

d) Tube light e) Three phase motor f) Soldering of wires

6. Foundry Trade: Demonstration and practice on Moulding tools and processes, Preparation of Green Sand Moulds for given Patterns.
7. Welding Shop: Demonstration and practice on Arc Welding and Gas welding. Preparation of Lap joint and Butt joint.
8. Plumbing: Demonstration and practice of Plumbing tools, Preparation of Pipe joints with coupling for same diameter and with reducer for different diameters.

TEXTBOOKS:

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

REFERENCES:

1. Elements of Workshop Technology, Vol. I by S. K. Hajra Choudhury & Others, Media Promoters and Publishers, Mumbai. 2007, 14th edition
2. Workshop Practice by H. S. Bawa, Tata-McGraw Hill, 2004.

CORRELATION OF COS WITH THE POS & PSOS:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	3						3			3	3
CO2	3	3	3						3			3	3
CO3	3	3	3						3			3	3
CO4	3	3	3						3			3	3
CO5	2	2	2						2			3	3

CO-PO MAPPING JUSTIFICATION:

CO	CO		Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
	Verb	BTL			
1	Apply	L3	PO1 PO2 PO3 PO9	Apply-L3 Review-L2 Develop-L3 Thumb Rule-L3	3 3 3 3
2	Analyze	L4	PO1 PO2 PO3 PO9	Apply-L3 Review-L2 Develop-L3 Thumb Rule-L3	3 3 3 3
3	Apply	L3	PO1 PO2 PO3 PO9	Apply-L3 Review-L2 Develop-L3 Thumb Rule-L3	3 3 3 3
4	Apply	L3	PO1 PO2 PO3 PO9	Apply-L3 Review-L2 Develop-L3 Thumb Rule-L3	3 3 3 3
5	Understand	L2	PO1 PO2 PO3 PO9	Apply-L3 Review-L2 Develop-L3 Thumb Rule-L3	2 2 2 2

JUSTIFICATION STATEMENTS:

CO1: Apply the wood working skills to prepare different joints
Action Verb: Apply (L3)
PO1 Verb: Apply (L3)
CO1 Action verb is same level as PO1 verb. Therefore, the correlation is high (3)
PO2 Verb: Review (L2)
CO1 Action verb is same level as PO2 verb. Therefore, the correlation is high (3)
PO3 Verb: Develop (L3)

CO1 Action verb is same level as PO3 verb. Therefore, the correlation is high (3)
PO9 Verb: Thumb Rule
CO1 Action verb is same level as PO9 verb. Therefore, the correlation is high (3)

CO2: Analyze the sheet metal and fitting operations to prepare various components
Action Verb: Analyse (L4)
PO1 Verb: Apply (L3)
CO2 Action verb is same level (greater) as PO1 verb. Therefore, the correlation is high (3)
PO2 Verb: Review (L2)
CO2 Action verb is same level (greater) as PO2 verb. Therefore, the correlation is high (3)
PO3 Verb: Develop (L3)
CO2 Action verb is same level (greater) as PO3 verb. Therefore, the correlation is high (3)
PO9 Verb: Thumb Rule
CO2 Action verb is same level (greater) as PO9 verb. Therefore, the correlation is high (3)

CO3: Apply the basic electrical engineering knowledge for house wiring practice
Action Verb: Apply (L3)
PO1 Verb: Apply (L3)
CO3 Action verb is same level as PO1 verb. Therefore, the correlation is high (3)
PO2 Verb: Review (L2)
CO3 Action verb is same level as PO2 verb. Therefore, the correlation is high (3)
PO3 Verb: Develop (L3)
CO3 Action verb is same level as PO3 verb. Therefore, the correlation is high (3)
PO9 Verb: Thumb Rule
CO3 Action verb is same level as PO9 verb. Therefore, the correlation is high (3)

CO4: Apply the Welding process for Lap and Butt Joints
Action Verb: Apply (L3)
PO1 Verb: Apply (L3)
CO4 Action verb is same level as PO1 verb. Therefore, the correlation is high (3)
PO2 Verb: Review (L2)
CO4 Action verb is same level as PO2 verb. Therefore, the correlation is high (3)
PO3 Verb: Develop (L3)
CO4 Action verb is same level as PO3 verb. Therefore, the correlation is high (3)
PO9 Verb: Thumb Rule
CO4 Action verb is same level as PO9 verb. Therefore, the correlation is high (3)

CO5: Understand the various plumbing pipe joints.
Action Verb: Understand (L2)
PO1 Verb: Apply (L2)
CO5 Action verb is less than as PO1 verb. Therefore, the correlation is high (2)
PO2 Verb: Review (L2)
CO5 Action verb is less than as PO2 verb. Therefore, the correlation is high (2)
PO3 Verb: Develop (L3)
CO5 Action verb is less than as PO3 verb. Therefore, the correlation is high (2)
PO9 Verb: Thumb Rule
CO5 Action verb is less than as PO9 verb. Therefore, the correlation is high (2)

I YEAR I SEMESTER

Subject Code	Subject Name	L	T/CL C	P	CREDITS
23APC0102	ENGINEERING MECHANICS & BUILDING PRACTICES LAB	0	0	3	1.5

Course Outcomes: After studying the course, students will be able to

CO1	Evaluate the forces, coefficient of friction between two different surfaces, inclined plane and the roller
CO2	Analyze the Polygon law of forces and Law of Moment using bell crank lever.
CO3	Evaluate the Centre of gravity for different cross-sections
CO4	Understand the Quality Testing and principles of Non- Destructive Testing for building materials.
CO5	Understand the tools, plumbing practices and safety measures in building construction.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Evaluate	the forces, coefficient of friction between two different surfaces, inclined plane and the roller			L5
2	Analyze	the Polygon law of forces and Law of Moment using bell crank lever.			L4
3	Evaluate	the Centre of gravity	for different cross-sections		L5
4	Understand	the Quality Testing and principles of Non- Destructive Testing	for building materials.		L2
5	Understand	the tools, plumbing practices and safety measures	in building construction.		L2

LIST OF EXPERIMENTS

1. To study various types of tools used in construction-CO5
2. Forces in Pin Jointed Trusses-CO1
3. Experimental Proof of Lami's Theorem-CO1
4. Verification of Polygon law of forces-CO2
5. Determination of Center of Gravity of different shaped Plane Lamina-CO3
6. Determination of coefficient of Static and Rolling Friction-CO1
7. Verification of Law of Moment using Rotation Disc Apparatus and Bell Crank Lever-CO2
8. Study of Alternative Materials like M-sand, Fly ash, Sea Sand etc.-CO4
9. Field-Visit to understand the Quality Testing – report-CO4
10. Safety Practices in Construction industry-CO5
11. Demonstration of Non-Destructive Testing - using Rebound Hammer & UPV-CO4
12. Study of Plumbing in buildings-CO5

NOTE: Students have to perform any 10 of the following Experiments

CORRELATION OF COS WITH THE POS & PSOS:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3		3		3							
CO2	3	3		3		3							
CO3	3	3		3		3							
CO4	2	1				2							
CO5	2	1				2							

CO-PO MAPPING JUSTIFICATION:

CO	CO		Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
	Verb	BTL			
1	Evaluate	L5	PO1 PO2 PO4 PO6	Apply (L3) Analyze (L4) Analyze (L4) Thumb Rule	3 3 3 3
2	Analyze	L4	PO1 PO2 PO4 PO6	Apply (L3) Analyze (L4) Analyze (L4) Thumb Rule	3 3 3 3
3	Evaluate	L5	PO1 PO2 PO4 PO6	Apply (L3) Analyze (L4) Analyze (L4) Thumb Rule	3 3 3 3
4	Understand	L2	PO1 PO2 PO6	Apply-L3 Apply-L3 Thumb Rule	2 1 2
5	Understand	L2	PO1 PO2 PO6	Apply-L3 Apply-L3 Thumb Rule	2 1 2

JUSTIFICATION STATEMENTS:

CO1: Evaluate the forces, coefficient of friction between two different surfaces, inclined plane and the roller.

Action Verb: Evaluate (L5)
PO1 Verb: Apply (L3)
CO1 Action verb is above the level of PO1 verb. Therefore, the correlation is high (3)
PO2 Verb: Analyze(L4)
CO1 Action verb is above the level of PO2 verb. Therefore, the correlation is high (3)
PO4 Verb: Analyze(L4)
CO1 Action verb is above the level of PO4 verb. Therefore, the correlation is high (3)
PO6 Verb: Thumb Rule
CO1 correlates highly with PO6. Therefore, the correlation is high (3)

CO2: Analyze the Polygon law of forces and Law of Moment using bell crank lever.

Action Verb: Analyze (L4)
PO1 Verb: Apply (L3)
CO2 Action verb is above the level of PO1 verb. Therefore, the correlation is high (3)
PO2 Verb: Analyze(L4)

CO2 Action verb is above the level of PO2 verb. Therefore, the correlation is high (3)
PO4 Verb: Analyze(L4)
CO2 Action verb is above the level of PO4 verb. Therefore, the correlation is high (3)
PO6 Verb: Thumb Rule
CO2 correlates highly with PO6. Therefore, the correlation is high (3)

CO3: Evaluate the Centre of gravity for different cross-sections
Action Verb: Analyze (L4)
PO1 Verb: Apply (L3)
CO2 Action verb is above the level of PO1 verb. Therefore, the correlation is high (3)
PO2 Verb: Analyze(L4)
CO2 Action verb is above the level of PO2 verb. Therefore, the correlation is high (3)
PO4 Verb: Analyze(L4)
CO2 Action verb is above the level of PO4 verb. Therefore, the correlation is high (3)
PO6 Verb: Thumb Rule
CO2 correlates highly with PO6. Therefore, the correlation is high (3)

CO4: Understand the Quality Testing and principles of Non- Destructive Testing for building materials.
Action Verb: Understand (L2)
PO1 Verb: Apply (L3)
CO4 Action verb is not as same level as PO1 verb. Therefore, the correlation is medium (2)
PO2 Verb: Analyze (L4)
CO4 Action verb is not as same level as PO2 verb. Therefore, the correlation is low (1)
PO7 Verb: Thumb Rule
CO4 correlates medium with PO6. Therefore, the correlation is medium (2)

CO5: Understand the tools, plumbing practices and safety measures in building construction.
Action Verb: Understand (L2)
PO1 Verb: Apply (L3)
CO5 Action verb is not as same level as PO1 verb. Therefore, the correlation is medium (2)
PO2 Verb: Analyze (L4)
CO5 Action verb is not as same level as PO2 verb. Therefore, the correlation is low (1)
PO7 Verb: Thumb Rule
CO5 correlates medium with PO6. Therefore, the correlation is medium (2)

I YEAR II SEMESTER

Subject Code	Subject Name	L	T/CL C	P	CREDITS
23AHM9903	HEALTH AND WELLNESS, YOGA AND SPORTS	0	0	1	0.5

Course Objectives:

The main objective of introducing this course is to make the students maintain their mental and physical wellness by balancing emotions in their life. It mainly enhances the essential traits required for the development of the personality.

Course Outcomes: After studying the course, students will be able to

CO1	Understand the health & fitness by diet
CO2	Understand the importance of yoga.
CO3	Apply The yoga practices including Surya Namaskar
CO4	Understand the importance of sports.
CO5	Analyze various activities that help enhance their health & Positive Personality

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Understand	Health & fitness by diet			L2
2	Understand	Importance of yoga.			L2
3	Apply	yoga practices including Surya Namaskar			L3
4	Understand	Importance of sports			L2
5	Analyze	Various activities that help enhance their health & Positive Personality			L5

UNIT I
Concept of health and fitness, Nutrition and Balanced diet, basic concept of immunity Relationship between diet and fitness, Globalization and its impact on health, Body Mass Index (BMI) of all age groups. **Activities:** i) Organizing health awareness programmes in community ii) Preparation of health profile iii) Preparation of chart for balance diet for all age groups
UNIT II
Concept of yoga, need for and importance of yoga, origin and history of yoga in Indian context, classification of yoga, Physiological effects of Asanas- Pranayama and meditation, stress management and yoga, Mental health and yoga practice. **Activities:** Yoga practices – Asana, Kriya, Mudra, Bandha, Dhyana, Surya Namaskar
UNIT III
Concept of Sports and fitness, importance, fitness components, history of sports, Ancient and Modern Olympics, Asian games and Commonwealth games.

Activities:

i) Participation in one major game and one individual sport viz., Athletics, Volleyball, Basketball, Handball,
Football, Badminton, Kabaddi, Kho-kho, Table tennis, Cricket etc.
Practicing general and specific warm up, aerobics
ii) Practicing cardiorespiratory fitness, treadmill, run test, 9 min walk, skipping and running.

REFERENCES:

1. Gordon Edlin, Eric Golanty. Health and Wellness, 14th Edn. Jones & Bartlett Learning, 2022
2. T.K.V.Desikachar. The Heart of Yoga: Developing a Personal Practice
3. Archie J.Bahm. Yoga Sutras of Patanjali, Jain Publishing Company, 1993
4. Wiseman, John Lofty, SAS Survival Handbook: The Ultimate Guide to Surviving Anywhere Third Edition, William Morrow Paperbacks, 2014
5.The Sports Rules Book/ Human Kinetics with Thomas Hanlon. -- 3rd ed. Human Kinetics, Inc.2014

GENERAL GUIDELINES:

1. Institutes must assign slots in the Timetable for the activities of Health/Sports/Yoga.
2. Institutes must provide field/facility and offer the minimum of five choices of as many as Games/Sports.
3. Institutes are required to provide sports instructor / yoga teacher to mentor the students.

EVALUATION GUIDELINES:

- Evaluated for a total of 100 marks.
- A student can select 6 activities of his/her choice with a minimum of 01 activity per unit. Each activity shall be evaluated by the concerned teacher for 15 marks, totaling to 90 marks.
- A student shall be evaluated by the concerned teacher for 10 marks by conducting viva in the subject

CORRELATION OF COS WITH THE POS & PSOS:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1						2							
CO2						2							
CO3						2							
CO4						2							
CO5						3							

CO-PO MAPPING JUSTIFICATION:

CO	CO		Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
	Verb	BTL			
1	Understand	L2	PO6	Thumb Rule	2
2	Understand	L2	PO6	Thumb Rule	2
3	Apply	L3	PO6	Thumb Rule	2
4	Understand	L2	PO6	Thumb Rule	2
5	Analyze	L5	PO6	Thumb Rule	3

JUSTIFICATION STATEMENTS:

CO1: Understand the health & fitness by diet
Action Verb: Understand (L2)

CO1 Action Verb is Understand of BTL 2. Using Thumb rule; L2 correlates PO6 as a moderate (2)

CO2: Understand the Importance of yoga
Action Verb: Understand (L2)
CO2 Action Verb is Understand of BTL 2. Using Thumb rule; L2 correlates PO6 as a moderate (2)

CO3: Apply yoga practices including Surya Namaskar
Action Verb: APPLY (L3)
CO3 Action Verb is APPLY of BTL 2. Using Thumb rule; L2 correlates PO6 as a moderate (2)

CO4: Understand Importance of sports
Action Verb: Understand (L2)
CO4 Action Verb is Understand of BTL 2. Using Thumb rule; L2 correlates PO6 as a moderate (2)
Action Verb: APPLY (L3)

CO5: Analyze the Various activities that help enhance their health & Positive Personality
Action Verb: Analyze (L4)
CO5 Action Verb is Analyze of BTL 2. Using Thumb rule; L4 correlates PO6 as a moderate (2)

B.Tech. – II Year I Semester

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits	Scheme of Examination (Max. Marks)		
				L	T/CLC	P	C	CIE	SEE	Total
1	BS	23ABS9909	Numerical and Statistical Methods	2	1	0	3	30	70	100
2	HM	23AHM9905	Universal Human Values–Understanding Harmony and Ethical Human Conduct	2	1	0	3	30	70	100
3	PC	23APC0103	Surveying	2	1	0	3	30	70	100
4	PC	23APC0104	Strength of Materials	2	1	0	3	30	70	100
5	PC	23APC0105	Fluid Mechanics	2	1	0	3	30	70	100
6	PC	23APC0106	Surveying Lab	0	0	3	1.5	30	70	100
7	PC	23APC0107	Strength of Materials Lab	0	0	3	1.5	30	70	100
8	SC	23ASC0101	Building Planning and Drawing	0	1	2	2	30	70	100
Total Credits				**10**	**06**	**08**	**20**	**240**	**560**	**800**

II YEAR I SEMESTER

Subject Code	Subject Name	L	T/CL C	P	CREDITS
23ABS9909	NUMERICAL & STATISTICAL METHODS	2	1	0	3

Course Outcomes: After studying the course, students will be able to

CO1	Analyze relevant numerical techniques for interpolation and concepts of curve fitting
CO2	Apply the different iteration methods to solve Algebraic, Transcendental and Simultaneous Equations
CO3	Evaluate different numerical methods with accuracy and efficiency for ordinary differential equations.
CO4	Analyze the techniques for testing of hypothesis for large samples
CO5	Analyze the techniques for testing of hypothesis for small samples

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Analyze	relevant numerical techniques	for interpolation and concepts of curve fitting		L4
2	Apply	the different iteration methods	to solve Algebraic, Transcendental and Simultaneous Equations		L3
3	Evaluate	different numerical methods with accuracy and efficiency	for ordinary differential equations		L5
4	Analyze	the techniques for testing of hypothesis	for large samples		L4
5	Analyze	the techniques for testing of hypothesis	for small samples		L4

UNIT-I - SOLUTION OF ALGEBRAIC & TRANSCENDENTAL EQUATIONS
Introduction-Bisection Method-Iterative method, Regula-falsi method and Newton Raphson method System of Algebraic equations: Gauss Elimination, Jacoby and Gauss Siedal method.
UNIT-II INTERPOLATION
Finite differences-Newton's forward and backward interpolation formulae – Lagrange's formulae. Curve fitting: Fitting of straight line, second-degree and Exponential curve by method of least squares.
UNIT-III SOLUTION OF INITIAL VALUE PROBLEMS TO ORDINARY DIFFERENTIAL EQUATIONS
Numerical solution of Ordinary Differential equations: Solution by Taylor's series-Picard's Method of successive Approximations-Euler's and modified Euler's methods-Runge-Kutta methods (second and fourth order).
UNIT-IV ESTIMATION AND TESTING OF HYPOTHESIS, LARGE SAMPLE TESTS
Estimation-parameters, statistics, sampling distribution, point estimation, Formulation of null hypothesis, alternative hypothesis, the critical and acceptance regions, level of significance, two types of errors and power of the test. Large Sample Tests: Test for single proportion, difference of proportions, test for single mean and difference of means. Confidence interval for parameters in one sample and two sample problems
UNIT-V SMALL SAMPLE TESTS
Student t-distribution (test for single mean, two means and paired t-test), testing of equality ofvariances (F-

test), $\chi 2$ - test for goodness of fit, $\chi 2$ - test for independence of attributes.

TEXTBOOKS:

1. B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 2017, 44th Edition.
2. S S Sastry, Introductory Methods of Numerical Analysis, PHI Learning Private Limited.
3. R.K.Jain and S.R.K.Iyengar, Advanced Engineering Mathematics, Alpha Science International Ltd.,2021 5th Edition(9th reprint).

REFERENCES:

1. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, 2018, 10th Edition.
2. Ronald E. Walpole, Probability and Statistics for Engineers and Scientists, PNIE
3. B.V.Ramana, Higher Engineering Mathematics, Mc Graw Hill publishers.
4. S.Chand, Probability and Statistics by Dr.T.K.V.Iyengar, Dr.B.Krishna Gandhi, S.Ranganatham, Dr.M.V.S.S.N.Prasad

WEB RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc17_ma14/preview
2. https://onlinecourses.nptel.ac.in/noc24_ma05/preview
3. http://nptel.ac.in/courses/111105090

CORRELATION OF COS WITH THE POS & PSOS:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1		3											
CO2	3												
CO3		3											
CO4		3											
CO5		3											

CO-PO MAPPING JUSTIFICATION:

Unit No	Course Outcomes					Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
	Lesson Plan Hrs	%	Correlation	CO's Action Verb	BTL			
1				Analyze	L4	PO2	Analyze(L4)	3
2				Apply	L3	PO1	Apply(L3)	3
3				Evaluate	L5	PO2	Analyze(L4)	3
4				Analyze	L4	PO2	Analyze(L4)	3
5				Analyze	L4	PO2	Analyze(L4)	3

JUSTIFICATION STATEMENTS:

CO1: Analyze relevant numerical techniques for interpolation and concepts of curve fitting: Analyze (L4)

PO2 Verb: Analyze (L4)

CO2 Action Verb is equal to PO2 verb; Therefore, correlation is high (3).

CO2: Apply the different iteration methods to solve Algebraic, Transcendental and Simultaneous Equations: Apply (L3) PO1 Verb: **Apply** (L3)
CO1 Action Verb is equal to PO1 verb; Therefore, correlation is high (3).

CO3: Evaluate different numerical methods with accuracy and efficiency for ordinary differential equations: Evaluate (L5)
PO2 Verb: Analyze (L4)
CO3 Action verb is high level to PO2 verb; therefore, the correlation is high (3).

CO4: Analyze the techniques for testing of hypothesis for large samples: Analyze (L4).
PO2 Verb: Analyze (L4)
CO4 Action Verb level is equal to PO2 verb; Therefore, correlation is high (3).

CO5: Analyze the techniques for testing of hypothesis for small samples: Analyze (L4)
PO2 Verb: Analyze (L4)
CO5 Action verb is equal level to PO2 verb; therefore, the correlation is high (3).

II YEAR I SEMESTER

Subject Code	Subject Name	L	T/CLC	P	CREDITS
23AHM9905	UNIVERSAL HUMAN VALUES – UNDERSTANDING HARMONY AND ETHICAL HUMAN CONDUCT	2	1	0	3

Course Outcomes: After studying the course, students will be able to

CO1	Understand the essentials of human values, self-exploration, happiness and prosperity for value added education.
CO2	Analyze the harmony in the human being as sentient 'I' and the material 'Body' in various aspects.
CO3	Apply the nine universal human values in relationships for harmony in the family and orderliness in the society.
CO4	Evaluate the interconnectedness of four orders of nature and holistic perception of harmony at all levels of existence.
CO5	Apply the holistic understanding of harmony on professional ethics through augmenting universal human order.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Understand	the essentials of human values, self-exploration, happiness and prosperity for value added education.			L2
2	Analyze	the harmony in the human being as sentient 'I' and the material 'Body' in various aspects.			L4
3	Apply	the nine universal human values in relationships for harmony in the family and orderliness in the society.			L3
4	Evaluate	the interconnectedness of four orders of nature and holistic perception of harmony at all levels of existence.			L5
5	Apply	the holistic understanding of harmony on professional ethics through augmenting universal human order.			L3

UNIT-I INTRODUCTION TO VALUE EDUCATION (6 LECTURES AND 3 TUTORIALS FOR PRACTICE SESSION)

Lecture 1: Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education)
Lecture 2: Understanding Value Education
Tutorial 1: Practice Session PS1 Sharing about Oneself
Lecture 3: self-exploration as the Process for Value Education
Lecture4: Continuous Happiness and Prosperity – the Basic Human Aspirations
Tutorial 2: Practice Session PS2 Exploring Human Consciousness
Lecture 5: Happiness and Prosperity – Current Scenario
Lecture 6: Method to Fulfill the Basic Human Aspirations
Tutorial 3: Practice Session PS3 Exploring Natural Acceptance

UNIT-II HARMONY IN THE HUMAN BEING (6 LECTURES AND 3 TUTORIALS FOR PRACTICE SESSION)

Lecture 7: Understanding Human being as the Co-existence of the self and the body.
Lecture 8: Distinguishing between the Needs of the self and the body
Tutorial 4: Practice Session PS4 Exploring the difference of Needs of self and body.
Lecture 9: The body as an Instrument of the self
Lecture 10: Understanding Harmony in the self
Tutorial 5: Practice Session PS5 Exploring Sources of Imagination in the self
Lecture 11: Harmony of the self with the body
Lecture 12: Programme to ensure self-regulation and Health
Tutorial 6: Practice Session PS6 Exploring Harmony of self with the body

UNIT-III HARMONY IN THE FAMILY AND SOCIETY (6 LECTURES AND 3 TUTORIALS FOR PRACTICE SESSION)

Lecture 13: Harmony in the Family – the Basic Unit of Human Interaction
Lecture 14: 'Trust' – the Foundational Value in Relationship
Tutorial 7: Practice Session PS7 Exploring the Feeling of Trust
Lecture 15: 'Respect' – as the Right Evaluation
Tutorial 8: Practice Session PS8 Exploring the Feeling of Respect
Lecture 16: Other Feelings, Justice in Human-to-Human Relationship
Lecture 17: Understanding Harmony in the Society
Lecture 18: Vision for the Universal Human Order
Tutorial 9: Practice Session PS9 Exploring Systems to fulfil Human Goal

UNIT-IV HARMONY IN THE NATURE/EXISTENCE (4 LECTURES AND 2 TUTORIALS FOR PRACTICE SESSION)

Lecture 19: Understanding Harmony in the Nature
Lecture 20: Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature
Tutorial 10: Practice Session PS10 Exploring the Four Orders of Nature
Lecture 21: Realizing Existence as Co-existence at All Levels
Lecture 22: The Holistic Perception of Harmony in Existence
Tutorial 11: Practice Session PS11 Exploring Co-existence in Existence.

UNIT-V IMPLICATIONS OF THE HOLISTIC UNDERSTANDING – A LOOK AT PROFESSIONAL ETHICS (6 LECTURES AND 3 TUTORIALS FOR PRACTICE SESSION)

Lecture 23: Natural Acceptance of Human Values
Lecture 24: Definitiveness of (Ethical) Human Conduct
Tutorial 12: Practice Session PS12 Exploring Ethical Human Conduct
Lecture 25: A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order
Lecture 26: Competence in Professional Ethics
Tutorial 13: Practice Session PS13 Exploring Humanistic Models in Education
Lecture 27: Holistic Technologies, Production Systems and Management Models-Typical Case Studies
Lecture 28: Strategies for Transition towards Value-based Life and Profession
Tutorial 14: Practice Session PS14 Exploring Steps of Transition towards Universal Human Order

TEXTBOOKS:

a. The Textbook
R R Gaur, R Asthana, G P Bagaria, *A Foundation Course in Human Values and Professional Ethics*, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1
b. The Teacher's Manual
R R Gaur, R Asthana, G P Bagaria,*Teachers' Manual for A Foundation Course in Human Values and Professional Ethics,* 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2

REFERENCES:

1. JeevanVidya: EkParichaya, A Nagaraj, JeevanVidyaPrakashan, 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
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj – PanditSunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland (English)

WEB RESOURCES:

1. https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%201-Introduction%20to%20Value%20Education.pdf
2. https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%202-Harmony%20in%20the%20Human%20Being.pdf
3. https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%203-Harmony%20in%20the%20Family.pdf
4. https://fdp-si.aicte-india.org/UHV%201%20Teaching%20Material/D3-S2%20Respect%20July%2023.pdf
5. https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%205-Harmony%20in%20the%20Nature%20and%20Existence.pdf
6. https://fdp-si.aicte-india.org/download/FDPTeachingMaterial/3-days%20FDP-SI%20UHV%20Teaching%20Material/Day%203%20Handouts/UHV%203D%20D3-S2A%20Und%20Nature-Existence.pdf
7. https://fdp-si.aicte-india.org/UHV%20II%20Teaching%20Material/UHV%20II%20Lecture%2023-25%20Ethics%20v1.pdf

8. https://www.studocu.com/in/document/kiet-group-of-institutions/universal-human-values/chapter-5-holistic-understanding-of-harmony-on-professional-ethics/62490385
https://onlinecourses.swayam2.ac.in/aic22_ge23/preview

CORRELATION OF COS WITH THE POS & PSOS:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1								2			2		
CO2							3	3					
CO3						2	2	2					
CO4						3	3	3			3		
CO5						2	2	2			2		

CO-PO MAPPING JUSTIFICATION:

Unit No	Course Outcomes					Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
	Lesson Plan Hrs	%	Correlation	CO's Action Verb	BTL			
1	7	19.4	2	Understand	2	PO8 PO11	Thumb Rule Thumb Rule	2 2
2	8	22.2	3	Analyze	4	PO7 PO8	Thumb Rule Thumb Rule	3 3
3	7	19.4	2	Apply	3	PO6 PO7 PO8	Thumb Rule Thumb Rule Thumb Rule	2 2 2
4	8	22.2	3	Evaluate	5	PO6 PO7 PO8 PO11	Thumb Rule Thumb Rule Thumb Rule Thumb Rule	3 3 3 3
5	7	19.4	2	Apply	3	PO6, PO7, PO8, PO11	Thumb Rule Thumb Rule Thumb Rule Thumb Rule	2 2 2 2

JUSTIFICATION STATEMENTS:

CO1: Understand the essentials of human values, self-exploration, happiness and prosperity for value added education.
Action Verb: Understand (L2)
CO1 Action Verb is Understand of BTL 2. Using Thumb rule, L2 correlates PO6 to PO11 as moderate (2).

CO2: Analyze the harmony in the human being as sentient 'I' and the material 'Body' in various aspects.
Action Verb: Analyze (L4)
CO2 Action Verb is Analyze of BTL 4. Using Thumb rule, L4 correlates PO6 to PO11 as high (3).

CO3: Apply the nine universal human values in relationships for harmony in the family and orderliness in the society.
Action Verb: Apply (L3)
CO3 Action Verb is Apply of BTL 3. Using Thumb rule, L3 correlates PO6 to PO11 as moderate (2)

CO4: Evaluate the interconnectedness of four orders of nature and holistic perception of harmony at all levels of existence.
Action Verb: Evaluate (L5)
CO4 Action Verb is Evaluate of BTL5. Using Thumb rule, L5 correlates PO6 to PO11 as high (3).

CO5: Apply the holistic understanding of harmony on professional ethics through augmenting universal human order.
Action Verb: Apply (L3)
CO5 Action Verb is Apply of BTL 3. Using Thumb rule, L3 correlates PO6 to PO11 as moderate (2).

II YEAR I SEMESTER

Subject Code	Subject Name	L	T/CL C	P	CREDITS
23APC0103	SURVEYING	2	1	0	3

Course Outcomes: After studying the course, students will be able to

CO1	Understand the basics of linear and angular measurements using different methods
CO2	Apply the concepts of leveling, contouring and computing of Areas and Volumes in earthworks
CO3	Apply trigonometrical leveling techniques to determine elevations in field scenarios.
CO4	Apply knowledge of curves and basic principles of modern surveying technologies.
CO5	Understand the fundamentals of photogrammetry and its applications for surveying.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Understand	the basics of linear and angular measurements			L2
2	Apply	the concepts of leveling, contouring & the techniques of computing Areas and Volumes		In field works	L3
3	Apply	the concepts of Theodolite survey		In field works	L3
4	Apply	the simple horizontal circular curves, Modern Surveying	in the survey system	for buildings and highway culverts	L3
5	Understand	the fundamentals of photogrammetry	in the survey system		L2

UNIT-I
Introduction and Basic Concepts: Introduction, Objectives, classification and principles of surveying, Surveying accessories. Introduction to Compass, leveling and Plane table surveying. **Linear distances-** Approximate methods, Direct Methods- Chains- Tapes, ranging, Tape corrections. **Prismatic Compass**- Bearings, included angles, Local Attraction, Magnetic Declination and dip and W.C.B and Q.B systems of locating bearings.
UNIT-II
Leveling- Types of levels, methods of leveling, and Determination of levels, Effect of Curvature of Earth and Refraction. **Contouring-** Characteristics and uses of Contours, methods of contour surveying. **Areas -** Determination of areas consisting of irregular boundary and regular boundary. **Volumes -**Determination of volume of earth work in cutting and embankments for level section, capacity of reservoirs.
UNIT-III
Theodolite Surveying: Types of Theodolites, temporary adjustments, measurement of horizontal angle by repetition method and reiteration method, measurement of vertical Angle, Trigonometrical leveling when base is accessible and inaccessible. **Traversing:** Methods of traversing, traverse computations and adjustments, Introduction to Omitted measurements.
UNIT-IV

Curves: Types of curves and their necessity, elements of simple, compound, reverse curves. Introduction to Tachometric Surveying.
Modern Surveying Methods: Principle and types of E.D.M. Instruments, Total station- advantages and Applications. Introduction to Global Positioning System. Introduction to Drone survey and LiDAR Survey (Light Detection And Ranging).

UNIT-V

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

TEXTBOOKS:

1. Surveying (Vol – 1 & 2) by Duggal S K, Tata McGraw Hill Publishing Co. Ltd. New Delhi, 5th edition, 2019.
2. Textbook of Surveying by C Venkatramaiah , Universities Press 1st Edition, 2011.

REFERENCES:

1. Surveying (Vol – 1), by B. C. Punmia, Ashok Kumar Jain and Arun Kumar Jain - Laxmi Publications (P) ltd., New Delhi, 18th edition 2024.
2. Surveying (Vol – 2), by B. C. Punmia, Ashok Kumar Jain and Arun Kumar Jain - Laxmi Publications (P) ltd., New Delhi 17th 2022.
3. Surveying (Vol – 3), by B. C. Punmia, Ashok Kumar Jain and Arun Kumar Jain - Laxmi Publications (P) ltd., New Delhi 16th 2023.
4. Plane Surveying and Higher Surveying‖ by Chandra A M, New age International Pvt. Ltd.,Publishers, New Delhi, 3rd Edition, 2015.
5. Surveying and Levelling by N.Basak Tata McGraw Hill Publishing Co. Ltd. New Delhi, 4th edition, 2014.
6. Surveying (Vol 1, 2 & 3), by Arora K R, Standard Book House, Delhi. Edition: 12th, 2015.

WEB RESOURCES:

https://koha.srmap.edu.in/cgi-bin/koha/opac detail.pl?biblionumber=11522&shelfbrowse_itemnumber=23066

CORRELATIONOFCOSWITHTHEPOS&PSOS:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	1				2							2
CO2	3	2				2							2
CO3	3	2				2							2
CO4	3	2				2							2
CO5	2	1				2							2

CO-POMAPPING JUSTIFICATION:

Unit No	Course Outcomes					Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
	Lesson Plan Hrs	%	Correlation	CO's Action Verb	BTL			
1				Understand	L2	PO1 PO2 PO6	Apply (L3) Analyze (L4) Thumb Rule	2 2 2
2				Apply	L3	PO1	Apply (L3)	3

						PO2 PO6	Analyze (L4) Thumb Rule	2 2
3				Apply	L3	PO1 PO2 PO6	Apply (L3) Analyze (L4) Thumb Rule	3 2 2
4				Apply	L3	PO1 PO2 PO6	Apply (L3) Analyze (L4) Thumb Rule	3 2 2
5				Understand	L2	PO1 PO2 PO6	Apply (L3) Analyze(L4) Thumb Rule	2 2 2

JUDGEMENT STATEMENTS:

CO 1: Understand the basics of linear and angular measurements using different methods
Action Verb: Understand (L2)
PO1: Apply(L3)
CO1 Action Verb is less than PO1 verb by one level; Therefore, correlation is moderate (2).
PO2: Analyze (L4)
CO1 Action Verb is less than PO2 verb by one level; Therefore, correlation is moderate (2).
CO1 Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO6 as moderate (2).

CO 2: Apply the concepts of leveling, contouring and computing of Areas and Volumes in earthworks
Action Verb: Apply (L3)
PO1: Apply(L3)
CO2 Action verb is equal to PO1 verb. Therefore, the correlation is high (3)
PO2: Analyze (L4)
CO2 Action Verb is low to PO2 verb. Therefore, the correlation is medium (2)
CO 2 Action verb Apply is of BTL 3. Using Thumb rule, L3 correlates PO6 as moderate (2).
CO 3: Apply trigonometrical leveling techniques to determine elevations in field scenarios.
Action Verb: Apply (L3)
PO1: Apply(L3)
CO3 Action verb is equal to PO1 verb. Therefore, the correlation is high (3)
PO2: Analyze (L4)
CO3 Action Verb is low to PO2 verb. Therefore, the correlation is medium (2)
CO 3 Action verb Apply is of BTL 3. Using Thumb rule, L3 correlates PO6 as moderate (2).
CO 4: Apply knowledge of curves and basic principles of modern surveying technologies.
Action Verb: Apply (L3)

PO1: Apply(L3)
CO4 Action verb is equal to PO1 verb. Therefore, the correlation is high (3)
PO2: Analyze (L4)
CO4 Action Verb is low to PO2 verb. Therefore, the correlation is medium (2)
CO 4 Action verb Apply is of BTL 3. Using Thumb rule, L3 correlates PO6 as moderate (2).

CO 5: Understand the fundamentals of photogrammetry and its applications for surveying.
Action Verb: Understand (L2)
PO1: Apply(L3)
CO1 Action Verb is less than PO1 verb by one level; Therefore, correlation is moderate (2).
PO2: Analyze (L4)
CO1 Action Verb is less than PO2 verb by one level; Therefore, correlation is moderate (2).
CO1 Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO6 as moderate (2).

II YEAR I SEMESTER

Subject Code	Subject Name	L	T/CLC	P	CREDITS
23APC0104	**STRENGTH OF MATERIALS**	**2**	**1**	**0**	**3**

Course Outcomes: After studying the course, students will be able to

CO1:	Analyze the behavior of composite bars under simple stresses and strains
CO2:	Apply concepts of shear force and bending moment for different load conditions on different types of beams
CO3:	Analyze the behavior of standard cross section subjected to bending, shear and torsional stresses
CO4:	Analyze the displacements of beams and springs using different methods
CO5:	Analyze the critical loads in columns and compound stresses in rigid bodies.

Course Outcomes	Action Verb	Knowledge Statement	Condition	Criteria	Blooms Level
1	Analyze	the behavior of composite bars		Under simple stresses and strains	L4
2	Apply	concepts of shear force and bending moment	For different load conditions	On different types of beams	L3
3	Analyze	The behavior of standard cross section		Subjected to bending, shear and torsional stresses	L4
4	Analyze	The displacement of beams and springs		Using different methods	L4
5	Analyze	the critical loads and compound stresses		in columns and rigid bodies	L4

UNIT-I
Simple Stresses and Strains: Elasticity and plasticity — Types of stresses and strains — Hooke's law — Factor of safety, Poisson's ratio - Relationship between Elastic constants — Bars of varying section — stresses in composite bars.
UNIT-II
Shear Force and Bending Moment: Definition of beam — Types of beams — Concept of shear force and bending moment — Point of contra flexure — Relation between S.F., B.M and rate of loading at a section of a beam; S.F and B.M diagrams for cantilever, simply supported and overhanging beams subjected to point loads, uniformly distributed loads, uniformly varying loads, partial uniformly distributed loads, couple and combination of these loads
UNIT-III
Flexural Stresses: Theory of simple bending — Assumptions — Derivation of bending equation, Neutral axis — Determination of bending stresses — section modulus of rectangular and circular sections (Solid and Hollow), I, T, Angle and Channel sections — Design of simple beams **Shear Stresses:** Derivation of formula — Shear stress distribution across various beam sections like rectangular, circular, I, T Angle sections. **Torsion** – circular shafts only
UNIT-IV

Deflection of Beams: Double integration and Macaulay's methods — Determination of slope and deflection for cantilever, simply supported and overhanging beams subjected different type of loading - Moment area method — application to simple cases of cantilever.

Springs:

Introduction – Types of springs – deflection of close and open coiled helical springs under axial pull and axial couple

UNIT-V

Columns: Introduction – Classification of columns – Axially loaded compression members – Euler's crippling load theory – Derivation of Euler's critical load formulae for various end conditions– Equivalent length – Slenderness ratio – Euler's critical stress – Limitations of Euler's theory – Rankine – Gordon formula – Eccentric loading and Secant formula – Prof. Perry's formula.

Introduction to Thin Cylinders and Compound Stresses:

Derivation of formula for longitudinal and circumferential stresses — hoop, longitudinal and volumetric strains — changes in diameter, and volume of thin cylinders.

Compound Stresses: Two-dimensional system, stress at a point on a plane, principal stresses and principal planes,

TEXTBOOKS:

1. R.K. Bansal, Strength of Materials, Lakshmi Publications House Pvt. Ltd, 2015.
2. R. Subramanian, Strength of Materials, Oxford University Press, 2016.
3. S Ramamrutham & R Narayan, Strength of Materials, Dhanpat Rai Publications, 2014

REFERENCES:

1. S.S.Bhavakatti, Strength of Materials, Third Edition, Vikas Publications.
2. S.Timoshenko, Strenth of Materilas Part- 2, Third Edition, CBS Publications.
3. R K Rajput, Strength of Materials, Fifth Edition, S.Chand Publications, 2012

CORRELATION OF COS WITH THE POS & PSOS:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3		3		3							2
CO2	3	2				2							2
CO3	3	3		3		3							2
CO4	3	3		3		3							2
CO5	3	3		3		3							2

CO-PO MAPPING JUSTIFICATION:

Unit No	Course Outcomes					Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
	Lesson Plan Hrs	%	Correlation	CO's Action Verb	BTL			
1	16/80	20	3	Analyze	L4	PO1 PO2 PO4 PO6	Apply (L3) Analyze (L4) Analyze (L4) Thumb Rule	3 3 3 3
2	16/80	20	3	Apply	L3	PO1 PO2 PO6	Apply (L3) Analyze (L4) Thumb Rule	3 2 2
3	16/80	20	3	Analyze	L4	PO1 PO2 PO4 PO6	Apply (L3) Analyze (L4) Analyze (L4) Thumb Rule	3 3 3 3
4	16/80	20	3	Analyze	L4	PO1 PO2 PO4	Apply (L3) Analyze (L4) Analyze (L4)	3 3 3

						PO6	Thumb Rule	3
5	16/80	20	3	Analyze	L4	PO1 PO2 PO4 PO6	Apply (L3) Analyze (L4) Analyze (L4) Thumb Rule	3 3 3 3

JUSTIFICATION STATEMENTS:

CO1: Analyze the behavior of composite bars under simple stresses and strains
Action Verb: Analyze (L4)
PO1: Apply(L3)
CO1 Action verb is greater than PO1 verb. Therefore, the correlation is high (3)
PO2: Analyze (L4)
CO1 Action verb is equal to PO2 verb. Therefore, the correlation is high (3)
PO 4: Analysis (L4)
CO1 Action Verb is equal to PO4; Therefore, correlation is high (3)
CO1 Action Verb Analyze is of BTL 4. Using Thumb rule, L4 correlates PO6 as moderate (3).

CO2: Apply concepts of shear force and bending moment for different load conditions on different types of beams
Action Verb: Apply (L3)
PO1: Apply(L3)
CO2 Action verb is equal to PO1 verb. Therefore, the correlation is high (3)
PO2: Analyze (L4)
CO2: Action Verb is low to PO2 verb. Therefore, the correlation is medium (2)
CO2 Action verb Apply is of BTL 3. Using Thumb rule, L3 correlates PO6 as moderate (2).

CO3: Analyze the behavior of standard cross section subjected to bending, shear and torsional stresses
Action Verb: Analyze (L4)
PO1: Apply(L3)
CO1 Action verb is greater than PO1 verb. Therefore, the correlation is high (3)
PO2: Analyze (L4)
CO1 Action verb is equal to PO2 verb. Therefore, the correlation is high (3)
PO 4: Analysis (L4)
CO1 Action Verb is equal to PO4; Therefore, correlation is high (3)
CO1 Action Verb Analyze is of BTL 4. Using Thumb rule, L4 correlates PO6 as moderate (3).

CO4: Analyze the displacements of beams using different methods (L4)
Action Verb: Analyze (L4)
PO1: Apply(L3)
CO1 Action verb is greater than PO1 verb. Therefore, the correlation is high (3)
PO2: Analyze (L4)
CO1 Action verb is equal to PO2 verb. Therefore, the correlation is high (3)
PO 4: Analysis (L4)
CO1 Action Verb is equal to PO4; Therefore, correlation is high (3)
CO1 Action Verb Analyze is of BTL 4. Using Thumb rule, L4 correlates PO6 as moderate (3).

CO5: Analyze the critical loads in columns and compound stresses in rigid bodies. **(L4)**
Action Verb: Analyze (L4)
PO1: Apply(L3)
CO1 Action verb is greater than PO1 verb. Therefore, the correlation is high (3)
PO2: Analyze (L4)
CO1 Action verb is equal to PO2 verb. Therefore, the correlation is high (3)
PO 4: Analysis (L4)

CO1 Action Verb is equal to PO4; Therefore, correlation is high (3)
CO1 Action Verb Analyze is of BTL 4. Using Thumb rule, L4 correlates PO6 as moderate (3).

II YEAR I SEMESTER

Subject Code	Subject Name	L	T/CL C	P	CREDITS
23APC0105	FLUID MECHANICS	2	1	0	3

Course Outcomes: After studying the course, students will be able to

CO1	Understand the basic characteristics and behavior of fluids
CO2	Apply the laws of fluid statics and concepts of Buoyancy
CO3	Apply the law of conservation of mass to differentiate type of flow in a pipe
CO4	Analyze the discharge of fluid flow in pipes using law of conservation of energy
CO5	Analyze the energy losses and flow characteristics through closed conduits

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Understand	Basic characteristics and behavior of fluids			L2
2	Apply	The laws of fluid statics and concepts of buoyancy			L3
3	Apply	The law of conservation of mass and Differentiate type of flow in a pipe			L3
4	Analyze	the discharge of fluid flow in pipes using law of conservation of energy			L4
5	Analyze	The energy losses and flow characteristics	through Closed Conduits		L4

UNIT-I
Basic concepts and definitions: Distinction between a fluid and a solid; Density, Specific weight, Specific gravity, Kinematic and dynamic viscosity; Variation of viscosity with temperature, Newton law of viscosity; Vapor pressure, Boiling point, Surface tension, Capillarity, Bulk modulus of elasticity, Compressibility.
UNIT-II
Fluid statics: Fluid Pressure: Pressure at a point, Pascal's law, pressure variation with temperature, density and altitude. Piezometer, U-Tube Manometer, Single Column Manometer, U Tube Differential Manometer. Pressure gauges, Hydrostatic pressure and force: horizontal, vertical and inclined surfaces. Buoyancy and stability of floating bodies.
UNIT-III
Fluid kinematics: Classification of fluid flow : steady and unsteady flow; uniform and non-uniform flow; laminar and turbulent flow; rotational and irrotational flow; compressible and incompressible flow; ideal and real fluid flow; one, two and three dimensional flows; Stream line, path line, streak line and stream tube; stream function, velocity potential function. One, two and three - Dimensional continuity equations in Cartesian coordinates.

UNIT-IV
Fluid Dynamics: Surface and body forces; Equations of motion - Euler's equation; Bernoulli's equation – Derivation; Energy Principle; Practical applications of Bernoulli's equation : Venturimeter, orifice meter and Pitot tube; Momentum principle; Forces exerted by fluid flow on pipe bend; Vortex Flow – Free and Forced; Definitions of Reynolds Number, Froude Number, Mach Number, Weber Number and Euler Number.
UNIT-V
Analysis Of Pipe Flow: Energy losses in pipelines; Darcy – Weisbach equation; Minor losses in pipelines; Hydraulic Grade Line and Total Energy Line; Concept of equivalent length – Pipes in Parallel and Series.

TEXTBOOKS:

1. P. M. Modi and S. M. Seth, Hydraulics and Fluid Mechanics, Standard Book House 22nd, 2019.
2. K. Subrahmanya, Theory and Applications of Fluid Mechanics, Tata McGraw Hill, 2nd edition 2018

REFERENCE BOOKS:

1. R. K. Bansal, A text of Fluid mechanics and hydraulic machines, Laxmi Publications
(P) Ltd., New Delhi 11th edition, 2024.
2. N. Narayana Pillai, Principles of Fluid Mechanics and Fluid Machines, Universities Press Pvt Ltd, Hyderabad. 3rd Edition 2009.
3. Fluid Mechanics by Frank M. White, Henry Xue, Tata McGraw Hill, 9th edition , 2022.
4. C. S. P. Ojha, R. Berndtsson and P. N. Chadramouli, Fluid Mechanics and Machinery, Oxford University Press, 2010.
5. Introduction to Fluid Mechanics & Fluid Machines by S K Som, Gautam Biswas, S Chakraborty Tata McGraw Hill, 3rd edition 2011.

ONLINE LEARNING RESOURCES:

https://archive.nptel.ac.in/courses/112/105/112105269/ https://nptel.ac.in/courses/112104118
https://nptel.ac.in/courses/105103192

CORRELATIONOFCOSWITHTHEPOS&PSOS:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	1				2							
CO2	3	2				2							
CO3	3	2				2							
CO4	2	3		3		3							
CO5	2	3		3		3							

CO-POMAPPINGJUSTIFICATION:

Unit No	Course Outcomes					Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
	Lesson Plan Hrs	%	Correlation	CO's Action Verb	BTL			
1				Understand	L2	PO1 PO2 PO7	Apply (L3) Analyze(L4) Thumb Rule	2 2 2
2				Apply	L3	PO1 PO2 PO6	Apply (L3) Analyze (L4) Thumb Rule	3 2 2

3				Apply	L3	PO1 PO2 PO6	Apply (L3) Analyze (L4) Thumb Rule	3 2 2
4				Analyze	L4	PO1 PO2 PO4 PO6	Apply (L3) Analyze (L4) Analyze (L4) Thumb Rule	2 3 3 3
5				Analyze	L4	PO1 PO2 PO4 PO6	Apply (L3) Analyze (L4) Analyze (L4) Thumb Rule	2 3 3 3

JUSTIFICATION STATEMENTS:

CO 1: Understand the basic characteristics and behavior of fluids

Action Verb: Understand (L2)

PO1: Apply(L3)

CO 1 Action Verb is less than PO1 verb by one level; Therefore, correlation is moderate (2).

PO2: Analyze (L4)

CO 1 Action Verb is less than PO2 verb by one level; Therefore, correlation is moderate (2).

CO 1 Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO6 as moderate (2).

CO 2: Apply the laws of fluid statics and concepts of Buoyancy

Action Verb: Apply (L3)

PO1: Apply(L3)

CO 2 Action verb is equal to PO1 verb. Therefore, the correlation is high (3)

PO2: Analyze (L4)

CO 2: Action Verb is low to PO2 verb. Therefore, the correlation is medium (2)

CO 2 Action verb Apply is of BTL 3. Using Thumb rule, L3 correlates PO6 as moderate (2).

CO 3: Apply the law of conservation of mass to differentiate type of flow in a pipe

Action Verb: Apply (L3)

PO1: Apply(L3)

CO 3 Action verb is equal to PO1 verb. Therefore, the correlation is high (3)

PO2: Analyze (L4)

CO 3 Action Verb is low to PO2 verb. Therefore, the correlation is medium (2)

CO 3 Action verb Apply is of BTL 3. Using Thumb rule, L3 correlates PO6 as moderate (2).

CO 4: Analyze the discharge of fluid flow in pipes using law of conservation of energy

Action Verb: Analyze (L4)

PO1: Apply(L3)

CO 4 Action verb is greater than PO1 verb. Therefore, the correlation is high (3)

PO2: Analyze (L4)

CO 4 Action verb is equal to PO2 verb. Therefore, the correlation is high (3)

PO 4: Analysis (L4)

CO 4 Action Verb is equal to PO4; Therefore, correlation is high (3)

CO 4 Action Verb Analyze is of BTL 4. Using Thumb rule, L4 correlates PO6 as moderate (3).

CO 5: Analyze the energy losses and flow characteristics through closed conduits

Action Verb: Analyze (L4)

PO1: Apply(L3)

CO 5 Action verb is greater than PO1 verb. Therefore, the correlation is high (3)

PO2: Analyze (L4)

CO 5 Action verb is equal to PO2 verb. Therefore, the correlation is high (3)

PO 4: Analysis (L4)

CO 5 Action Verb is equal to PO4; Therefore, correlation is high (3)

CO 5 Action Verb Analyze is of BTL 4. Using Thumb rule, L4 correlates PO6 as moderate (3).

II YEAR I SEMESTER

Subject Code	Subject Name	L	T/CL C	P	CREDITS
23APC0106	SURVEYING LAB	0	0	3	1.5

Course Outcomes: After studying the course, students will be able to

CO1	Apply surveying techniques (chain & compass) for road profiles, offsets & distances.
CO2	Analyze the area of a defined boundary using the plane table radiation method
CO3	Analyze the elevations on the surface of the ground by levelling methods
CO4	Analyze the height, horizontal and vertical angles by theodolite on earth surface.
CO5	Evaluate the elevations, depressions, distance, curves and contours on the ground surface for preparation of maps

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Apply	Surveying techniques (chain & compass)		road profiles, offsets & distances.	L3
2	Analyze	the area of a defined boundary	using the plane table radiation method		L4
3	Analyze	the elevations	by levelling methods	on the surface of the ground	L4
4	Analyze	the height, horizontal and vertical angles		by theodolite on earth surface	L4
5	Evaluate	the elevations, depressions, distance, curves and contours		on the ground surface for preparation of maps	L5

List of Field Works:

1. Chain survey of road profile with offsets in case of road widening -CO1
2. Determination of distance between two inaccessible points by using compass -CO1
3. Plane table survey: finding the area of a given boundary by the method of radiation –CO2
4. Fly levelling: Height of the instrument method (differential leveling) –CO3
5. Fly levelling: rise and fall method –CO3
6. Theodolite survey: determining the horizontal and vertical angles by the method of repetition method -CO4
7. Theodolite survey: finding the distance between two in accessible points -CO4
8. Theodolite survey: finding the height of far object -CO4
9. Determination of area and perimeter using total station -CO4
10. Determination of distance between two inaccessible points by using total station-CO5
11. Setting out a curve using total station-CO5
12. Determining the levels of contours-CO5

CORRELATION OF CO'S WITH THE PO'S &PSO'S:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2				2							
CO2	2	3		3		3							

CO3	2	3		3		3							
CO4	2	3		3		3							
CO5	2	2	2	2		3							

CO-PO MAPPING JUSTIFICATION:

Unit No	Course Outcomes		Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
	CO's Action Verb	BTL			
1	Apply	L3	PO1 PO2 PO6	Apply (L3) Analyze (L4) Thumb Rule	3 2 2
2	Analyze	L4	PO1 PO2 PO4 PO6	Apply (L3) Analyze (L4) Analyze (L4) Thumb Rule	2 3 3 3
3	Analyze	L4	PO1 PO2 PO4 PO6	Apply (L3) Analyze (L4) Analyze (L4) Thumb Rule	2 3 3 3
4	Analyze	L4	PO1 PO2 PO4 PO6	Apply (L3) Analyze (L4) Analyze (L4) Thumb Rule	2 3 3 3
5	Evaluate	L5	PO1 PO2 PO3 PO4 PO6	Apply (L3) Analyze (L4) Design (L6) Analysis (L4) Thumb Rule	2 2 2 2 3

JUSTIFICATION STATEMENTS:

CO 1: Apply surveying techniques (chain & compass) for road profiles, offsets & distances.
Action Verb: Apply (L3)
PO1: Apply(L3)
CO 1 Action verb is equal to PO1 verb. Therefore, the correlation is high (3)
PO2: Analyze (L4)
CO 1 Action Verb is low to PO2 verb. Therefore, the correlation is medium (2)
CO 1 Action verb Apply is of BTL 3. Using Thumb rule, L3 correlates PO6 as moderate (2).

CO 2: Analyze the area of a defined boundary using the plane table radiation method
Action Verb: Analyze (L4)
PO1: Apply(L3)
CO 2 Action verb is greater than PO1 verb. Therefore, the correlation is high (3)
PO2: Analyze (L4)
CO 2 Action verb is equal to PO2 verb. Therefore, the correlation is high (3)
PO 4: Analysis (L4)
CO 3 Action Verb is equal to PO4; Therefore, correlation is high (3)
CO 3 Action Verb Analyze is of BTL 4. Using Thumb rule, L4 correlates PO6 as moderate (3).

CO 3: Analyze the elevations on the surface of the ground by levelling methods

Action Verb: Analyze (L4)
PO1: Apply(L3)
CO 3 Action verb is greater than PO1 verb. Therefore, the correlation is high (3)
PO2: Analyze (L4)
CO 3 Action verb is equal to PO2 verb. Therefore, the correlation is high (3)
PO 4: Analysis (L4)
CO 3 Action Verb is equal to PO4; Therefore, correlation is high (3)
CO 3 Action Verb Analyze is of BTL 4. Using Thumb rule, L4 correlates PO6 as moderate (3).

CO 4: Analyze the height, horizontal and vertical angles by theodolite on earth surface.
Action Verb: Analyze (L4)
PO1: Apply(L3)
CO 4 Action verb is greater than PO1 verb. Therefore, the correlation is high (3)
PO2: Analyze (L4)
CO 4 Action verb is equal to PO2 verb. Therefore, the correlation is high (3)
PO 4: Analysis (L4)
CO 5 Action Verb is equal to PO4; Therefore, correlation is high (3)
CO 5 Action Verb Analyze is of BTL 4. Using Thumb rule, L4 correlates PO6 as moderate (3).

CO 5: Evaluate the elevations, depressions, distance, curves and contours on the ground surface for preparation of maps
Action Verb: Evaluate (L5)
PO1: Apply (L3)
CO 5 Action verb is greater than PO1 verb; Therefore, correlation is moderate (2).
PO2: Analyze (L4)
CO 5 Action verb is greater than PO2 verb by one level; Therefore, correlation is moderate (2).
PO3: Design
CO 5 Action verb is less than PO3 verb by one level; Therefore, correlation is moderate (2).
PO4: Design
CO 5 Action verb is less than PO3 verb by one level; Therefore, correlation is moderate (2).
PO6: Action verb Evaluate is of BTL 5. Using Thumb rule, L5 correlates PO6 as High (3)

II YEAR I SEMESTER

Subject Code	Subject Name	L	T/CL C	P	CREDITS
23APC0107	STRENGTH OF MATERIALS LAB	0	0	3	1.5

Course Outcomes: After studying the course, students will be able to

CO1	Apply the engineering principles to analyze the support reactions and bending behavior of beams under different support conditions
CO2	Analyze the relationship between material elastic properties and the performance of mechanical components.
CO3	Analyze the behavior of steel under impact load and couple acting on it.
CO4	Analyze the load-deflection behavior of open-coiled and close-coiled springs under compression
CO5	Evaluate the compressive strength and failure modes of wood and concrete specimens

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Apply	the engineering principles to analyze the support reactions and bending behavior	under different loading conditions	of beams	L3
2	Analyze	the relationship between material properties		the performance of mechanical components	L4
3	Analyze	the behavior of steel	Under impact load and couple acting on it.		L4
4	Analyze	the load-deflection behavior of open-coiled and close-coiled springs	Under compression		L4
5	Evaluate	the compressive strength and failure modes		of wood and concrete Specimen	L5

LIST OF EXPERIMENTS:

1. Tension test -CO2
2. Bending test on (Steel/Wood) Cantilever beam -CO1
3. Bending test on simply supported beam -CO1
4. Torsion test –CO3
5. Hardness test -CO2
6. Compression test on O0pen coiled springs –CO4
7. Tension test on Closely coiled springs –CO4
8. Compression test on wood/ concrete –CO5
9. Izod / Charpy Impact test on metals –CO3
10. Shear test on metals –CO3
11. Use of electrical resistance strain gauges –CO2
12. Continuous beam – deflection test -CO1

CORRELATION OF COS WITH THE POS & PSOS:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO 1	PSO 2
CO1	3	2				2							
CO2	3	3		3		3							
CO3	3	2	2	2		3							
CO4	3	3		3		3							
CO5	3	2	2	2		3							

CO-PO MAPPING JUSTIFICATION:

Unit No	Course Outcomes		Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
	CO's Action Verb	BTL			
1	Apply	L3	PO1 PO2 PO6	Apply (L3) Analyze (L4) Thumb Rule	3 2 2
2	Analyze	L4	PO1 PO2 PO4 PO6	Apply (L3) Analyze (L4) Analyze (L4) Thumb Rule	3 3 3 3
3	Analyze	L4	PO1 PO2 PO4 PO6	Apply (L3) Analyze (L4) Analysis (L4) Thumb Rule	3 3 3 3
4	Analyze	L4	PO1 PO2 PO4 PO6	Apply (L3) Analyze (L4) Analysis (L4) Thumb Rule	3 3 3 3
5	Evaluate	L5	PO1 PO2 PO3 PO4 PO6	Apply (L3) Analyze (L4) Design (L6) Analysis (L4) Thumb Rule	2 2 2 2 3

JUSTIFICATION STATEMENTS:

CO1: Apply the engineering principles to analyze the support reactions and bending behavior of beams under different support conditions
Action Verb: Apply (L4)
PO1: Apply(L3)
CO 1 Action verb is equal to PO1 verb. Therefore the correlation is high (3)
PO2: Analyze (L4)
CO 1 Action Verb is low to PO2 verb. Therefore the correlation is medium (2)
CO 1 Action verb Apply is of BTL 3. Using Thumb rule, L3 correlates PO6 as moderate (2).
CO2: Analyze the relationship between material elastic properties and the performance of mechanical components.
Action Verb: Analyze (L4)
PO1: Apply(L3)
CO2 Action verb is equal to PO1 verb. Therefore, the correlation is high (3)
PO2: Analyze (L4)

CO2: Action Verb is low to PO2 verb. Therefore, the correlation is medium (2)
CO2 Action verb Apply is of BTL 3. Using Thumb rule, L3 correlates PO6 as moderate (2).

CO3: Analyze the behavior of steel under impact load and couple acting on it.
Action Verb: Analyze (L4)
PO1: Apply(L3)
CO1 Action verb is greater than PO1 verb. Therefore, the correlation is high (3)
PO2: Analyze (L4)
CO1 Action verb is equal to PO2 verb. Therefore, the correlation is high (3)
PO 4: Analysis (L4)
CO1 Action Verb is equal to PO4; Therefore, correlation is high (3)
CO1 Action Verb Analyze is of BTL 4. Using Thumb rule, L4 correlates PO6 as moderate (3).

CO4: Analyze the load-deflection behavior of open-coiled and close-coiled springs under compression
Action Verb: Analyze (L4)
PO1: Apply(L3)
CO 4 Action verb is greater than PO1 verb. Therefore, the correlation is high (3)
PO2: Analyze (L4)
CO 4 Action verb is equal to PO2 verb. Therefore, the correlation is high (3)
PO 4: Analysis (L4)
CO 5 Action Verb is equal to PO4; Therefore, correlation is high (3)
CO 5 Action Verb Analyze is of BTL 4. Using Thumb rule, L4 correlates PO6 as moderate (3).

CO5: Evaluate the compressive strength and failure modes of wood and concrete specimens
Action Verb: Evaluate (L5)
PO1: Apply (L3)
CO 5 Action verb is greater than PO1 verb; Therefore, correlation is moderate (2).
PO2: Analyze (L4)
CO 5 Action verb is greater than PO2 verb by one level; Therefore, correlation is moderate (2).
PO3: Design
CO 5 Action verb is less than PO3 verb by one level; Therefore, correlation is moderate (2).
PO4: Design
CO 5 Action verb is less than PO3 verb by one level; Therefore, correlation is moderate (2).
PO6: Action verb Evaluate is of BTL 5. Using Thumb rule, L5 correlates PO6 as High (3)

II YEAR I SEMESTER

Subject Code	Subject Name	L	T/CL C	P	CREDITS
23ASC0101	BUILDING PLANNING AND DRAWING	0	1	2	2

Course Outcomes: After studying the course, students will be able to

CO1	Apply the sign conventions to represent various building materials
CO2	Apply the distinct brickwork patterns used in construction
CO3	Create the building elements as per building bye-laws
CO4	Create the residential building as per building bye-laws
CO5	Create the public and industrial buildings as per building bye-laws

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	**Apply**	the sign conventions		to represent various building materials	L3
2	**Apply**	the distinct brickwork patterns		used in construction	L3
3	**Create**	the building elements	as per building bye-laws		L6
4	**Create**	the residential building	as per building bye-laws		L6
5	**Create**	the public and industrial buildings	as per building bye-laws		L6

LIST OF EXERCISES:

1. Detailing & Drawing of Sign Conventions-CO1
2. Detailing & Drawing of English Bond-CO2
3. Detailing & Drawing of Flemish Bond-CO2
4. Detailing & Drawing of Doors-CO3
5. Detailing & Drawing of Windows-CO3
6. Detailing & Drawing of Ventilators &Roofs-CO3
7. Drawing of Line Diagram of Residential Buildings by using Building Bye- Laws -CO4
8. Drawing of Plan, Elevation & Section from line diagram for a single Storey Building-CO4
9. Drawing of Plan, Elevation & Section for Hospital Building -CO5
10. Drawing of Plan, Elevation & Section for Industrial Building -CO5

TEXT BOOKS:

1. Planning, designing and Scheduling, Gurcharan Singh and Jagdish Singh
2. Building planning and drawing by Dr. N. Kumara Swamy & A. Kameswara Rao.
3. Building drawing, M G Shah, C M Kale and S Y Patki, Tata McGraw Hill, New Delhi.

REFERENCES:

1. National Building Code 2016 (Volume- I & II).
2. Principles of Building Drawing, M G Shah and C M Kale, Trinity Publications, New Delhi.
3. Civil Engineering drawing and House planning, B. P. Verma, Khanna publishers, NewDelhi.
4. Civil Engineering Building practice, Suraj Singh: CBS Publications, New Delhi, and Chennai

CORRELATION OF CO'S WITH THE PO'S & PSO'S:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3				2	2						2	
CO2	3				2	2						2	
CO3	3				3	3						2	
CO4	3				3	3						3	
CO5	3				3	3						3	

CO-POMAPPING JUSTIFICATION:

Unit No	Course Outcomes		Program Outcome (PO)	PO(s):Action Verb and BTL(forPO1 to PO11)	Level of Correlation (0-3)
	CO's Action Verb	BTL			
1	Apply	L3	PO1 PO5 PO6	Apply(L3) Create(L5) Thumb Rule	3 2 2
2	Apply	L3	PO1 PO5 PO6	Apply(L3) Create(L5) Thumb Rule	3 2 2
3	Create	L6	PO1 PO2 PO3 PO4 PO6	Apply (L3) Analyze (L4) Design (L6) Analysis (L4) Thumb Rule	2 2 3 2 3
4	Create	L6	PO1 PO2 PO3 PO4 PO6	Apply (L3) Analyze (L4) Design (L6) Analysis (L4) Thumb Rule	2 2 3 2 3
5	Create	L6	PO1 PO2 PO3 PO4 PO6	Apply (L3) Analyze (L4) Design (L6) Analysis (L4) Thumb Rule	2 2 3 2 3

JUSTIFICATION STATEMENTS:

CO1: Apply the sign conventions to represent various building materials.
Action Verb: Apply (L3) PO1 Verb: Apply (L3)
CO1 Action verb is same level as PO1 verb. Therefore, the correlation is high (3)
PO5 Verb: Create (L6)
CO1 Action verb is less than level as PO5 verb. Therefore, the correlation is medium (2)
PO6 Verb: Thumb Rule
CO1 Correlates medium with PO6. Therefore, the correlation is medium (2)

CO2: Apply the distinct brickwork patterns used in construction.
Action Verb: Apply (L3) PO1 Verb: Apply (L3)

CO2 Action verb is same level as PO1 verb. Therefore, the correlation is high (3)
PO5 Verb: Create (L6)
CO2 Action verb is less than level as PO5 verb. Therefore, the correlation is medium (2)
PO6 Verb: Thumb Rule
CO2 Correlates medium with PO6. Therefore, the correlation is medium (2)

CO3: Create the building elements as per building bye-laws.
Action Verb: Create (L6) PO1: Apply (L3)
CO: Action verb is greater than PO1 verb; Therefore correlation is moderate (2).
PO2: Analyze (L4)
CO Action verb is greater than PO2 verb by one level; Therefore correlation is moderate (2).
PO3: Design
CO Action verb is equal to PO3 verb by one level; Therefore, correlation is high (3).
PO4: Analysis
CO Action verb is less than PO3 verb; Therefore, correlation is moderate (2).
PO6: Action verb Evaluate is of BTL 6. Using Thumb rule, L6 correlates PO6 as High (3**CO4: Create** the residential building as per building bye-laws.

CO4: Create the residential building as per building bye-laws
Action Verb: Create (L6) PO1: Apply (L3)
CO 4: Action verb is greater than PO1 verb; Therefore, correlation is moderate (2).
PO2: Analyze (L4)
CO 4 Action verb is greater than PO2 verb by one level; Therefore, correlation is moderate (2).
PO3: Design
CO 4 Action verb is equal to PO3 verb by one level; Therefore, correlation is high (3).
PO4: Analysis
CO 4 Action verb is less than PO3 verb; Therefore, correlation is moderate (2).
PO6: Action verb Evaluate is of BTL 6. Using Thumb rule, L6 correlates PO6 as High (3)

CO5: Create public and industrial buildings as per building bye-laws
Action Verb: Create (L6) PO1: Apply (L3)
CO 5: Action verb is greater than PO1 verb; Therefore, correlation is moderate (2).
PO2: Analyze (L4)
CO 5 Action verb is greater than PO2 verb by one level; Therefore, correlation is moderate (2).
PO3: Design
CO 5 Action verb is equal to PO3 verb by one level; Therefore, correlation is high (3).
PO4: Analysis
CO 5 Action verb is less than PO3 verb; Therefore, correlation is moderate (2).
PO6: Action verb Evaluate is of BTL 6. Using Thumb rule, L6 correlates PO6 as High (3)

B.Tech. – II Year II Semester

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits	Scheme of Examination (Max. Marks)		
				L	T/CLC	P	C	CIE	SEE	Total
1	HM	23AHMMB01	Managerial Economics and Financial Analysis	2	0	0	2	30	70	100
2	PC	23APC0108	Engineering Geology	2	1	0	3	30	70	100
3	PC	23APC0109	Concrete Technology	2	1	0	3	30	70	100
4	PC	23APC0110	Structural Analysis	2	1	0	3	30	70	100
5	PC	23APC0111	Hydraulics &Hydraulic Machinery	2	1	0	3	30	70	100
6	PC	23APC0112	Concrete Technology Lab	0	0	3	1.5	30	70	100
7	PC	23APC0113	Engineering Geology lab	0	0	3	1.5	30	70	100
8	SC	23ASC9901	Soft Skills	0	1	2	2	30	70	100
9	ES	23AES0304	Design Thinking & Innovation	0	1	2	2	30	70	100
10	MC	23AMC9901	Environmental Science	2	0	0	-	30	-	30
Total Credits				**12**	**06**	**10**	**21**	**300**	**630**	**930**
Mandatory Community Service Project Internship of 08 weeks duration during summer vacation										

II YEAR II SEMESTER

Subject Code	Subject Name	L	T/CLC	P	CREDITS
23AHMMB01	MANAGERIAL ECONOMICS AND FINANCIAL ANALYSIS	2	0	0	2

Course Outcomes: After studying the course, students will be able to

CO1	Understand the fundamentals of managerial economics and Apply the forecasting techniques for estimation of demand.
CO2	Understand the production and cost concepts to optimize the output
CO3	Analyze the price output relationship in different markets.
CO4	Evaluate the capital budgeting techniques to invest in various projects.
CO5	Analyze the accounting statements to evaluate the financial performance of business entity.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Understand Apply	The fundamentals of Managerial economics and the demand of a product	by using statistical and survey methods.		L3
2	Understand	Production and cost concepts		To optimize the output	L2
3	Analyze	Price output relationship		In perfect and imperfect competition markets	L4
4	Evaluate	Capital budgeting techniques		To invest in various projects	L5
5	Analyze	Accounting statements		to evaluate the financial performance of business entity	L4

UNIT-I MANAGERIAL ECONOMICS
Introduction – meaning, nature, significance, functions, and advantages, ME and its role in other fields. Demand - Concept, Function, Law of Demand- Demand Elasticity-Types– Measurement. Demand Forecasting- Factors governing forecasting, Methods.
UNIT-II PRODUCTION AND COST ANALYSIS
Introduction – Nature, meaning, significance, functions and advantages. Production Function– Least-cost combination– Short run and Long run Production Function- Iso quants and Iso costs, MRTS, CobbDouglas Production Function- Laws of Returns- Internal and External Economies of scale. Cost & BreakEven Analysis- Cost concepts and Cost behavior- Break- Even Analysis (BEA) - Determination of BreakEven Point (Simple Problems) - Managerial significance and limitations of Break-Even Analysis.
UNIT-III BUSINESS ORGANIZATIONS AND MARKETS

Introduction-Forms of Business Organizations- Sole Proprietary - Partnership - Joint Stock Companies - Public Sector Enterprises.Types of Markets - Perfect and Imperfect Competition - Features of Perfect Competition, Monopoly- Monopolistic Competition– Oligopoly- Price-Output Determination- Pricing Methods and strategies.

UNIT-IV CAPITAL BUDGETING

Introduction- Nature, meaning, significance, types of working capital, Components, Sources of Shortterm and Long-term Capital, Estimating Working capital requirements. Capital Budgeting – Features, Proposals, Time value of money. Methods and Evaluation of Projects – Pay Back Method, Accounting Rate of Return (ARR), Net Present Value (NPV), and Internal Rate Return (IRR) Method, Profitability Index(PI) Method (simple problems).

UNIT-V FINANCIAL ACCOUNTING AND ANALYSIS

Introduction - Concepts and Conventions- Double- Entry Book Keeping, Journal, Ledger, Trial Balance- Final Accounts (Trading Account, Profit and Loss Account and Balance Sheet with simple adjustments).

Financial Analysis - Analysis and Interpretation of Liquidity Ratios, Activity Ratios, and Capital structure Ratios and Profitability.

TEXTBOOKS:

1. Varshney & Maheswari: Managerial Economics, Sultan Chand.
2. Aryasri: Business Economics and Financial Analysis, 4/e, MGH.

REFERENCES:

1. Ahuja Hl Managerial economics Schand.
2. S.A. Siddiqui and A.S. Siddiqui: Managerial Economics and Financial Analysis, New Age International.
3. Joseph G. Nellis and David Parker: Principles of Business Economics, Pearson, 2/e,New Delhi.
4. Domnick Salvatore: Managerial Economics in a Global Economy, Cengage.

WEB RESOURCES:

https://www.slideshare.net/123ps/managerial-economics-ppt
https://www.slideshare.net/rossanz/production-and-cost-45827016
https://www.slideshare.net/darkyla/business-organizations-19917607
https://www.slideshare.net/balarajbl/market-and-classification-of-market
https://www.slideshare.net/ruchi101/capital-budgeting-ppt-59565396
https://www.slideshare.net/ashu1983/financial-accounting

CORRELATION OF COS WITH THE POS & PSOS:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3												
CO2	1									1			
CO3	3									3			
CO4										3			
CO5										3			

CO-PO MAPPING JUSTIFICATION:

	Course Outcomes	Program		Level of

Unit No	Lesson Plan Hrs	%	Correlation	CO's Action Verb	BTL	Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO11)	Correlation (0-3)
1	**10**	16.1%	2	Apply	L3	PO1	Apply	3
2	14	22.5%	3	Understand	L2	PO1 PO10	Apply Apply	1 1
3	14	22.5%	3	Analyze	L4	PO1 PO10	Apply Apply	3 3
4	10	16.1%	2	Evaluate	L5	PO10	Apply	3
5	14	22.5%	3	Analyze	L4	PO10	Apply	3

JUSTIFICATION STATEMENTS:

CO1: Understand the fundamentals of managerial economics and Apply the forecasting techniques for estimation of demand.
Action Verb: Apply (L3)
PO1 Verb: Apply (L3)
CO1 Action verb is same as PO1verb. Therefore, the correlation is high (3)
CO2: Understand the production and cost concepts to optimize the output.
Action Verb: Understand (L2)
PO1: Apply (L3)
CO2 Action verb is less than PO1 verb by two levels. Therefore, the correlation is low (1)
PO10: Apply (L3)
CO2 Action verb is less than PO1 verb by two levels. Therefore, the correlation is low (1)
CO3: Analyze the price output relationship in different markets.
Action Verb: Analyze (L4)
PO1: Apply (L3)
CO3 Action verb is more than PO1 verb by one level. Therefore, the correlation is high (3)
PO10: Apply (L3)
CO3 Action verb is more than PO1 verb by one level. Therefore, the correlation is high (3)
CO4: Evaluate the capital budgeting techniques to invest in various projects.
Action Verb: Evaluate (L5)
PO10: Apply (L3)
CO4 Action verb is more than PO1 verb by one level. Therefore, the correlation is high (3)
CO5: Analyze the accounting statements to evaluate the financial performance of business entity.
Action Verb: Analyze (L4)
PO10: Apply (L3)
CO5 Action verb is more than PO1 verb by one level. Therefore, the correlation is high (3)

II YEAR II SEMESTER

Subject Code	Subject Name	L	T/CLC	P	CREDITS
23APC0108	ENGINEERING GEOLOGY	2	1	0	3

Course Outcomes: After studying the course, students will be able to

CO1	Understand the importance of Geology in Civil engineering
CO2	Understand the classification and properties of minerals and rocks
CO3	Apply the structural geology in rocks
CO4	Understand the concept of Ground water, Natural Disasters using Geophysical methods
CO5	Understand the geological strata for construction of Dams, tunnels, and reservoirs

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Understand	Importance of Geology			L2
2	Understand	Classification and properties		Minerals and rocks	L2
3	Apply	Structural geology		Rocks	L3
4	Understand	Concept of Ground water, Natural Disasters	Geophysical methods		L2
5	Understand	Geological strata for construction		Dams, tunnels, and reservoirs	L2

UNIT-I
INTRODUCTION: Branches of Geology, Importance of Geology in Civil Engineering with case studies, weathering of rocks, Geological agents, weathering process of Rock, Rivers and geological work of rivers.
UNIT-II
MINERALOGY AND PETROLOGY: Definitions of mineral and rock-Different methods of study of mineral and rock. Physical properties of minerals and rocks for megascopic study for the following minerals and rocks. Common rock forming minerals: Feldspar, Quartz Group, Olivine, Augite, Hornblende, Mica Group, Asbestos, Talc, Chlorite, Kyanite, Garnet, Calcite and ore forming minerals are Pyrite, Hematite, Magnetite, Chlorite, Galena, Pyrolusite, Graphite, Chromite, Magnetite and Bauxite. Classification, structures, textures and forms of Igneous rocks, Sedimentary rocks, Metamorphic rocks, and their megascopic study of granite varieties, (pink, gray, green). Pegmatite, Dolerite, Basalt etc., Shale, Sand Stone, Lime Stone, Laterite, Quartzite, Gneiss, Schist, Marble, Khondalite and Slate.
UNIT-III
STRUCTURAL GEOLOGY: Strike, Dip and Outcrop study of common geological structures associating with the rocks such as Folds, Faults, Joints and Unconformities- parts, types, mechanism and their importance in Civil Engineering.
UNIT-IV
GROUND WATER: Water table, Cone of depression, Geological controls of Ground Water Movement, Ground Water Exploration Techniques.

EARTHQUAKES AND LAND SLIDES: Terminology, Classification, causes and effects, Shield areas and Seismic bells, Richter scale intensity, Precautions of building constructions in seismic areas. Classification of Landslides, Causes and Effects, measures to be taken prevent their occurrence at Landslides.

GEOPHYSICS: Importance of Geophysical methods, Classification, Principles of Geophysical study by Gravity method, Magnetic method, Electrical methods, Seismic methods, Radiometric method and Electrical resistivity, Seismic refraction methods and Engineering properties of rocks.

UNIT-V

Geology of Dams, Reservoirs and Tunnels: Types and purpose of Dams, Geological considerations in the selection of a Dam site. Geology consideration for successful constructions of reservoirs, Life of Reservoirs. Purpose of Tunnelling, effects, Lining of Tunnels. Influence of Geology for successful Tunnelling.

TEXTBOOKS:

1. Principles of Engineering Geology by K.V.G.K. Gokhale, B.S. Publications
2. Engineering Geology by D.Venkata Reddy Vikas Publications
3. Engineering Geology by Vasudev Kanithi Universities Press

REFERENCES:

1. Engineering Geology by N. Chenna Kesavulu, Laxmi Publications. 2nd Edition 2014.
2. Engineering Geology by Subinoy Gangopadhay Oxford University press 1st edition,2012.
3. Engineering & General Geology by Parbin Singh Katson educational series 8th2023
4. Engineering Geology by S.K. Duggal, H.K. Pandey & N. Rawal Mc Graw-Hill

WEB RESOURCES:

1. https://nptel.ac.in/courses/105105106
2. https://onlinecourses.nptel.ac.in/noc23_ce107/preview
3. https://www.nptelvideos.com/civil_engineering/engineering_geology_video_lectures.php
4. https://archive.nptel.ac.in/courses/105/104/105104147/

CORRELATION OF COS WITH THE POS & PSOS:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2				2						2	2
CO2	2	2				2						2	2
CO3	2	2				2						2	2
CO4	2	2				2						2	2
CO5	2	2				2						2	2

CO-PO MAPPING JUSTIFICATION:

Unit No	Course Outcomes					Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
	Lesson Plan Hrs	%	Correlation	CO's Action Verb	BTL			
1	12/65	18	2	Understand	L2	PO1 PO2 PO6	Apply(L3) Analyze(L4) Thumb Rule	2 2 2
2	12/65	18	2	Understand	L2	PO1 PO2	Apply(L3) Analyze(L4)	2 2

						PO6	Thumb Rule	2
3	17/65	26	3	Apply	L3	PO1 PO2 PO6	Apply(L3) Analyze(L4) Thumb Rule	3 2 2
4	12/65	18	2	Understand	L2	PO1 PO2 PO6	Apply(L3) Analyze(L4) Thumb Rule	2 2 2
5	12/65	18	2	Understand	L2	PO1 PO2 PO6	Apply(L3) Analyze(L4) Thumb Rule	2 2 2

JUSTIFICATION STATEMENTS:

CO 1: Understand the importance of Geology in Civil engineering
Action Verb: Understand (L2)
PO1: Apply(L3)
CO 1 Action Verb is less than PO1 verb by one level; Therefore, correlation is moderate (2).
PO2: Analyze (L4)
CO 1 Action Verb is less than PO2 verb by one level; Therefore, correlation is moderate (2).
CO 1 Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO6 as moderate (2).

CO 2: Understand the classification and properties of minerals and rocks
Action Verb: Understand (L2)
PO1: Apply(L3)
CO 2 Action Verb is less than PO1 verb by one level; Therefore, correlation is moderate (2).
PO2: Analyze (L4)
CO 2 Action Verb is less than PO2 verb by one level; Therefore, correlation is moderate (2).
CO 2 Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO6 as moderate (2).

CO 3: Apply the structural geology in rocks
Action Verb: Apply (L3)
PO1: Apply(L3)
CO 3 Action verb is equal to PO1 verb. Therefore, the correlation is high (3)
PO2: Analyze (L4)
CO 3: Action Verb is low to PO2 verb. Therefore, the correlation is medium (2)
CO 3 Action verb Apply is of BTL 3. Using Thumb rule, L3 correlates PO6 as moderate (2).

CO 4: Understand the concept of Ground water, Natural Disasters using Geophysical methods
Action Verb: Understand (L2)
PO1: Apply(L3)
CO 2 Action Verb is less than PO1 verb by one level; Therefore, correlation is moderate (2).
PO2: Analyze (L4)
CO 2 Action Verb is less than PO2 verb by one level; Therefore, correlation is moderate (2).
CO 2 Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO6 as moderate (2).

CO 5: Understand the geological strata for construction of Dams, tunnels, and reservoirs
Action Verb: Understand (L2)
PO1: Apply(L3)
CO 2 Action Verb is less than PO1 verb by one level; Therefore, correlation is moderate (2).
PO2: Analyze (L4)
CO 2 Action Verb is less than PO2 verb by one level; Therefore, correlation is moderate (2).
CO 2 Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO6 as moderate (2).

II YEAR II SEMESTER

Subject Code	Subject Name	L	T/CLC	P	CREDITS
23APC0109	CONCRETE TECHNOLOGY	2	1	0	3

Course Outcomes: After studying the course, students will be able to

CO1	Understand the basic ingredients of concrete
CO2	Understand the manufacturing process and fresh properties of concrete
CO3	Understand the concepts of strength gain and hardened properties of concrete
CO4	Understand the engineering properties and special applications of concrete.
CO5	Design concrete mix proportioning for economical and durable concrete

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Understand	the basic ingredients		of concrete	L2
2	Understand	the manufacturing process and fresh properties of concrete		of concrete	L2
3	Understand	the concepts of strength gain and hardened properties		of concrete	L2
4	Understand	the engineering properties of concrete and applications		of various special concretes	L2
5	Design	concrete mix proportioning		for economical and durable concrete	L6

UNIT-I

CEMENTS: Portland cement – Chemical composition – Hydration, Setting of cement, Fineness of cement, Structure of hydrate cement – Test for physical properties – Different grades of cements – Admixtures – Mineral and chemical admixtures – accelerators, retarders, air entrainers, plasticizers, super plasticizers, fly ash and silica fume

AGGREGATES: Classification of aggregate – Particle shape & texture – Bond, strength & other mechanical properties of aggregates – Specific gravity, Bulk density, porosity, adsorption & moisture content of aggregate – Bulking of sand –Deleterious substances – Soundness – Alkali aggregate reaction – Thermal properties – Sieve analysis – Fineness modulus – Grading curves – Grading of fine & coarse Aggregates – Maximum aggregate size- Quality of mixing water

UNIT-II

FRESH CONCRETE: Steps in Manufacture of Concrete–proportion, mixing, placing, compaction, finishing, curing – including various types in each stage. Properties of fresh concrete-Workability – Factors affecting workability – Measurement of workability by different tests, setting times of concrete, Effect of time and temperature on workability – Segregation & bleeding – Mixing and vibration of concrete, Ready mixed concrete, Shotcrete

UNIT-III

HARDENED CONCRETE: Water / Cement ratio – Abram's Law – Gel/space ratio – Nature of strength of concrete –Maturity concept – Strength in tension & compression – Factors affecting strength – Relation between compression & tensile strength – Curing Testing of Hardened Concrete:

Compression test – Tension test – Factors affecting strength – Flexure test –Splitting test – Non-destructive testing methods – Codal provisions for NDT

UNIT-IV

ELASTICITY, CREEP & SHRINKAGE – Modulus of elasticity – Dynamic modulus of elasticity – Poisson's ratio – Creep of concrete – Factors influencing creep – Relation between creep & time – Nature of creep – Effects of creep – Shrinkage –types of shrinkage

UNIT-V

MIX DESIGN AND SPECIAL CONCRETES:

Factors in the choice of mix proportions –Quality control of concrete- Statistical methods- Acceptance Criteria-Concepts Proportioning of concrete mixes by ACI method and IS Code method Ready mixed concrete, Fibre reinforced concrete – Different types of fibres – Factors affecting properties of FRC, High performance concrete – Self consolidating concrete, Self-healing concrete.

TEXTBOOKS:

1. Concrete Technology by M. S. Shetty. – S. Chand & Co.; 2004
2. Concrete Technology by M.L. Gambhir. – Tata Mc.Graw Hill Publishers, New Delhi 5th edition 2013.
3. Concrete Technology by A.R. Santha Kumar, Oxford University Press, New Delhi

REFERENCES:

1. Concrete Microstructure, Properties of Materials by P.K. Mehta and Moterio. McGrawHill 4th edition 2014
2. Properties of Concrete by A.M. Neville – PEARSON – 4th edition
3. Concrete Technology by Job Thomas, Cengagae Publications, 1st edition, 2015
4. Concrete Technology, J.J. Brooks and A. M. Neville, Pearson, 2019, 2nd Edition.

CODE BOOK: IS Code: IS 10262 – 2019

CORRELATION OF COS WITH THE POS & PSOS:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2				2							2
CO2	2	2				2							2
CO3	2	2				2							2
CO4	2	2				2						2	2
CO5	2	2	3	2		3						2	2

CO-PO MAPPING JUSTIFICATION:

Unit No	Course Outcomes					Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
	Lesson Plan Hrs	%	Correlation	CO's Action Verb	BTL			
1	9/60	15	2	Understand	L2	PO1 PO2 PO6	Apply (L3) Analyze (L4) Thumb Rule	2 2 2
2	11/60	18	2	Understand	L2	PO1 PO2 PO6	Apply (L3) Analyze (L4) Thumb Rule	2 2 2

3	11/60	18	2	Understand	L2	PO1 PO2 PO6	Apply (L3) Analyze (L4) Thumb Rule	2 2 2
4	10/60	17	2	Understand	L2	PO1 PO2 PO6	Apply (L3) Analyze (L4) Thumb Rule	2 2 2
5	19/60	32	3	Design	L6	PO1 PO2 PO3 PO4 PO6	Apply (L3) Analyze (L4) Analyze (L4) Analyze (L4) Thumb Rule	2 2 2 2 3

JUSTIFICATION STATEMENTS:

CO 1: Understand the basic ingredients of concrete
Action Verb: Understand (L2)
PO1: Apply(L3)
CO 1 Action Verb is less than PO1 verb by one level; Therefore, correlation is moderate (2).
PO2: Analyze (L4)
CO 1 Action Verb is less than PO2 verb by one level; Therefore, correlation is moderate (2).
CO 1 Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO6 as moderate (2).

CO 2: Understand the manufacturing process and fresh properties of concrete
Action Verb: Understand (L2)
PO1: Apply(L3)
CO 2 Action Verb is less than PO1 verb by one level; Therefore, correlation is moderate (2).
PO2: Analyze (L4)
CO 2 Action Verb is less than PO2 verb by one level; Therefore, correlation is moderate (2).
CO 2 Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO6 as moderate (2).

CO 3: Understand the concepts of strength gain and hardened properties of concrete
Action Verb: Understand (L2)
PO1: Apply(L3)
CO 3 Action Verb is less than PO1 verb by one level; Therefore, correlation is moderate (2).
PO2: Analyze (L4)
CO 3 Action Verb is less than PO2 verb by one level; Therefore, correlation is moderate (2).
CO 3 Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO6 as moderate (2).

CO 4: Understand the engineering properties and special applications of concrete.
Action Verb: Understand (L2)
PO1: Apply(L3)
CO 4 Action Verb is less than PO1 verb by one level; Therefore, correlation is moderate (2).
PO2: Analyze (L4)
CO 4 Action Verb is less than PO2 verb by one level; Therefore, correlation is moderate (2).
CO 4 Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO6 as moderate (2).

CO5: Design concrete mix proportioning for economical and durable concrete
Action Verb: Design (L6)
PO1: Apply (L3)
CO: Action verb is greater than PO1 verb; Therefore, correlation is moderate (2).
PO2: Analyze (L4)
CO Action verb is greater than PO2 verb by one level; Therefore, correlation is moderate (2).
PO3: Design
CO Action verb is equal to PO3 verb by one level; Therefore, correlation is high (3).
PO4: Analysis
CO Action verb is less than PO3 verb; Therefore, correlation is moderate (2).
PO6: Action verb Design is of BTL 6. Using Thumb rule, L6 correlates PO6 as High (3)

II YEAR II SEMESTER

Subject Code	Subject Name	L	T/CLC	P	CREDITS
23APC0110	STRUCTURAL ANLAYSIS	2	1	0	3

Course Outcomes: After studying the course, students will be able to

CO1	Analyze the beams and trusses using Energy Theorems.
CO2	Analyze indeterminate structures by using Castigliano's–II theorem
CO3	Analysis of fixed and continuous beams
CO4	Analyze continuous beams and portal frames by using slope-deflection method
CO5	Analyze continuous beams and portal frames by using moment distribution method

Course Outcomes	Action Verb	Knowledge Statement	Condition	Criteria	Blooms Level
CO1	Analyze	Energy Theorems	Castigliano"s theorems-I	Analysis of beam and Frame	L4
CO2	Analyze	Indeterminate Trusses	Castigliano"s theorems-II	analysis of indeterminate structures	L4
CO3	Analyze	Fixed and Continues Beams		Analysis of Fixed and Continuos Beams	L4
CO4	Analyze	Beam and Portal Frames	Slope Deflection Method	Analysis of Beams and Frames structures	L4
CO5	Analyze	Beam and Portal Frames	Moment Distribution Method	Analysis of Beams and Frames structures	L4

UNIT-I
ENERGY THEOREMS: Introduction-Strain energy in linear elastic system, expression of strain energy due to axial load, bending moment and shear forces – Castigliano's – I theorem. Deflections of simple beams and pin jointed trusses.
UNIT-II
ANALYSIS OF INDETERMINATE STRUCTURES: Indeterminate Structural Analysis – Determination of static and kinematic indeterminacies – Solution of trusses with upto two degrees of internal and external indeterminacies –Castigliano's–II theorem.
UNIT-III
FIXED BEAMS & CONTINUOUS BEAMS: Introduction to statically indeterminate beams with uniformly distributed load, central point load, eccentric point load, number of point loads, uniformly varying load, couple and combination of loads – Shear force and Bending moment diagrams – Deflection of fixed beams effect of sinking of support, effect of rotation of a support.
UNIT-IV
SLOPE-DEFLECTION METHOD: Introduction-derivation of slope deflection equations- application to continuous beams with and without settlement of supports - Analysis of single- bay portal frames without sway.
UNIT-V

MOMENT DISTRIBUTION METHOD: Introduction to moment distribution method- Application to continuous beams with and without settlement of supports - Analysis of single- bay storey portal frames without sway.

TEXTBOOKS:

1. Analysis of Structures –Vol-I&II by V.N.Vazirani & M.M.Ratwani, Khanna Publications, New Delhi.
2. Basic Structural Analysis by C.S.Reddy., Tata McGraw Hill Publishers. 3rd edition 2017.

REFERENCE BOOKS:

1. Structural analysis by Aslam Kassimali Cengage publications 6th edition 2020.
2. Structural analysis Vol.I and II by Dr.R.Vaidyanathan and Dr.PPerumal– Laxmi publications. 3rd 2016
3. Introduction to structural analysis by B.D.Nautiyal, New Age international publishers, New Delhi.

WEB SOURCE:

https://archive.nptel.ac.in/courses/105/105/105105166/
https://onlinecourses.nptel.ac.in/noc24_ce31/preview

CORRELATION OF CO'S WITH THE PO'S&PSO'S:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3		3		3						2	2
CO2	3	3		3		3						2	2
CO3	3	3		3		3						2	2
CO4	3	2				2						2	2
CO5	3	3		3		3						2	2

CO-PO MAPPING JUSTIFICATION:

Unit No	Course Outcomes					Program Outcome (PO)	PO(s): Action Verb and BTL(for PO1 to PO11)	Level of Correlation (0-3)
	Lesson Plan Hrs	%	Correlation	CO's Action Verb	BTL			
1	16/80	20	3	Analyze	L4	PO1 PO2 PO4 PO6	Apply (L3) Analyze (L4) Analyze (L4) Thumb Rule	3 3 3 3
2	16/80	20	3	Analyze	L4	PO1 PO2 PO4 PO6	Apply (L3) Analyze (L4) Analyze (L4) Thumb Rule	3 3 3 3
3	16/80	20	3	Analyze	L4	PO1 PO2 PO4 PO6	Apply (L3) Analyze (L4) Analyze (L4) Thumb Rule)	3 3 3 3
4	16/80	20	3	Analyze	L4	PO1 PO2 PO4 PO6	Apply (L3) Analyze (L4) Analyze (L4) Thumb Rule)	3 3 3 3
5	16/80	20	3	Analyze	L4	PO1 PO2 PO4 PO6	Apply (L3) Analyze (L4) Analyze (L4) Thumb Rule	3 3 3 3

JUSTIFICATION STATEMENTS:

CO 1: Analyze the beams and trusses using Energy Theorems.

Action Verb: Analyze (L4)

PO1: Apply(L3)
CO 1 Action verb is greater than PO1 verb. Therefore, the correlation is high (3)
PO2: Analyze (L4)
CO 1 Action verb is equal to PO2 verb. Therefore, the correlation is high (3)
PO 4: Analysis (L4)
CO 1 Action Verb is equal to PO4; Therefore, correlation is high (3)
CO 1 Action Verb Analyze is of BTL 4. Using Thumb rule, L4 correlates PO6 as moderate (3).

CO 2: Analyze indeterminate structures by using Castigliano's–II theorem
Action Verb: Analyze (L4)
PO1: Apply(L3)
CO 2 Action verb is greater than PO1 verb. Therefore, the correlation is high (3)
PO2: Analyze (L4)
CO 2 Action verb is equal to PO2 verb. Therefore, the correlation is high (3)
PO 4: Analysis (L4)
CO 2 Action Verb is equal to PO4; Therefore, correlation is high (3)
CO 2 Action Verb Analyze is of BTL 4. Using Thumb rule, L4 correlates PO6 as moderate (3).

CO 3: Analysis of fixed and continuous beams
Action Verb: Analyze (L4)
PO1: Apply(L3)
CO 3 Action verb is greater than PO1 verb. Therefore, the correlation is high (3)
PO2: Analyze (L4)
CO 3 Action verb is equal to PO2 verb. Therefore, the correlation is high (3)
PO 4: Analysis (L4)
CO 3 Action Verb is equal to PO4; Therefore, correlation is high (3)
CO 3 Action Verb Analyze is of BTL 4. Using Thumb rule, L4 correlates PO6 as moderate (3).

CO 4: Analyze continuous beams and portal frames by using slope-deflection method
Action Verb: Analyze (L4)
PO1: Apply(L3)
CO 4 Action verb is greater than PO1 verb. Therefore, the correlation is high (3)
PO2: Analyze (L4)
CO 4 Action verb is equal to PO2 verb. Therefore, the correlation is high (3)
PO 4: Analysis (L4)
CO 4 Action Verb is equal to PO4; Therefore, correlation is high (3)
CO 4 Action Verb Analyze is of BTL 4. Using Thumb rule, L4 correlates PO6 as moderate (3).

CO5: Analyze continuous beams and portal frames by using moment distribution method
Action Verb: Analyze (L4)
PO1: Apply(L3)
CO 5 Action verb is greater than PO1 verb. Therefore, the correlation is high (3)
PO2: Analyze (L4)
CO 5 Action verb is equal to PO2 verb. Therefore, the correlation is high (3)
PO 4: Analysis (L4)
CO 5 Action Verb is equal to PO4; Therefore, correlation is high (3)
CO 5 Action Verb Analyze is of BTL 4. Using Thumb rule, L4 correlates PO6 as moderate (3).

II YEAR II SEMESTER

Subject Code	Subject Name	L	T/CLC	P	CREDITS
23APC0111	HYDRAULICS &HYDRAULIC MACHINERY	2	1	0	3

Course Outcomes: After studying the course, students will be able to

CO1	Apply the Laminar and Turbulent flow concept in pipes
CO2	Analyze the uniform flows in open-channel flow systems.
CO3	Analyze the uniform flows in open-channel flow systems.
CO4	Evaluate the performance of impact of jets on plates and its application in different turbines.
CO5	Analyze the performance of Centrifugal pumps

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Apply	the laminar and turbulent concept	in pipes		L2
2	Analyze	The uniform flows	in open- channel flow systems		L4
3	Analyze	The non-uniform flows	in open- channel flow systems		L4
4	Evaluate	The performance of impact of jets	Plates & turbines		L5
5	Analyze	The performance of centrifugal pumps			L4

UNIT-I

Laminar & Turbulent flow in pipes: Laminar Flow- Laminar flow through: circular pipes, annulus and parallel plates. Stoke‘s law, Measurement of viscosity. Reynolds experiment, Transition from laminar to turbulent flow. Resistance to flow of fluid in smooth and rough pipes-Moody‘s diagram – Introduction to boundary layer theory.

UNIT-II

Uniform flow in Open Channels: Open Channel Flow - Comparison between open channel flow and pipe flow, geometrical parameters of a channel, classification of open channels, classification of open channel flow, Velocity Distribution of channel section. Hydraulically efficient channel sections: Rectangular, trapezoidal and triangular channels, Energy and Momentum correction factors.

UNIT-III

Non-Uniform flow in Open Channels: Specific energy, critical flow, discharge curve, Specific force, Specific depth, and Critical depth. Measurement of Discharge and Velocity – Gradually Varied Flow-Dynamic Equation of Gradually Varied Flow. Hydraulic Jump and classification - Elements and characteristics- Energy dissipation.

UNIT-IV

Impact of Jets: Hydrodynamic force of jets on stationary and moving flat, inclined and curved vanes - Velocity triangles at inlet and outlet - Work done and efficiency

Hydraulic Turbines: Classification of turbines; pelton wheel and its design. Francis turbine and its design - efficiency - Draft tube: theory - characteristic curves of hydraulic turbines. Cavitation: causes and effects.

UNIT-V

Pumps: Working principles of a centrifugal pump, work done by impeller; heads, losses and efficiencies; minimum starting speed; Priming; specific speed; limitation of suction lift, net positive suction head (NPSH); Performance and characteristic curves; Cavitation effects; Multistage centrifugal pumps; troubles and remedies.

TEXTBOOKS:

1. P. M. Modi and S. M. Seth, Hydraulics and Fluid Mechanics, Standard Book House 22nd, 2019.
2. K. Subrahmanya, Theory and Applications of Fluid Mechanics, Tata McGraw Hill, 2nd edition 2018

REFERENCES:

1. R. K. Bansal, A text of Fluid mechanics and hydraulic machines, Laxmi Publications (P) Ltd., New Delhi 11th edition, 2024.
2. N. Narayana Pillai, Principles of Fluid Mechanics and Fluid Machines, Universities Press Pvt Ltd, Hyderabad. 3rd Edition 2009.
3. Fluid Mechanics by Frank M. White, Henry Xue, Tata McGraw Hill, 9th edition , 2022.
4. C. S. P. Ojha, R. Berndtsson and P. N. Chadramouli, Fluid Mechanics and Machinery, Oxford University Press, 2010.
5. Introduction to Fluid Mechanics & Fluid Machines by S K Som, Gautam Biswas, S Chakraborty Tata McGraw Hill, 3rd edition 2011.

WEB RESOURCES:

https://nptel.ac.in/courses/105105203
https://archive.nptel.ac.in/courses/112/106/112106300/
https://archive.nptel.ac.in/courses/112/103/112103249/

CORRELATION OF COS WITH THE POS & PSOS:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	1				2	2						2
CO2	2	3		3		3							2
CO3	2	3		3		3							2
CO4	2	2	2	2		3					3	2	2
CO5	2	3	2	2		3					3	2	2

CO-PO MAPPING JUSTIFICATION:

Unit No	Course Outcomes					Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
	Lesson Plan Hrs	%	Correlation	CO's Action Verb	BTL			
1	11/82	13	2	Understand	L2	PO1 PO2 PO6	Apply (L3) Analyze(L4) Thumb Rule	2 1 2
2	17/82	21	3	Analyze	L4	PO1 PO2 PO4 PO6	Apply(L3) Analyze(L4) Analyze(L4) Thumb Rule	2 3 3 3
3	17/82	21	3	Analyze	L4	PO1 PO2 PO4 PO6	Apply(L3) Analyze(L4) Analyze(L4) Thumb Rule	2 3 3 3
4	19/82	23	3	Evaluate	L5	PO1 PO2 PO3 PO4	Apply(L3) Analyze(L4) Design (L6) Analyze(L4)	2 2 2 2

						PO6	Thumb Rule	3
5	18/82	22	3	Analyze	L4	PO1 PO2 PO4 PO6	Apply(L3) Analyze(L4) Analyze(L4) Thumb Rule	2 3 3 3

JUSTIFICATION STATEMENTS:

CO 1: Apply the Laminar and Turbulent flow concept in pipes
Action Verb: Understand (L2)
PO1: Apply(L3)
CO 1 Action Verb is less than PO1 verb by one level; Therefore, correlation is moderate (2).
PO2: Analyze (L4)
CO 1 Action Verb is less than PO2 verb by one level; Therefore, correlation is low (1).
CO 1 Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO6 as moderate (2).

CO 2: Analyze the uniform flows in open-channel flow systems.
Action Verb: Analyze (L4)
PO1: Apply(L3)
CO 2 Action verb is greater than PO1 verb. Therefore, the correlation is high (3)
PO2: Analyze (L4)
CO 2 Action verb is equal to PO2 verb. Therefore, the correlation is high (3)
PO 4: Analysis (L4)
CO 2 Action Verb is equal to PO4; Therefore, correlation is high (3)
CO 2 Action Verb Analyze is of BTL 4. Using Thumb rule, L4 correlates PO6 as moderate (3).

CO 3: Analyze the uniform flows in open-channel flow systems.
Action Verb: Analyze (L4)
PO1: Apply(L3)
CO 3 Action verb is greater than PO1 verb. Therefore, the correlation is high (3)
PO2: Analyze (L4)
CO 3 Action verb is equal to PO2 verb. Therefore, the correlation is high (3)
PO 4: Analysis (L4)
CO 3 Action Verb is equal to PO4; Therefore, correlation is high (3)
CO 3 Action Verb Analyze is of BTL 4. Using Thumb rule, L4 correlates PO6 as moderate (3).

CO 4: Evaluate the performance of impact of jets on plates and its application in different turbines.
Action Verb: Evaluate (L5)
PO1: Apply (L3)
CO 4: Action verb is greater than PO1 verb; Therefore, correlation is moderate (2).
PO2: Analyze (L4)
CO 4Action verb is greater than PO2 verb by one level; Therefore, correlation is moderate (2).
PO3: Design
CO 4 Action verb is less than PO3 verb by one level; Therefore, correlation is moderate (2).
PO4: Design
CO 4 Action verb is less than PO3 verb by one level; Therefore, correlation is moderate (2).
PO6: Action verb Evaluate is of BTL 5. Using Thumb rule, L5 correlates PO6 as High (3)
PO11: Action verb Evaluate is of BTL 5. Using Thumb rule, L5 correlates PO11 as High (3)

CO 5: Analyze the performance of Centrifugal pumps
Action Verb: Analyze (L4)
PO1: Apply(L3)
CO 5 Action verb is greater than PO1 verb. Therefore, the correlation is high (3)
PO2: Analyze (L4)
CO 5 Action verb is equal to PO2 verb. Therefore, the correlation is high (3)
PO 4: Analysis (L4)
CO 5 Action Verb is equal to PO4; Therefore, correlation is high (3)
CO 5 Action Verb Analyze is of BTL 4. Using Thumb rule, L4 correlates PO6 as moderate (3).

II YEAR II SEMESTER

Subject Code	Subject Name	L	T/CLC	P	CREDITS
23APC0112	CONCRETE TECHNOLOGY LAB	0	0	3	1.5

Course Outcomes: After studying the course, students will be able to

CO1	Evaluate the quality and suitability of cement for concrete production
CO2	Evaluate the properties of fine aggregate for concrete production
CO3	Evaluate the properties of coarse aggregate for concrete production
CO4	Analyze the fresh properties of concrete by various test methods
CO5	Analyze the hardened properties of concrete by various test methods

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Evaluate	the quality and suitability of cement		for concrete production	L5
2	Evaluate	the properties of fine aggregate		for concrete production	L5
3	Evaluate	the properties of coarse aggregate		for concrete production	L5
4	Analyze	the fresh properties		of concrete	L4
5	Analyze	the hardened properties		of concrete	L4

LIST OF EXPERIMENTS

1. Tests on Cement – CO1
- Normal Consistency and Fineness of cement.
- Initial setting time and Final setting time of cement.
- Specific gravity and soundness of cement.
- Compressive strength of cement.

2. Tests on Fine Aggregates –CO2
- Grading and fineness modulus of Fine aggregate by sieve analysis.
- Specific gravity of fine aggregate
- Water absorption and Bulking of sand

3. Tests on Coarse Aggregates –CO3
- Grading and fineness modulus of coarse aggregate by sieve analysis.
- Specific gravity of coarse aggregate
- Water absorption of Coarse aggregates

4. Tests on fresh Concrete –CO4
- Workability of concrete by compaction factor method
- Workability of concrete by slump test
- Workability of concrete by Vee-bee test.

5. Tests on Hardened Concrete –CO5
- Compressive strength of cement concrete and Modulus of rupture

- Young's Modulus and Poisson's Ratio
- Split tensile strength of concrete.
- Non-Destructive testing on concrete (for demonstration)

CORRELATION OF COS WITH THE POS & PSOS:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3		3		3					3		
CO2	3	3		3		3					3		
CO3	3	3		3		3					3		
CO4	3	3		3		3							
CO5	3	3		3		3							

CO-PO MAPPING JUSTIFICATION:

CO	CO		Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
	Verb	BTL			
1	Evaluate	L5	PO1 PO2 PO3 PO4 PO6 PO11	Apply (L3) Analyze (L4) Design (L6) Design (L6) Thumb Rule Thumb Rule	3 3 3 3 3
2	Evaluate	L5	PO1 PO2 PO3 PO4 PO6 PO11	Apply (L3) Analyze (L4) Design (L6) Design (L6) Thumb Rule Thumb Rule	3 3 3 3 3
3	Evaluate	L5	PO1 PO2 PO3 PO4 PO6 PO11	Apply (L3) Analyze (L4) Design (L6) Design (L6) Thumb Rule Thumb Rule	3 3 3 3 3
4	Analyze	L4	PO1 PO2 PO4 PO6	Apply (L3) Analyze (L4) Analysis (L4) Thumb Rule	3 3 3 3
5	Analyze	L4	PO1 PO2 PO4 PO6	Apply (L3) Analyze (L4) Analysis (L4) Thumb Rule	3 3 3 3

JUSTIFICATION STATEMENTS:

CO 1: Evaluate the quality and suitability of cement for concrete production
Action Verb: Evaluate (L5)
PO1: Apply (L3)
CO 1: Action verb is greater than PO1 verb; Therefore, correlation is moderate (2).
PO2: Analyze (L4)
CO 1 Action verb is greater than PO2 verb by one level; Therefore, correlation is moderate (2).

PO3: Design
CO 1 Action verb is less than PO3 verb by one level; Therefore, correlation is moderate (2).
PO4: Design
CO 1 Action verb is less than PO3 verb by one level; Therefore, correlation is moderate (2).
PO6: Action verb Evaluate is of BTL 5. Using Thumb rule, L5 correlates PO6 as High (3)
PO11: Action verb Evaluate is of BTL 5. Using Thumb rule, L5 correlates PO11 as High (3)

CO 2: Evaluate the properties of fine aggregate for concrete production

Action Verb: Evaluate (L5)
PO1: Apply (L3)
CO 2: Action verb is greater than PO1 verb; Therefore, correlation is moderate (2).
PO2: Analyze (L4)
CO 2 Action verb is greater than PO2 verb by one level; Therefore, correlation is moderate (2).
PO3: Design
CO 2 Action verb is less than PO3 verb by one level; Therefore, correlation is moderate (2).
PO4: Design
CO 2 Action verb is less than PO3 verb by one level; Therefore, correlation is moderate (2).
PO6: Action verb Evaluate is of BTL 5. Using Thumb rule, L5 correlates PO6 as High (3)
PO11: Action verb Evaluate is of BTL 5. Using Thumb rule, L5 correlates PO11 as High (3)

CO 3: Evaluate the properties of coarse aggregate for concrete production

Action Verb: Evaluate (L5)
PO1: Apply (L3)
CO 3: Action verb is greater than PO1 verb; Therefore, correlation is moderate (2).
PO2: Analyze (L4)
CO 3 Action verb is greater than PO2 verb by one level; Therefore, correlation is moderate (2).
PO3: Design
CO 3 Action verb is less than PO3 verb by one level; Therefore, correlation is moderate (2).
PO4: Design
CO 3 Action verb is less than PO3 verb by one level; Therefore, correlation is moderate (2).
PO6: Action verb Evaluate is of BTL 5. Using Thumb rule, L5 correlates PO6 as High (3)
PO11: Action verb Evaluate is of BTL 5. Using Thumb rule, L5 correlates PO11 as High (3)

CO 4: Analyze the fresh properties of concrete by various test methods

Action Verb: Analyze (L4)
PO1: Apply(L3)
CO 4 Action verb is greater than PO1 verb. Therefore, the correlation is high (3)
PO2: Analyze (L4)
CO 4 Action verb is equal to PO2 verb. Therefore, the correlation is high (3)
PO 4: Analysis (L4)
CO 4 Action Verb is equal to PO4; Therefore, correlation is high (3)
CO 4 Action Verb Analyze is of BTL 4. Using Thumb rule, L4 correlates PO6 as moderate (3).

CO 5: Analyze the hardened properties of concrete by various test methods

Action Verb: Analyze (L4)
PO1: Apply(L3)
CO 5 Action verb is greater than PO1 verb. Therefore, the correlation is high (3)
PO2: Analyze (L4)
CO 5 Action verb is equal to PO2 verb. Therefore, the correlation is high (3)
PO 4: Analysis (L4)
CO 5 Action Verb is equal to PO4; Therefore, correlation is high (3)
CO 5 Action Verb Analyze is of BTL 4. Using Thumb rule, L4 correlates PO6 as moderate (3).

II YEAR II SEMESTER

Subject Code	Subject Name	L	T/CLC	P	CREDITS
23APC0113	ENGINEERING GEOLOGY LAB	0	0	3	1.5

Course Outcomes: After studying the course, students will be able to

CO1	Apply the physical properties of minerals and rocks to real world scenarios
CO2	Evaluate the accuracy and limitations of geological maps based on the data used for their formation
CO3	Analyze basic strike and dip problems using geological maps and sections
CO4	Evaluate the Strength of rocks using laboratory equipment's
CO5	Analyze the Bore Hole data and Field data

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Apply	The physical properties of minerals and rocks		Real world scenarios	L3
2	Evaluate	Accuracy and limitations of geological maps	Based on the data used for their formation		L5
3	Analyze	basic strike and dip problem		using geological maps and sections	L4
4	Evaluate	Strength of rocks		using laboratory equipment's	L5
5	Analyze	Bore Hole data and Field data		from the field	L4

LIST OF EXPERIMENTS

1. Physical properties of minerals: Mega-scopic identification of
   a) Rock forming minerals – Quartz group, Feldspar group, Garnet group, Mica group & Talc, Chlorite, Olivine, Kyanite, Asbestos, Tourmelene, Calcite, Gypsum, etc…
   b) Ore forming minerals – Magnetite, Hematite, Pyrite, Pyralusite, Graphite, Chromite,etc…
2. Megascopic description and identification of rocks.
   a) Igneous rocks – Types of Granite, Pegmatite, Gabbro, Dolerite, Syenite, Granite Poryphery, Basalt, etc.
   b) Sedimentary rocks – Sand stone, Ferrugineous sand stone, Lime stone, Shale, Laterite, Conglomerate, etc.
   c) Metamorphic rocks – Biotite – Granite Gneiss, Slate, Muscovite & Biotiteschist,Marble, Khondalite, etc.
3. Interpretation and drawing of sections for geological maps showing tilted beds, faults, unconformities etc.
4. Simple Structural Geology problems.
5. Bore hole data.
6. Strength of the rock using laboratory tests.
7. Field work – To identify Minerals, Rocks, Geomorphology& Structural Geology.

REFERENCES:

1. 'Applied Engineering Geology Practicals' by M T Mauthesha Reddy, New AgeInternational Publishers, 2nd Edition.
2. 'Foundations of Engineering Geology' by Tony Waltham, Spon Press, 3rd edition, 2009.

CORRELATION OF COS WITH THE POS & PSOS:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2		3		3							
CO2	3	3		3		3							
CO3	3	3		3		3							
CO4	3	3		3		3					3		
CO5	3	3		3		3							

CO-PO MAPPING JUSTIFICATION:

CO	CO		Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
	Verb	BTL			
1	Apply	L3	PO1 PO2 PO4 PO6	Apply(L3) Analyze(L4) Analyze(L4) Thumb Rule	2 2 3 3
2	Evaluate	L5	PO1 PO2 PO3 PO4 PO6 PO11	Apply (L3) Analyze (L4) Design (L6) Design (L6) Thumb Rule Thumb Rule	3 3 3 3 3
3	Analyze	L4	PO1 PO2 PO4 PO6	Apply(L3) Analyze(L4) Analyze(L4) Thumb Rule	3 3 3 3
4	Evaluate	L5	PO1 PO2 PO3 PO4 PO6 PO11	Apply (L3) Analyze (L4) Design (L6) Design (L6) Thumb Rule Thumb Rule	3 3 3 3 3
5	Analyze	L4	PO1 PO2 PO4 PO6	Apply(L3) Analyze(L4) Analyze(L4) Thumb Rule	3 3 3 3

JUSTIFICATION STATEMENTS:

CO 1: Apply the physical properties of minerals and rocks to real world scenarios
Action Verb: Apply (L3)
PO1: Apply(L3)
CO 1 Action verb is equal to PO1 verb. Therefore, the correlation is high (3)
PO2: Analyze (L4)
CO 1Action Verb is low to PO2 verb. Therefore, the correlation is medium (2)
CO 1 Action verb Apply is of BTL 3. Using Thumb rule, L3 correlates PO6 as moderate (2).

CO 2: Evaluate the accuracy and limitations of geological maps based on the data used for their formation
Action Verb: Evaluate (L5)
PO1: Apply (L3)
CO 2 Action verb is greater than PO1 verb; Therefore, correlation is moderate (2).
PO2: Analyze (L4)
CO 2 Action verb is greater than PO2 verb by one level; Therefore, correlation is moderate (2).
PO3: Design
CO 2 Action verb is less than PO3 verb by one level; Therefore, correlation is moderate (2).
PO4: Design
CO 2 Action verb is less than PO3 verb by one level; Therefore, correlation is moderate (2).
PO6: Action verb Evaluate is of BTL 5. Using Thumb rule, L5 correlates PO6 as High (3)
PO11: Action verb Evaluate is of BTL 5. Using Thumb rule, L5 correlates PO11 as High (3)

CO 3: Analyze basic strike and dip problems using geological maps and sections
Action Verb: Analyze (L4)
PO1: Apply(L3)
CO 3 Action verb is greater than PO1 verb. Therefore, the correlation is high (3)
PO2: Analyze (L4)
CO 3 Action verb is equal to PO2 verb. Therefore, the correlation is high (3)
PO 4: Analysis (L4)
CO 3 Action Verb is equal to PO4; Therefore, correlation is high (3)
CO 3 Action Verb Analyze is of BTL 4. Using Thumb rule, L4 correlates PO6 as moderate (3).

CO 4: Evaluate the Strength of rocks using laboratory equipment's
Action Verb: Evaluate (L5)
PO1: Apply (L3)
CO 4 Action verb is greater than PO1 verb; Therefore, correlation is moderate (2).
PO2: Analyze (L4)
CO 4 Action verb is greater than PO2 verb by one level; Therefore, correlation is moderate (2).
PO3: Design
CO 4 Action verb is less than PO3 verb by one level; Therefore, correlation is moderate (2).
PO4: Design
CO 4 Action verb is less than PO3 verb by one level; Therefore, correlation is moderate (2).
PO6: Action verb Evaluate is of BTL 5. Using Thumb rule, L5 correlates PO6 as High (3)
PO11: Action verb Evaluate is of BTL 5. Using Thumb rule, L5 correlates PO11 as High (3)

CO 5: Analyze the Bore Hole data and Field data
Action Verb: Analyze (L4)
PO1: Apply(L3)
CO 5 Action verb is greater than PO1 verb. Therefore, the correlation is high (3)
PO2: Analyze (L4)
CO 5 Action verb is equal to PO2 verb. Therefore, the correlation is high (3)
PO 4: Analysis (L4)
CO 5 Action Verb is equal to PO4; Therefore, correlation is high (3)
CO 5 Action Verb Analyze is of BTL 4. Using Thumb rule, L4 correlates PO6 as moderate (3).

II YEAR II SEMESTER

Subject Code	Subject Name	L	T/CLC	P	CREDITS
23ASC9901	SOFT SKILLS LAB	0	1	2	2

Course Outcomes: After studying the course, students will be able to

CO1	Understand the various techniques of soft skills and communication skills.
CO2	Analyze the listening and thinking skills to enhance professional development.
CO3	Apply the critical thinking skills in problem solving and decision making through Discussions.
CO4	Evaluate the emotional intelligence and stress management for individuals and groups.
CO5	Apply the corporate etiquette atmosphere to enhance professional behavior in workplace environment.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Understand	the various techniques of soft skills and communication skills.			**L2**
2	Analyze	the listening and thinking skills to enhance professional development			**L4**
3	Apply	the critical thinking skills in problem solving and decision making through Discussions.			**L3**
4	Evaluate	the emotional intelligence and stress management to control in themselves and others.			**L5**
5	Apply	the corporate etiquette atmosphere to enhance processional behavior in workplace environment.			**L3**

UNIT-I

Soft Skills - Introduction, Need - Mastering Techniques of Soft Skills – Communication Skills - Significance, process, types - Barriers of communication - Improving techniques.

Activities:

Intrapersonal Skills- Narration about self- strengths and weaknesses- clarity of thought – self-expression – articulating with felicity. (The facilitator can guide the participants before the activity citing examples from the lives of the great, anecdotes and literary sources)

Interpersonal Skills- Group Discussion – Debate – Team Tasks - Book and film Reviews by groups - Group leader presenting views (non- controversial and secular) on contemporary issues or on a given topic.
Verbal Communication- Oral Presentations- Extempore- brief addresses and speeches- convincing- negotiating- agreeing and disagreeing with professional grace.

Non-verbal communication – Public speaking – Mock interviews – presentations with an objective to identify non- verbal clues and remedy the lapses on observation

UNIT-II CRITICAL THINKING

Active Listening – Observation – Curiosity – Introspection – Analytical Thinking – Open-mindedness – Creative Thinking - Positive thinking - Reflection

Activities:

Gathering information and statistics on a topic - sequencing – assorting – reasoning – critiquing issues –placing the problem – finding the root cause - seeking viable solution – judging with rationale – evaluating the views of others - Case Study, Story Analysis

UNIT-III PROBLEM SOLVING & DECISION MAKING

Meaning & features of Problem Solving – Managing Conflict – Conflict resolution – Team building - Effective decision making in teams – Methods & Styles

Activities:

Placing a problem which involves conflict of interests, choice and views – formulating the problem – exploring solutions by proper reasoning – Discussion on important professional, career and organizational decisions and initiate debate on the appropriateness of the decision. Case Study & Group Discussion

UNIT-IV EMOTIONAL INTELLIGENCE & STRESS MANAGEMENT

Managing Emotions – Thinking before Reacting – Empathy for Others – Self-awareness – Self-Regulation – Stress factors – Controlling Stress – Tips

Activities:

Providing situations for the participants to express emotions such as happiness, enthusiasm, gratitude, sympathy, and confidence, compassion in the form of written or oral presentations.

Providing opportunities for the participants to narrate certain crisis and stress –ridden situations caused by failure, anger, jealousy, resentment and frustration in the form of written and oral presentation, Organizing Debates

UNIT-V CORPORATE ETIQUETTE

Etiquette- Introduction, concept, significance - Corporate etiquette - meaning, modern etiquette, benefits - Global and local culture sensitivity - Gender Sensitivity - Etiquette in interaction- Cell phone etiquette - Dining etiquette - Netiquette - Job interview etiquette -Corporate grooming tips - Overcoming challenges

Activities:

Providing situations to take part in the Role Plays where the students will learn about bad and good manners and etiquette - Group Activities to showcase gender sensitivity, dining etiquette etc. - Conducting mock job interviews - Case Study - Business Etiquette Games

TEXTBOOKS:

1. Mitra Barun K, Personality Development and Soft Skills, Oxford University Press, Pap/Cdr edition 2012
2. Dr Shikha Kapoor, Personality Development and Soft Skills: Preparing for Tomorrow, I K International Publishing House, 2018

REFERENCES:

1. Sharma, Prashant, Soft Skills: Personality Development for Life Success, BPB Publications 2018.
2. Alex K, Soft Skills S Chand & Co, 2012 (Revised edition)
3. Gajendra Singh Chauhan & Sangeetha Sharma, Soft Skills: An Integrated Approach to Maximize Personality Published by Wiley, 2013
4. Pillai, Sabina & Fernandez Agna, Soft Skills and Employability Skills, Cambridge University Press, 2018

5. Soft Skills for a Big Impact (English, Paperback, Renu Shorey) Publisher: Notion Press
6. Dr. Rajiv Kumar Jain, Dr. Usha Jain, Life Skills (Paperback English) Publisher: Vayu Education of India, 2014

WEB RESOURCES:

1. https://youtu.be/DUlsNJtg2L8?list=PLLy_2iUCG87CQhELCytvXh0E_y-bOO1_q
2. https://youtu.be/xBaLgJZ0t6A?list=PLzf4HHlsQFwJZel_j2PUy0pwjVUgj7KlJ
3. https://youtu.be/-Y-R9hDl7lU
4. https://youtu.be/gkLsn4ddmTs
5. https://youtu.be/2bf9K2rRWwo
6. https://youtu.be/FchfE3c2jzc
7. https://www.businesstrainingworks.com/training-resource/five-free-business-etiquette-training-games/
8. https://onlinecourses.nptel.ac.in/noc24_hs15/preview
9. https://onlinecourses.nptel.ac.in/noc21_hs76/preview

CORRELATION OF COS WITH THE POS & PSOS:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1									2				
CO2								3	3				
CO3								2					
CO4								3					
CO5								2	2				

CO-PO MAPPING JUSTIFICATION:

Unit No	Course Outcomes					Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
	Lesson Plan Hrs	%	Correlation	CO's Action Verb	BTL			
1				Understand	L2	PO9	Thumb rule	2
2				Analyze	L4	PO8 PO9	Thumb rule	3 3
3				Apply	L3	PO8	Thumb rule	2
4				Evaluate	L5	PO8	Thumb rule	3
5				Apply	L3	PO8 PO9	Thumb rule	2 2

JUSTIFICATION STATEMENTS:

CO1: Understand the various techniques of soft skills and communication skills.

Action Verb: Understand (L2)

CO1 Action Verb Understand is of BTL 2. Using Thumb rule, L2 correlates PO6 to PO11 as moderate (2).

CO2: Analyze the listening and thinking skills to enhance professional development.

Action Verb: Analyze (L4)

CO2 Action Verb Analyze is of BTL 4. Using Thumb rule, L4 correlates PO6 to PO11 as high (3)

CO3: Apply the critical thinking skills in problem solving and decision making through Discussions.

Action Verb: Apply (L3)

CO3 Action Verb Apply is of BTL 3. Using Thumb rule, L3 correlates PO6 to PO11 as moderate (2).

CO4: Evaluate the emotional intelligence and stress management to control themselves and others.

Action Verb: Evaluate (L5)

CO4 Action Verb Evaluate is of BTL 5. Using Thumb rule, L2 correlates PO6 to PO11 as high (3).

CO5: Apply the corporate etiquette atmosphere to enhance processional behavior in workplace environment.

Action Verb: Create e (L3)

II YEAR II SEMESTER

Subject Code	Subject Name	L	T/CLC	P	CREDITS
23AES0304	DESIGN THINKING & INNOVATION	1	0	2	2

Course Outcomes: After studying the course, students will be able to

CO1	Understand the concepts and principles of design thinking process.
CO2	Apply the design thinking techniques for solving problems in various sectors.
CO3	Analyze the art of innovation & creativity in product development
CO4	Apply the design guidelines for produced development.
CO5	Analyze the design thinking strategies for solving real time business issues.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Understand	the concepts and principles of design thinking process.			L2
2	Apply	the design thinking techniques for solving problems in various sectors.			L3
3	Analyze	the art of innovation & creativity in product development			L4
4	Apply	the design guidelines for produced development.			L3
5	Analyze	the design thinking strategies for solving real time business issues.			L4

UNIT-I

Introduction to Design Thinking

Introduction to elements and principles of Design, basics of design-dot, line, shape, form as fundamental design components. Principles of design. Introduction to design thinking, history of Design Thinking, New materials in Industry

UNIT-II

Design Thinking Process

Design thinking process (empathize, analyze, idea & prototype), implementing the process in driving inventions, design thinking in social innovations. Tools of design thinking - person, costumer, journey map, brainstorming, product development

Activity: Every student presents their idea in three minutes, Every student can present design process in the form of flow diagram or flow chart etc. Every student should explain about product development.

UNIT-III

Innovation

Art of innovation, Difference between innovation and creativity, role of creativity and innovation in organizations- Creativity to Innovation- Teams for innovation- Measuring the impact and value of creativity.

Activity: Debate on innovation and creativity, Flow and planning from idea to innovation, Debate on value-based innovation

UNIT-IV

Product Design

Problem formation, introduction to product design, Product strategies, Product value, Product planning, product specifications- Innovation towards product design- Case studies **Activity:** Importance of modelling, how to set specifications, Explaining their own product design.
UNIT-V
Design Thinking in Business Processes Design Thinking applied in Business & Strategic Innovation, Design Thinking principles that redefine business – Business challenges: Growth, Predictability, Change, Maintaining Relevance, Extreme competition, Standardization. Design thinking to meet corporate needs- Design thinking for Startups- Defining and testing Business Models and Business Cases- Developing & testing prototypes **Activity:** How to market our own product, About maintenance, Reliability and plan for startup.

TEXTBOOKS:

1. Tim Brown,Change by design, Harper Bollins (2009)
2. Idris Mootee, Design Thinking for Strategic Innovation, 2013, John Wiley & Sons.

REFERENCES:

1. David Lee, Design Thinking in the Classroom, Ulysses press
2. Shrutin N Shetty, Design the Future, Norton Press
3. William Lidwell,Universal Principles of Design- Kritinaholden, Jill Butter.
4. Chesbrough.H, The Era of Open Innovation – 2013

WEB RESOURCES:

https://nptel.ac.in/courses/110/106/110106124/
https://nptel.ac.in/courses/109/104/109104109/
https://swayam.gov.in/nd1_noc19_mg60/preview

CORRELATION OF COS WITH THE POS & PSOS:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2		2									2	2
CO2	2	2	2									2	2
CO3	2	2	2			1						2	2
CO4	2	2	2			1						2	2
CO5	2	2	2			2						2	2

CO-PO MAPPING JUSTIFICATION:

Unit No	Course Outcomes					Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
	Lesson Plan Hrs	%	Correlation	CO's Action Verb	BTL			
1	**11**	**20.3**	**L3**	**Understand**	**L2**	PO1 PO3	Apply (L3) Develop (L3)	2 2
2	**10**	**18.5**	**L2**	**Apply**	**L3**	PO1 PO2 PO3	Apply (L3) Identify (L3) Develop (L3)	3 3 3
3	**11**	**20.3**	**L3**	**Analyze**	**L4**	PO1 PO2 PO3	Apply (L3) Identify (L3) Develop (L3)	3 3 3

						PO6	Thumb Rule	1
4	**12**	**22.2**	**L3**	**Apply**	**L3**	PO1 PO2 PO3 PO6	Apply (L3) Identify (L3) Develop (L3) Thumb Rule	3 3 3 1
5	**10**	**18.5**	**L2**	**Analyze**	**L4**	PO1 PO2 PO3 PO6	Apply (L3) Identify (L3) Develop (L3) Thumb Rule	3 3 3 2

JUSTIFICATION STATEMENTS:

CO1: Understand the concepts and principles of design thinking process.
Action Verb: Understand (L2)
PO1Verb: Apply (L3)
CO1 Action verb is lower than PO1 verb. Therefore, the correlation is medium (2)
PO3 Verb: Develop (L3)
CO1 Action verb is lower than PO3 verb. Therefore, the correlation is medium (2)

CO2: Apply the design thinking techniques for solving problems in various sectors.
PO1 Verb: Apply (L3)
CO2 Action verb is same level as PO1 verb. Therefore, the correlation is high (3)
PO2 Verb: Identify (L3)
CO2 Action verb is same level as PO2 verb. Therefore, the correlation is high (3)
PO3 Verb: Develop (L3)
CO2 Action verb is same level as PO3 verb. Therefore, the correlation is high (3)
CO3: Analyze the art of innovation & creativity in product development.
Action Verb: Analyze (L4)
PO1 Verb: Apply (L3)
CO3 Action verb is same level (greater) as PO1 verb. Therefore, the correlation is high (3)
PO2 Verb: Identify (L3)
CO3 Action verb is same level (greater) as PO2 verb. Therefore, the correlation is high (3)
PO3 Verb: Develop (L3)
CO3 Action verb is same level (greater) as PO3 verb. Therefore, the correlation is high (3)
PO6 Verb: Thumb Rule
As per thumb rule CO3 co-relates slightly with PO6 verb. Therefore, the correlation is high (3)
CO4: Apply the design guidelines for produced development.
Action Verb: Apply (L3)
PO1 Verb: Apply (L3)
CO4 Action verb is same level as PO1 verb. Therefore, the correlation is high (3)
PO2 Verb: Identify (L3)
CO4 Action verb is same level as PO2 verb. Therefore, the correlation is high (3)
PO3 Verb: Develop (L3)
CO4 Action verb is same level as PO3 verb. Therefore, the correlation is high (3)
PO6 Verb: Thumb Rule
As per thumb rule CO4 co-relates slightly with PO6 verb. Therefore, the correlation is high (3)
CO5: Analyze the design thinking strategies for solving real time business issues.
Action Verb: Analyze (L4)
PO1 Verb: Apply (L3)
CO5 Action verb is same level (greater) as PO1 verb. Therefore, the correlation is high (3)
PO2 Verb: Identify (L3)
CO5 Action verb is same level (greater) as PO2 verb. Therefore, the correlation is high (3)
PO3 Verb: Develop (L3)
CO5 Action verb is same level (greater) as PO3 verb. Therefore, the correlation is low (1)
PO6 Verb: Thumb Rule
As per thumb rule CO5 co-relates moderately with PO6 verb. Therefore, the correlation is high (3)level (greater) as PO3 verb. Therefore, the correlation is low (1) PO6 Verb: Thumb Rule As per thumb rule CO5 co-relates moderately with PO6 verb. Therefore, the correlation is high (3)

II YEAR II SEMESTER

Subject Code	Subject Name	L	T/CLC	P	CREDITS
23AMC9901	ENVIRONMENTAL SCIENCE	2	0	0	0

Course Outcomes: After studying the course, students will be able to

CO1	Understand the multidisciplinary nature of environmental studies, various renewable and nonrenewable resources
CO2	Understand the ecosystem and biodiversity to solve complex environmental problems
CO3	Apply the various types of pollution, solid waste management, and related preventive measures
CO4	Apply the rainwater harvesting, watershed management, ozone layer depletion, and wasteland reclamation
CO5	Analyze the population explosion and impact of environmental health issues on human beings.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Understand	the multidisciplinary nature of environmental studies, various renewable and nonrenewable resources.			L2
2	Understand	the ecosystem and biodiversity	to solve complex environmental problems		L2
3	Apply	the various types of pollution, solid waste management, and related preventive measures			L3
4	Apply	the rainwater harvesting, watershed management, ozone layer depletion, and wasteland reclamation			L3
5	Analyze	the population explosion and impact of environmental health issues on human being.			L4

UNIT-I

Multidisciplinary Nature of Environmental Studies: Introduction Multidisciplinary Nature of Environmental Studies - Definition, Scope and Importance – Need for Public Awareness.

Natural Resources: Renewable and non-renewable energy resources –Natural resources and associated problems.

Forest resources: Use and over – exploitation, deforestation, case studies – Timber extraction – Mining, dams and other effects on forest and tribal people.

Water resources: Use and overutilization of surface and sub-surface – Floods, drought, conflicts over water, dams – benefits and problems.

Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.

Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticides problems, water logging, salinity, case studies.

Energy resources: Renewable and non-renewable energy resources.

UNIT-II

Ecosystems: Concept of an ecosystem. – Structure and functions of an ecosystem – Producers, consumers and decomposers – Energy flow in the ecosystem – Ecological succession – Food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the following ecosystem: Forest ecosystem, Grassland ecosystem, Desert ecosystem and Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).

Biodiversity And Its Conservation : Introduction- Definition:genetic, species and ecosystem diversity – Value of biodiversity: consumptive use, Productive use, social, ethical, aesthetic and option values – Biodiversity at global, National and local levels – India as a mega-diversity nation – Hot-sports of biodiversity – Threats to biodiversity:

habitat loss, poaching of wildlife, man - wildlife conflicts Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity

UNIT-III

Environmental Pollution: Definition, Causes, effects and its controlmeasures of: Air Pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, and Thermal pollution and Nuclear hazards.

Solid Waste Management: Causes, effects and control measures of urban and industrial wastes – Role of an individual in prevention of pollution – Pollution case studies – Disaster management: earthquakes, cyclones, tsunamis, and landslides.

UNIT-IV

Social Issues and the Environment: From Unsustainable to Sustainable development – Urban problems related to energy – Water conservation, Rainwater harvesting and Watershed Management – Resettlement and rehabilitation of people Case studies – Environmental ethics: Issues and possible solutions – Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies–Wasteland reclamation. – Consumerism and waste products. – Environment Protection Act. – Air (Prevention and Control of Pollution) Act. – Water (Prevention and control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act Public awareness.

UNIT-V

Human Population and the Environment: Population growth, variation among nations. Population explosion – Family Welfare Programs. – Environment and human health – Human Rights – Value Education – HIV/AIDS – Women and Child Welfare – Role of Information Technology in Environment and human health – Case studies.

TEXTBOOKS:

1. Textbook of Environmental Studies for Undergraduate Courses Erach Bharucha for University Grants Commission, Universities Press.
2. Palaniswamy, “Environmental Studies”, Pearson education S.Azeem Unnisa,
3. “Environmental Studies” Academic Publishing Company K.Raghavan Nambiar,
4. “Text book of Environmental Studies for Undergraduate Courses as per UGC model syllabus”, Scitech Publications (India), Pvt. Ltd.

REFERENCES:

1. Deeksha Dave and E.Sai Baba Reddy, "Textbook of Environmental Science", Cengage Publications.
2. M.Anji Reddy, "Text book of Environmental Sciences and Technology", BS Publication.
3. J.P.Sharma, Comprehensive Environmental studies, Laxmi publications.
4. J. Glynn Henry and Gary W. Heinke, "Environmental Sciences and Engineering", Prentice hall of India Private limited
5. G.R.Chatwal, "A Text Book of Environmental Studies" Himalaya Publishing House
6. Gilbert M. Masters and Wendell P. Ela, "Introduction to Environmental Engineering and Science, Prentice hall of India Private limited.

CORRELATION OF COS WITH THE POS & PSOS:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1						2	2						
CO2							2						
CO3						2	2						
CO4						2	2						
CO5							2						

CO-PO MAPPING JUSTIFICATION:

Unit No	Course Outcomes					Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
	Lesson Plan Hrs	%	Correlation	CO's Action Verb	BTL			
1	10	12	23	3	Understand	**L2**	PO6, PO7	Thumb Rule Thumb Rule
2	15	15	28	3	Understand	**L2**	PO7	Thumb Rule
3	8	8	15	2	Apply	**L3**	PO6 PO7	Thumb Rule Thumb Rule
4	9	10	19	2	Apply	**L3**	PO6, PO7	Thumb Rule Thumb Rule
5	8	8	15	2	Analyze	**L4**	PO7	Thumb Rule

JUSTIFICATION STATEMENTS:

CO1: Understand the multidisciplinary nature of environmental studies, various renewable and nonrenewable resources.
Action Verb: Understand (L2)
Using Thumb rule, CO1correlatesPO6 and PO7 as a moderate (2)

CO2: Understand the ecosystem and biodiversity to solve complex environmental problems
Action Verb: Understand (L2)
Using Thumb rule, CO2 correlates PO7 as a moderate (2)

CO3: Apply the various types of pollution, solid waste management, and related preventive measures
Action Verb: APPLY (L3)
Using Thumb rule, CO3 correlates PO6 and PO7 as a moderate (2)

CO4: Apply the rainwater harvesting, watershed management, ozone layer depletion, and wasteland reclamation.
Action Verb: APPLY (L3)
Using Thumb rule, CO4 correlates PO6 and PO7 as a moderate (2)

CO5: Analyze the population explosion and impact of environmental health issues on human being
Action Verb: Analyze (L4)
Using Thumb rule, CO5 correlates PO7 as a moderate (2)

B.Tech. – III Year I Semester

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits	Scheme of Examination (Max. Marks)		
				L	T/CLC	P	C	CIE	SEE	Total
1	PC	23APC0114	Water Resources Engineering	2	1	0	3	30	70	100
2	PC	23APC0115	Design Of Reinforced Concrete Structures	2	1	0	3	30	70	100
3	PC	23APC0116	Geotechnical Engineering	2	1	0	3	30	70	100
4	ES	23AES0504	Introduction to Quantum Technology & Applications	2	1	0	3	30	70	100
5	PE	23APE0101	Cost Effective Housing Techniques	2	1	0	3	30	70	100
	PE	23APE0102	Experimental Stress Analysis							
	PE	23APE0103	Environmental Impact Assessment							
6	OE		Open Elective – I	2	1	0	3	25	75	100
7	PC	23APC0117	Geotechnical Engineering Lab	0	0	3	1.5	30	70	100
8	PC	23APC0118	Fluid Mechanics Hydraulic Machines Lab	0	0	3	1.5	30	70	100
9	SC	23ASC0102	**Skill oriented course** Estimation, Specifications, Costing & Valuation	0	1	2	2	30	70	100
10	ES	23AES0404	Tinkering Lab	0	0	2	1	30	70	100
11	CSP	23APR0101	Evaluation of Community Service Project	-	-	-	2	100	-	100
Total Credits				**12**	**7**	**10**	**26**	**395**	**705**	**1100**

OPEN ELECTIVE – I

S.No.	Course Code	Course Name	Offered by the Dept.
1	23AOE0201	Electrical Safety Practices and Standards	EEE
2	23AOE0301	Sustainable Energy Technologies	ME
3	23AOE0401	Electronic Circuits	ECE
4	23AOE0501	Java Programming	CSE & ALLIED IT
5	23AOE0502	Introduction to Artificial Intelligence	
6	23AOE0503	Quantum Technologies and Applications	
7	23AOE9901	Mathematics for Machine Learning and AI	MATHEMATICS
8	23AOE9906	Materials Characterization Techniques	PHYSICS
9	23AOE9911	Chemistry of Energy Systems	CHEMISTRY
10	23AOE9915	English for Competitive Examinations	HUMANITIES
11	23AOEMB01	Entrepreneurship and New Venture Creation	

Note:

4. A student is permitted to register for Honors or a Minor in IV semester after the results of III Semester are declared and students may be allowed to take maximum two subjects per semester pertaining to their Minor from V Semester onwards.
5. A student shall not be permitted to take courses as Open Electives/Minor/Honors with content substantially equivalent to the courses pursued in the student's primary major.
6. A student is permitted to select a Minor program only if the institution is already offering a Major degree program in that discipline.

III YEAR I SEMESTER

Subject Code	Subject Name	L	T/CLC	P	CREDITS
23APC0114	WATER RESOURCES ENGINEERING	2	1	0	3

Course Outcomes: After studying the course, students will be able to

CO1	Understand the hydrologic cycle and analyze rainfall, evaporation, infiltration, and runoff data.
CO2	Analyze hydrographs and groundwater properties for flood and aquifer assessment.
CO3	Evaluate crop water requirements and irrigation efficiencies based on soil-water-plant relationships.
CO4	Apply Kennedy's and Lacey's theories for channel design and assess water logging prevention methods.
CO5	Design diversion head works and compute uplift pressures using Bligh's and Khosla's theories.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Understand	Hydrologic cycle			L2
2	Analyze	Hydrograph characteristics and groundwater parameters	rainfall and aquifer data	Derive flood hydrographs	L4
3	Evaluate	Water requirements of crops and irrigation efficiency	soil, crop, and climate data	crop water needs	L5
4	Apply	Kennedy's and Lacey's silt theories and waterlogging concepts			L3
5	Design	Diversion head works using Bligh's and Khosla's theories			L6

UNIT-I

INTRODUCTION TO HYDROLOGY: Engineering Hydrology and Its Applications; Hydrologic Cycle; Precipitation- Types and forms, Rainfall Measurement, Types of Rain Gauges, Computation of Average Rainfall Over a Basin, Presentation and Interpretation of Rainfall Data. Evaporation- Factors Affecting Evaporation, Measurement of Evaporation; Infiltration- Factors Affecting Infiltration, Measurement of Infiltration, Infiltration Indices; Run off- Factors Affecting Run- off, Computation of Run-Off; Design Flood; Estimation of Maximum Rate of Run-Off; Separation of Base Flow.

UNIT-II

HYDROGRAPH ANALYSIS: Hydrograph; Unit Hydrograph- Construction and Limitations of Unit Hydrograph, Application of The Unit Hydrograph to The Construction of a Flood Hydrograph Resulting from Rainfall of Unit Duration; S-Hydrograph.

GROUND WATER: Introduction; Aquifer; Aquiclude; Aquifuge; Aquifer Parameters Porosity, Specific Yield, Specific Retention; Divisions of Sub–Surface Water; Water Table; Types of Aquifers; Storage Coefficient-Coefficient of Permeability and Transmissibility

UNIT-III

IRRIGATION: Introduction; Necessity and Importance of Irrigation; Advantages and Ill Effects of Irrigation; Types of Irrigation; Methods of Application of Irrigation Water; Quality for Irrigation Water. Duty and Delta; Duty at Various Places; Relation Between Duty and Delta; Factors Affecting Duty; Methods of Improving Duty.

WATER REQUIREMENT OF CROPS: Types of Soils, Indian Agricultural Soils, Preparation of Land for Irrigation; Soil Fertility; Soil-Water-Plant Relationship; Vertical Distribution of Soil Moisture; Soil Moisture Tension; Soil Moisture Stress; Various Soil Moisture Constants; Limiting Soil Moisture Conditions; Depth and Frequency of Irrigation; Gross Command Area; Culturable Command Area; Culturable Cultivated and Uncultivated Area; Kor Depth and Kor Period; Crop Seasons and Crop Rotation; Irrigation Efficiencies; Determination of Irrigation Requirements of Crops; Assessment of Irrigation Water. Consumptive Use of Water-Factors Affecting Consumptive Use, Direct Measurement and Determination By Use of Equations (Theory Only)

UNIT-IV

CHANNELS – SILT THEORIES: Classification; Canal Alignment; Inundation Canals; Cross–Section of An Irrigation Channel; Balancing Depth; Borrow Pit; Spoil Bank; Land Width; Silt Theories–Kennedy's Theory,

Kennedy‘s Method of Channel Design; Drawbacks in Kennedy‘s Theory; Lacey‘s Regime Theory- Lacey‘s Theory Applied to Channel Design; Defects in Lacey‘s Theory; Comparison of Kennedy‘s and Lacey‘s Theory. **WATER LOGGING and CANAL LINING:** Water Logging; Effects of Water Logging; Causes of Water Logging; Remedial Measures; Saline and Alkaline Soils and their Reclamation; Losses in Canal; Lining of Irrigation Channels – Necessity, Advantages and Disadvantages; Types of Lining; Design of Lined Canal.

UNIT-V

DIVERSION HEAD WORKS: Types of Diversion Head Works; Diversion and Storage Head Works; Weirs and Barrages; Layouts of Diversion Head Works; Components; Causes and Failure of Hydraulic Structures on Permeable Foundations; Bligh‘s Creep Theory; Khosla‘s Theory; Determination of Uplift Pressure, Impervious Floors Using Bligh‘s and Khosla‘s Theory; Exit Gradient.

TEXTBOOKS:

4. Irrigation and Water Power Engineering by Punmia & Lal, Laxmi Publications Pvt. Ltd., New Delhi 17th Edition 2021
5. Engineering Hydrology by K. Subramanya, The Tata McGraw Hill Company, Delhi 5th Edition 2020

REFERENCES:

8. Irrigation Engineering and Hydraulic Structures By S. K. Garg; Khanna Publishers, Delhi 36th Edition
9. Engineering Hydrology By Jayarami Reddy, Laxmi Publications Pvt. Ltd., New Delhi 3rd Edition 2016

WEB RESOURCES:

1. https://nptel.ac.in/courses/105101214

CORRELATION OF COS WITH THE POS & PSOS:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2			2							3	2
CO2	3	3	3									3	2
CO3	3	3										2	3
CO4	2		3									2	3
CO5	3	3	3	3								3	3

CO-PO MAPPING JUSTIFICATION:

Unit No	Course Outcomes					Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
	Lesson Plan Hrs	%	Correlation	CO’s Action Verb	BTL			
1	12	20	3	Understand	L2	PO1 PO2 PO6	Apply (L3) Analyze (L4) Thumb Rule	2 2 3
2	12	20	3	Analyze	L4	PO1 PO2 PO3	Apply (L3) Analyze (L4) Design (L6)	3 3 2
3	12	20	2	Evaluate	L5	PO1 PO2	Apply (L3) Analyze (L4	2 2
4	12	20	2	Apply	L3	PO1 PO3	Apply (L3) Design (L6)	2
5	12	20	3	Design	L6	PO1 PO2 PO3 PO4	Apply (L3) Analyze (L4) Design (L6) Analysis (L4)	2 2 3 2

JUSTIFICATION STATEMENTS:

CO 1: Understand the hydrologic cycle and analyze rainfall, evaporation, infiltration, and runoff data.
Action Verb: Understand (L2)
PO1: Apply (L3)
CO 1 Action Verb is less than PO1 verb by one level; Therefore, correlation is moderate (2).
PO2: Analyze (L4)
CO 1 Action Verb is less than PO2 verb by two levels; Therefore, correlation is moderate (2).
PO6: Thumb Rule (L2)
CO 1 Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO6 as moderate (2).

CO 2: Analyze hydrographs and groundwater properties for flood and aquifer assessment.
Action Verb: Analyze (L4)
PO1: Apply (L3)
CO 2 Action Verb is greater than PO1 verb by one level; Therefore, correlation is high (3).
PO2: Analyze (L4)
CO 2 Action Verb is equal to PO2 verb; Therefore, correlation is high (3).
PO3: Design (L6)
CO 2 Action Verb is less than PO3 verb by two levels; Therefore, correlation is moderate (2).

CO 3: Evaluate crop water requirements and irrigation efficiencies based on soil-water-plant relationships.
Action Verb: Evaluate (L5)
PO1: Apply (L3)
CO 3 Action Verb is greater than PO1 verb by two levels; Therefore, correlation is moderate (2).
PO2: Analyze (L4)
CO Action Verb is greater than PO2 verb by one level; Therefore, correlation is moderate (2).

CO 4: Apply Kennedy's and Lacey's theories for channel design and assess water logging prevention methods.
Action Verb: Apply (L3)
PO1: Apply (L3)
CO 4 Action Verb is greater than PO1 verb by one level; Therefore, correlation is high (3).
PO3: Design (L6)
CO 4 Action Verb is less than PO3 verb by three levels; Therefore, correlation is moderate (2).

CO 5: Design diversion head works and compute uplift pressures using Bligh's and Khosla's theories.
Action Verb: Design (L6)
PO1: Apply (L3)
CO 5 Action Verb is greater than PO1 verb by three levels; Therefore, correlation is moderate (2).
PO2: Analyze (L4)
CO 5 Action Verb is greater than PO2 verb by two levels; Therefore, correlation is moderate (2).
PO3: Design (L6)
CO 5 Action Verb is equal to PO3 verb; Therefore, correlation is high (3).
PO4: Analysis (L4)
CO Action Verb is greater than PO4 verb by two levels; Therefore, correlation is moderate (2).

III YEAR I SEMESTER

Subject Code	Subject Name	L	T/CLC	P	CREDITS
23APC0115	DESIGN OF REINFORCED CONCRETE STRUCTURES	2	1	0	3

Course Outcomes: After studying the course, students will be able to

CO1	Design singly and doubly reinforced rectangular concrete beams using limit state methods in compliance with IS code guidelines.
CO2	Design reinforced concrete flanged beams for flexure using Limit State Method using IS code provisions
CO3	Design cantilever, one-way, two-way, and continuous slabs subjected to uniformly distributed loads under various boundary conditions using the Limit State Method.
CO4	Design columns and Footings for various loading conditions in compliance with IS code guidelines
CO5	Design RC members subjected to combined actions of bending, shear, and torsion, ensuring structural safety and stability.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Design	singly and doubly reinforced rectangular concrete beams	in compliance with IS code guidelines.	using limit state methods	L6
2	Design	reinforced concrete flanged beams for flexure	in compliance with IS code guidelines.	using limit state methods	L6
3	Design	cantilever, one-way, two-way, and continuous slabs subjected to uniformly distributed loads	under various boundary conditions		L6
4	Design	columns and Footings for various loading conditions	in compliance with IS code guidelines.		L6
5	Design	RC members subjected to combined actions of bending, shear, and torsion	ensuring structural safety and stability.		L6

UNIT-I

METHODS of DESIGN of CONCRETE STRUCTURES Concept of Elastic Method, Ultimate Load Method and Limit State Method – Working Stress Method as Detailed in IS Code - Design of Singly Reinforced Beam by Working Stress Method - Limit State Philosophy as Detailed in IS Code - Advantages of Limit State Method Over Other Methods

UNIT-II

LIMIT STATE METHOD - FLANGED BEAM, SHEAR & TORSION

Analysis and Design of Singly and Doubly Reinforced Rectangular Beams By Limit State Method -Analysis and Design of Flanged Beams – Use of Design Aids for Flexure -

UNIT-III

LIMIT STATE DESIGN of SLABS Analysis and Design of Cantilever, One Way, Two Way and Continuous Slabs Subjected to Uniformly Distributed Load for Various Boundary Conditions

LIMIT STATE DESIGN OF STAIRCASE

Types of Staircases – Design of Dog-Legged Staircase

UNIT-IV

LIMIT STATE DESIGN of COLUMNS

Types of Columns – Design of Short Rectangular and Circular Columns for Axial, Uniaxial and Biaxial Bending.

LIMIT STATE DESIGN of FOOTING

Design of Wall Footing – Design of Axially and Eccentrically Loaded Rectangular Pad and Sloped Footings – Design of Combined Rectangular Footing for Two Columns Only.

UNIT-V
LIMIT STATE of SERVICEABILITY and MISCELLANEOUS (Aspects of Deflection, Cracking aspects) Behaviour of RC Members in Bond and Anchorage - Design Requirements as Per Current Code - Behaviour of RC Beams in Shear and torsion - Design of RC Members for Combined Bending, Shear and torsion - Serviceability.

TEXTBOOKS:

1. B. C. Punmia, Ashok Kumar Jain and Arun Kumar Jain, Limit State Design, Laxmi Publications Pvt. Ltd., New Delhi
2. P. C. Varghese, Limit State—Designed of Reinforced Concrete, Prentice Hall of India, New Delhi

REFERENCES:

1. N. Krishnaraju, —Structural Design and Drawing, Universities Press Pvt ltd, Hyderabad.4rdedition 2020.
2. N.C. Sinha and S.K. Roy, Fundamentals of Reinforced Concrete, S. Chand Publishers
3. N. Subramanian, —Design of Reinforced Concrete Structures, Oxford University Press

WEB RESOURCES:

https://archive.nptel.ac.in/courses/105/105/105105105/

Codes/Tables: IS 456-2000 and relevant sheets (Pertaining to columns) of SP 16 Code books to be permitted into the examinations Hall.

NOTE: Assignment on preparation of drawing sheets detailing various RC Elements

All the designs to be taught in Limit State Method Following plates should be prepared by the students.

1. Reinforcement particulars of T-beams and L-beams.
2. Reinforcement detailing of continuous beams.
3. Reinforcement particulars of columns and footings.
4. Detailing of One-way, Two way and continuous slabs

Exam Pattern:

The end examination paper should consist of Part A and Part B.
Part A consists of two questions in Design and Drawing out of which one question is to be answered.
Part-B should consist of five questions on design out of which three are to be answered. Weightage for Part - A is 40% and Part-B is 60%.

CORRELATION OF COS WITH THE POS & PSOS:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	3	2		3					3	2	3
CO2	2	2	3	2		3					3	2	3
CO3	2	2	3	2		3					3	2	3
CO4	2	2	3	2		3					3	2	3
CO5	2	2	3	2		3					3	2	3

CO-PO MAPPING JUSTIFICATION:

Unit No	Course Outcomes					Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
	Lesson Plan Hrs	%	Correlation	CO's Action Verb	BTL			
1	16	20	3	Design	L6	PO1 PO2 PO3 PO4 PO6 PO11	Apply (L3) Analyze (L4) Design (L6) Analysis (L4) Thumb Rule Thumb Rule	2 2 3 2 3 3
2	16	20	3	Design	L6	PO1 PO2 PO3 PO4 PO6 PO11	Apply (L3) Analyze (L4) Design (L6) Analysis (L4) Thumb Rule Thumb Rule	2 2 3 2 3 3
3	16	20	3	Design	L6	PO1 PO2 PO3 PO4 PO6 PO11	Apply (L3) Analyze (L4) Design (L6) Analysis (L4) Thumb Rule Thumb Rule	2 2 3 2 3 3
4	16	20	3	Design	L6	PO1 PO2 PO3 PO4 PO6 PO11	Apply (L3) Analyze (L4) Design (L6) Analysis (L4) Thumb Rule Thumb Rule	2 2 3 2 3 3
5	16	20	3	Design	L6	PO1 PO2 PO3 PO4 PO6 PO11	Apply (L3) Analyze (L4) Design (L6) Analysis (L4) Thumb Rule Thumb Rule	2 2 3 2 3 3

JUSTIFICATION STATEMENTS:

CO 1: Design singly and doubly reinforced rectangular concrete beams using limit state methods in compliance with IS code guidelines.

Action Verb: Design (L6)

PO1: Apply (L3)

CO 1 Action Verb is greater than PO1 verb by three levels; Therefore, correlation is moderate (2).

PO2: Analyze (L4)

CO 1 Action Verb is greater than PO2 verb by two levels; Therefore, correlation is moderate (2).

PO3: Design (L6)

CO 1 Action Verb is equal to PO3 verb; Therefore, correlation is high (3).

PO4: Analysis (L4)

CO 1 Action Verb is greater than PO4 verb by two levels; Therefore, correlation is moderate (2).

PO6: Thumb Rule (L6)

CO 1 Action Verb is of BTL 6. Using Thumb rule, L6 correlates PO6 as high (3).

PO11: Thumb Rule (L6)

CO 1 Action Verb is of BTL 6. Using Thumb rule, L6 correlates PO11 as high (3)

CO 2: Design reinforced concrete flanged beams for flexure using Limit State Method using IS code provisions

Action Verb: Design (L6)

PO1: Apply (L3)

CO 2 Action Verb is greater than PO1 verb by three levels; Therefore, correlation is moderate (2).

PO2: Analyze (L4)
CO 2 Action Verb is greater than PO2 verb by two levels; Therefore, correlation is moderate (2).
PO3: Design (L6)
CO 2 Action Verb is equal to PO3 verb; Therefore, correlation is high (3).
PO4: Analysis (L4)
CO 2 Action Verb is greater than PO4 verb by two levels; Therefore, correlation is moderate (2).
PO6: Thumb Rule (L6)
CO 2 Action Verb is of BTL 6. Using Thumb rule, L6 correlates PO6 as high (3).
PO11: Thumb Rule (L6)
CO 2 Action Verb is of BTL 6. Using Thumb rule, L6 correlates PO11 as high (3)

CO 3: Design cantilever, one-way, two-way, and continuous slabs subjected to uniformly distributed loads under various boundary conditions using the Limit State Method.

Action Verb: Design (L6)
PO1: Apply (L3)
CO 3 Action Verb is greater than PO1 verb by three levels; Therefore, correlation is moderate (2).
PO2: Analyze (L4)
CO 3 Action Verb is greater than PO2 verb by two levels; Therefore, correlation is moderate (2).
PO3: Design (L6)
CO 3 Action Verb is equal to PO3 verb; Therefore, correlation is high (3).
PO4: Analysis (L4)
CO 3 Action Verb is greater than PO4 verb by two levels; Therefore, correlation is moderate (2).
PO6: Thumb Rule (L6)
CO 3 Action Verb is of BTL 6. Using Thumb rule, L6 correlates PO6 as high (3).
PO11: Thumb Rule (L6)
CO 3 Action Verb is of BTL 6. Using Thumb rule, L6 correlates PO11 as high (3)

CO 4: Design columns and Footings for various loading conditions in compliance with IS code guidelines

Action Verb: Design (L6)
PO1: Apply (L3)
CO 4 Action Verb is greater than PO1 verb by three levels; Therefore, correlation is moderate (2).
PO2: Analyze (L4)
CO 4 Action Verb is greater than PO2 verb by two levels; Therefore, correlation is moderate (2).
PO3: Design (L6)
CO 4 Action Verb is equal to PO3 verb; Therefore, correlation is high (3).
PO4: Analysis (L4)
CO 4 Action Verb is greater than PO4 verb by two levels; Therefore, correlation is moderate (2).
PO6: Thumb Rule (L6)
CO 4 Action Verb is of BTL 6. Using Thumb rule, L6 correlates PO6 as high (3).
PO11: Thumb Rule (L6**)**
CO 4 Action Verb is of BTL 6. Using Thumb rule, L6 correlates PO11 as high (3)

CO 5: Design RC members subjected to combined actions of bending, shear, and torsion, ensuring structural safety and stability.

Action Verb: Design (L6)
PO1: Apply (L3)
CO 5 Action Verb is greater than PO1 verb by three levels; Therefore, correlation is moderate (2).
PO2: Analyze (L4)
CO 5 Action Verb is greater than PO2 verb by two levels; Therefore, correlation is moderate (2).
PO3: Design (L6)
CO 5 Action Verb is equal to PO3 verb; Therefore, correlation is high (3).
PO4: Analysis (L4)
CO 5 Action Verb is greater than PO4 verb by two levels; Therefore, correlation is moderate (2).
PO6: Thumb Rule (L6)
CO 5 Action Verb is of BTL 6. Using Thumb rule, L6 correlates PO6 as high (3).
PO11: Thumb Rule (L6)
CO 5 Action Verb is of BTL 6. Using Thumb rule, L6 correlates PO11 as high (3)

III YEAR I SEMESTER

Subject Code	Subject Name	L	T/CLC	P	CREDITS
23APC0116	GEOTECHNICAL ENGINEERING	2	1	0	3

Course Outcomes: After studying the course, students will be able to

CO1	Analyze the index properties for classification of soils.
CO2	Analyze the permeability and seepage problems using Darcy ‘s law and flow net concepts for soils.
CO3	Analyze the stress distribution theories under different loading conditions.
CO4	Analyze the consolidation under different loading conditions.
CO5	Evaluate soil shear strength under various drainage conditions.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Analyze	The index properties for classification		Of Soils	L4
2	Analyze	The permeability and seepage problems	using Darcy ‘s law and flow net concepts	For soils	L4
3	Analyze	stress distribution theories	under different loading conditions		L4
4	Analyze	consolidation	under different loading conditions		L4
5	Evaluate	soil shear strength	under various drainage conditions		L5

UNIT-I

INTRODUCTION: Soil Formation-Soil structure - Adsorbed water - Mass- Volume relationship — Relative density. Index Properties of Soils: Moisture Content, Specific Gravity, In-situ density, Grain size analysis — Sieve and Hydrometer methods — Consistency limits and indices -I.S. Classification of soils.

UNIT-II

PERMEABILITY: Soil Water — Capillary Rise — Flow of Water Through Soils - Darcy's Law- Permeability Factors Affecting — Laboratory Determination of Coefficient of Permeability-Permeability of Layered Systems.

SEEPAGE THROUGH SOILS: Total, Neutral and Effective Stresses - Quick Sand Condition — Seepage Through Soils — Flow Nets : Characteristics and Uses.

UNIT-III

STRESS DISTRIBUTION IN SOILS: Boussinesq's and Wester Guard's Theories For Point Loads and Areas of Different Shapes — Newmark's Influence Chart Compaction: Mechanism of Compaction — Factors Affecting — Effects Of Compaction on Soil Properties. — Field Compaction Equipment — Compaction Control.

UNIT-IV

CONSOLIDATION: Types of Compressibility -Primary Consolidation and Secondary Consolidation - Stress History of Clay; E-P And E-Log P Curves — Normally Consolidated Soil, Over Consolidated Soil and Under Consolidated Soil — Pre-Consolidation Pressure and Its Determination — Terzaghi's I-D Consolidation Theory — Coefficient of Consolidation: Square Root Time and Logarithm of Time Fitting Methods.

UNIT-V

SHEAR STRENGTH OF SOILS: Importance of Shear Strength- Mohr's- Coulomb Failure Theories — Types of Laboratory Tests for Strength Parameters Strength Tests Based on Drainage Conditions — Critical Void Ratio —Liquefaction.

TEXTBOOKS:

1. Soil Mechanics and Foundation Engg by K.R.Arora, Standard Publishers and Distributors Delhi 7th edition 2009
2. Geotechnical Engineering by C.Venkataramiah, New Age International Pvt. Ltd, (2002).

REFERENCES:

1. Soil Mechanics and Foundation by B.C.Punmia, Ashok Kumar Jain andArun Kumar Jain, Laxmi, publications Pvt.Ltd., New Delhi17thedition 2017
2. Geotechnical Engineering by IqbalH.Khan, PHI Pubilishers, 4th edition.
3. Basic and Applied Soil Mechanics by GopalRanjan& ASR Rao, New age International Pvt.Ltd, New Delhi 3rdedition 2016

WEB RESOURCES:

https://nptel.ac.in/courses/105101201
https://nptel.ac.in/courses/105105185

CORRELATION OF COS WITH THE POS & PSOS:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	3		3		3							
CO2	2	3		3		3							
CO3	2	3		3		3							
CO4	2	3		3		3							
CO5	2	2	2	2		3					3		

CO-PO MAPPING JUSTIFICATION:

Unit No	Course Outcomes					Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
	Lesson Plan Hrs	%	Correlation	CO's Action Verb	BTL			
1	16	25	3	Analyze	L4	PO1 PO2 PO4 PO6	Apply (L3) Analyze (L4) Analyze (L4) Thumb Rule	2 3 3 3
2	16	25	3	Analyze	L4	PO1 PO2 PO4 PO6	Apply (L3) Analyze (L4) Analyze (L4) Thumb Rule	2 3 3 3
3	12	18.75	2	Analyze	L4	PO1 PO2 PO4 PO6	Apply (L3) Analyze (L4) Analyze (L4) Thumb Rule	2 3 3 3
4	10	15.62	2	Analyze	L4	PO1 PO2 PO4 PO6	Apply (L3) Analyze (L4) Analyze (L4) Thumb Rule	2 3 3 3
5	10	15.62	2	Evaluate	L5	PO1 PO2 PO3 PO4 PO6 PO11	Apply (L3) Analyze (L4) Design (L6) Analysis (L4) Thumb Rule Thumb Rule	2 2 2 2 3 3

JUSTIFICATION STATEMENTS:

CO1: Analyze the index properties for classification of soils.

Action Verb: Analyze (L4)

PO1: Apply(L3)

CO 1 Action verb is greater than PO1 verb. Therefore, the correlation is moderate (2).

PO2: Analyze (L4)

CO 1 Action verb is equal to PO2 verb. Therefore, the correlation is high (3)

PO 4: Analysis (L4)

CO 1 Action Verb is equal to PO4; Therefore, correlation is high (3)

CO 1 Action Verb Analyze is of BTL 4. Using Thumb rule, L4 correlates PO6 as high (3).

CO2: Analyze the permeability and seepage problems using Darcy 's law and flow net concepts for soils.
Action Verb: Analyze (L4)
PO1: Apply(L3)
CO 2 Action verb is greater than PO1 verb. Therefore, the correlation is moderate (2).
PO2: Analyze (L4)
CO 2 Action verb is equal to PO2 verb. Therefore, the correlation is high (3)
PO 4: Analysis (L4)
CO 2 Action Verb is equal to PO4; Therefore, correlation is high (3)
CO 2 Action Verb Analyze is of BTL 4. Using Thumb rule, L4 correlates PO6 as high (3).
CO3: Analyze the stress distribution theories under different loading conditions.
Action Verb: Analyze (L4)
PO1: Apply(L3)
CO 3 Action verb is greater than PO1 verb. Therefore, the correlation is moderate (2).
PO2: Analyze (L4)
CO 3 Action verb is equal to PO2 verb. Therefore, the correlation is high (3)
PO 4: Analysis (L4)
CO 3 Action Verb is equal to PO4; Therefore, correlation is high (3)
CO 3 Action Verb Analyze is of BTL 4. Using Thumb rule, L4 correlates PO6 as high (3).
CO4: Analyze the consolidation under different loading conditions.
Action Verb: Analyze (L4)
PO1: Apply(L3)
CO 4 Action verb is greater than PO1 verb. Therefore, the correlation is moderate (2).
PO2: Analyze (L4)
CO 4 Action verb is equal to PO2 verb. Therefore, the correlation is high (3)
PO 4: Analysis (L4)
CO 4 Action Verb is equal to PO4; Therefore, correlation is high (3)
CO 4 Action Verb Analyze is of BTL 4. Using Thumb rule, L4 correlates PO6 as high (3).
CO5: Evaluate soil shear strength under various drainage conditions.
Action Verb: Evaluate (L5)
PO1: Apply (L3)
CO 5: Action verb is greater than PO1 verb; Therefore, correlation is moderate (2).
PO2: Analyze (L4)
CO 5 Action verb is greater than PO2 verb by one level; Therefore, correlation is moderate (2).
PO3: Design
CO 5 Action verb is less than PO3 verb by one level; Therefore, correlation is moderate (2).
PO4: Design
CO 5 Action verb is less than PO3 verb by one level; Therefore, correlation is moderate (2).
PO6: Action verb Evaluate is of BTL 5. Using Thumb rule, L5 correlates PO6 as High (3)
PO11: Action verb Evaluate is of BTL 5. Using Thumb rule, L5 correlates PO11 as High (3)

III YEAR I SEMESTER

Subject Code	Subject Name	L	T/CLC	P	CREDITS
23AES0504	INTRODUCTION TO QUANTUM TECHNOLOGIES AND APPLICATIONS	2	1	0	3

Course Outcomes: After studying the course, students will be able to

CO1	**Understand** the transition from classical to quantum physics and quantum states**.**
CO2	**Understand** qubits, quantum systems, and their philosophical significance.
CO3	**Analyze** quantum computer requirements, system fragility, hardware platforms, and software roles.
CO4	**Analyze** quantum information, communication, computing, and their future potential.
CO5	**Apply** quantum applications, industry cases, challenges, and opportunities.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	**Understand**	the transition from classical		to quantum physics and quantum states**.**	L2
2	**Understand**	qubits, quantum systems, and their philosophical significance			L2
3	**Analyze**	quantum computer requirements, system fragility, hardware platforms, and software roles.			L4
4	**Analyze**	quantum information, communication, computing, and their future potential.			L4
5	**Apply**	quantum applications, industry cases, challenges, and opportunities.			L3

UNIT-I

Introduction to Quantum Theory and Technologies

The transition from classical to quantum physics, Fundamental principles explained conceptually: Superposition, Entanglement, Uncertainty Principle, Wave-particle duality, Classical vs Quantum mechanics – theoretical comparison,Quantum states and measurement: nature of observation,Overview of quantum systems: electrons, photons, atoms,The concept of quantization: discrete energy levels,Why quantum? Strategic, scientific, and technological significance,A snapshot of quantum technologies: Computing, Communication, and Sensing,National and global quantum missions: India's Quantum Mission, EU, USA, China

UNIT-II

Theoretical Structure of Quantum Information Systems

What is a qubit? Conceptual understanding using spin and polarization, Comparison: classical bits vs quantum bits, Quantum systems: trapped ions, superconducting circuits, photons (non-engineering view),Quantum coherence and decoherence – intuitive explanation, Theoretical concepts: Hilbert spaces, quantum states, operators – only interpreted in abstract, The role of entanglement and non-locality in systems, Quantum information vs classical information: principles and differences, Philosophical implications: randomness, determinism, and observer role

UNIT-III

Building a Quantum Computer – Theoretical Challenges and Requirements

What is required to build a quantum computer (conceptual overview)?,Fragility of quantum systems: decoherence, noise, and control, Conditions for a functional quantum system: Isolation, Error management, Scalability, Stability, Theoretical barriers:

Why maintaining entanglement is difficult, Error correction as a theoretical necessity, Quantum hardware platforms (brief conceptual comparison), Superconducting circuits, Trapped ions, Photonics, Vision vs reality: what's working and what remains elusive, The role of quantum software in managing theoretical complexities

UNIT-IV

Quantum Communication and Computing – Theoretical Perspective

Quantum vs Classical Information, Basics of Quantum Communication, Quantum Key Distribution (QKD),Role of Entanglement in Communication, The Idea of the Quantum Internet – Secure Global Networking, Introduction to Quantum Computing, Quantum Parallelism (Many States at Once), Classical vs Quantum Gates, Challenges: Decoherence and Error Correction, Real-World Importance and Future Potential

UNIT-V

Applications, Use Cases, and the Quantum Future

Real-world application domains: Healthcare (drug discovery),Material science, Logistics and optimization, Quantum sensing and precision timing, Industrial case studies: IBM, Google, Microsoft, PsiQuantum,Ethical, societal, and policy considerations, Challenges to adoption: cost, skills, standardization,Emerging careers in quantum: roles, skillsets, and preparation pathways,Educational and research landscape – India's opportunity in the global quantum race

TEXTBOOKS:

1. Michael A. Nielsen, Isaac L. Chuang, *Quantum Computation and Quantum Information*, Cambridge University Press, 10th Anniversary Edition, 2010.
2. Eleanor Rieffel and Wolfgang Polak, *Quantum Computing: A Gentle Introduction*, MIT Press, 2011.
3. Chris Bernhardt, *Quantum Computing for Everyone*, MIT Press, 2019.

REFERENCES:

1. David McMahon, *Quantum Computing Explained*, Wiley, 2008.
2. Phillip Kaye, Raymond Laflamme, Michele Mosca, *An Introduction to Quantum Computing*, Oxford University Press, 2007.
3. Scott Aaronson, *Quantum Computing Since Democritus*, Cambridge University Press, 2013.
4. **Alastair I.M. Rae**, *Quantum Physics: A Beginner's Guide*, Oneworld Publications, Revised Edition, 2005.
5. **Eleanor G. Rieffel, Wolfgang H. Polak**, *Quantum Computing: A Gentle Introduction*, MIT Press, 2011.
6. **Leonard Susskind, Art Friedman**, *Quantum Mechanics: The Theoretical Minimum*, Basic Books, 2014.
7. **Bruce Rosenblum, Fred Kuttner**, *Quantum Enigma: Physics Encounters Consciousness*, Oxford University Press, 2nd Edition, 2011.
8. **GiulianoBenenti, GiulioCasati, GiulianoStrini**, *Principles of Quantum Computation and Information, Volume I: Basic Concepts*, World Scientific Publishing, 2004.

WEB RESOURCES:

- IBM Quantum Experience and Qiskit Tutorials
- Coursera – Quantum Mechanics and Quantum Computation by UC Berkeley
- edX – The Quantum Internet and Quantum Computers
- YouTube – Quantum Computing for the Determined by Michael Nielsen
- Qiskit Textbook – IBM Quantum

CORRELATION OF COS WITH THE POS & PSOS:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	1									3	2	3
CO2	2	1									3	3	2
CO3	3	3									3	3	3
CO4	3	3							3		3	2	
CO5	3	3						3			3		3

CO-PO MAPPING JUSTIFICATION:

Unit No	Course Outcomes					Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
	Lesson Plan Hrs	%	Correlation	CO's Action Verb	BTL			
1	9	20	2	CO1: Understand	L2	PO1 PO2 PO11	PO1: Apply(L3) PO2: Analyze (L4) PO11: Thumb Rule	2 1 3

2	9	20	2	CO2: Understand	L2	PO1 PO2 PO11	PO1: Apply(L3) PO2: Analyze (L4) PO11: Thumb Rule	2 1 3
3	9	20	2	CO3: Analyze	L4	PO1 PO2 PO11	PO1: Apply(L3) PO2: Analyze (L4) PO11: Thumb Rule	3 3 3
4	9	20	2	CO4: Analyze	L4	PO1 PO2 PO11	PO1: Apply(L3) PO2: Analyze (L4) PO11: Thumb Rule	3 3 3
5	9	20	2	CO5: Analyze	L4	PO1 PO2 PO11	PO1: Apply(L3) PO2: Apply(L3) PO11: Thumb Rule	3 3 3

JUSTIFICATION STATEMENTS:

CO1: Understand the transition from classical to quantum physics and quantum states.

Action Verb: Understand (L2)

PO1 Verb: Apply (L3)

CO1 Action verb is less than one level PO1 verb. Therefore, the correlation is moderate (2)

PO2 Verb: Analyze (L4)

CO1 Action verb is less than two level PO2 verb. Therefore, the correlation is low (1)

PO11: Thumb Rule

Quantum physics demands that we accept probability and discreteness at nature's core. Therefore, the correlation is high (3)

CO2: Understand qubits, quantum systems, and their philosophical significance.

Action Verb: Understand (L2)

PO1: Apply (L3)

CO2 Action verb is less than one level PO1 verb. Therefore, the correlation is moderate (2)

PO2: Analyze (L4)

CO2 Action verb is less than two level PO2 verb. Therefore, the correlation is low (1)

PO11: Thumb Rule

A qubit is a superposed quantum state that enables powerful new ways to store and process information. Therefore, the correlation is high (3)

CO3: Analyze quantum computer requirements, system fragility, hardware platforms, and software roles.

Action Verb: Apply (L3)

PO1: Apply (L3)

CO3 Action verb is same as PO1 verb. Therefore, the correlation is high (3)

PO2: Analyze (L4)

CO3 Action verb is greater than as PO2 verb. Therefore, the correlation is high (3)

PO11: Thumb Rule

Building a quantum computer requires stable qubits, precise control, error correction, and scalability. Therefore, the correlation is high (3)

CO4: Analyze quantum information, communication, computing, and their future potential.

Action Verb: Analyze (L4)

PO1: Apply (L3)

CO4 Action verb is greater than PO1 verb. Therefore, the correlation is high (3)

PO2: Analyze (L4)

CO4 Action verb is same as PO2 verb. Therefore, the correlation is high (3)

PO11: Thumb Rule

Quantum communication and computing leverage superposition, entanglement, and no-cloning to enable secure communication and powerful computation. Therefore, the correlation is high (3)

CO5: Analyze quantum applications, industry cases, challenges, and opportunities.

Action Verb: Analyze (L4)

PO1: Apply (L3)

CO5 Action verb is same as PO . Therefore, the correlation is high(3)

PO2: Apply(L3)

CO5 Action verb is same as PO2 verb. Therefore, the correlation is high (3)

PO11: Thumb Rule

Quantum technologies enable breakthroughs in healthcare, materials, optimization, and security. Therefore, the correlation is high (3)

III YEAR I SEMESTER

Subject Code	Subject Name	L	T/CLC	P	CREDITS
23APE0101	COST EFFECTIVE HOUSING TECHNIQUES (PE – I)	2	1	0	3

Course Outcomes: After studying the course, students will be able to

CO1	Understand the current status of urban and rural housing and analyze the role of finance and planning in housing development.
CO2	Understand cost-effective construction techniques, including prefabrication and innovative roofing/flooring systems
CO3	Understand alternative building materials and infrastructure services for cost-effective housing solutions
CO4	Understand rural housing techniques, including traditional mud housing, soil stabilization, and fire treatment for roofing
CO5	Understand housing solutions for disaster-prone areas by incorporating earthquake, cyclone, and flood-resistant strategies

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Understand	current status of urban and rural housing and analyze the role of finance and planning		in housing development.	L2
2	Understand	cost-effective construction techniques, including prefabrication and innovative roofing/flooring systems			L2
3	Understand	alternative building materials and infrastructure services		for cost-effective housing solutions	L2
4	Understand	rural housing techniques, including traditional mud housing, soil stabilization, and fire treatment		for roofing	L2
5	Understand	Understand housing solutions for disaster-prone areas by incorporating earthquake, cyclone, and flood-resistant strategies			L2

UNIT-I

a) **HOUSING SCENARIO:** Introducing - Status of Urban Housing - Status of Rural Housing
b) **HOUSING FINANCE**: Introducing - Existing Finance System in India - Government Role as Facilitator - Status at Rural Housing Finance – Impedimently in Housing Finance and Related Issues
c) **LAND USE AND PHYSICAL PLANNING FOR HOUSING:** Introduction - Planning of Urban Land - Urban Land Ceiling and Regulation Act - Efficiency of Building Bye Lass - Residential Densities
d) **HOUSING THE URBAN POOR:** Introduction - Living Conditions in Slums - Approaches and Strategies for Housing Urban Poor.

UNIT-II

DEVELOPMENT AND ADOPTION OF LOW COST RESILIENT HOUSING TECHNOLOGY Introduction - Adoption of Innovative Cost Effective Construction Techniques - Adoption of Precast Elements in Partial Prefabrication- Adopting of total Prefabrication of Mass Housing in India- General Remarks On Pre Cast Rooting/Flooring Systems -Economical Wall System - Single Brick Thick Loading Bearing Wall - 19cm Thick Load Bearing Masonry Walls - Half Brick Thick Load Bearing Wall – Fly-Ash Gypsum Thick for Masonry - Stone Block Masonry - Adoption of Precast R.C. Plank and Join System for Roof/Floor in The Building

UNIT-III

ALTERNATIVE BUILDING MATERIALS FOR LOW-COST HOUSING Introduction - Substitute for Scarce Materials – Ferro-Cement - Gypsum Boards - Timber Substitutions - Industrial Wastes - Agricultural Wastes - Alternative Building Maintenance **LOW-COST INFRASTRUCTURE SERVICES:** Introduction - Present Status - Technological Options - Low-Cost Sanitation - Domestic Wall - Water Supply, Energy
UNIT-IV
RURAL HOUSING: Introduction Traditional Practice of Rural Housing Continuous - Mud Housing Technology Mud Roofs - Characteristics of Mud - Fire Treatment for Thatch Roof - Soil Stabilization - Rural Housing Program
UNIT-V
HOUSING IN DISASTER PRONE AREAS: Introduction – Earthquake - Damages to Houses - Traditional Prone Areas - Type of Damages and Railways of Non-Engineered Buildings - Repair and Restore Action of Earthquake Damaged Non-Engineered Buildings Recommendations for Future Constructions. Requirements of Structural Safety of Thin Precast Roofing Units Against Earthquake forces Status of R&D in Earthquake Strengthening Measures - Floods, Cyclone, Future Safety

TEXTBOOKS:

1. Building materials for low – income houses – Internastional council for building research studies and documentation.
2. Hand book of low cost housing by A.K.Lal – Newage international publishers.
3. Low cost Housing – G.C. Mathur by South Asia Books

REFERENCES:

1. Properties of concrete – Neville A.m. Pitman Publishing Limited, London.
2. Light weight concrete, Academic Kiado, Rudhai.G – Publishing home of Hungarian Academy of Sciences 1963.
3. Modern trendsin housing in developing countries – A.G. MadhavaRao, D.S. Rama chandra Murthy & G.Annamalai. E. & F. N. Spon Publishers

WEB RESOUCES:

https://nptel.ac.in/courses/124107001

CORRELATION OF COS WITH THE POS & PSOS:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2				2							
CO2	2	2				2						2	
CO3	2	2				2						2	
CO4	2	2				2						2	
CO5	2	2				2							

CO-PO MAPPING JUSTIFICATION:

Unit No	Course Outcomes					Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
	Lesson Plan Hrs	%	Correlation	CO's Action Verb	BTL			
1				Understand	L2	PO1 PO2 PO6	Apply (L3) Analyze (L4) Thumb Rule	2 2 2
2				Understand	L2	PO1 PO2 PO6	Apply (L3) Analyze (L4) Thumb Rule	2 2 2
3				Understand	L2	PO1 PO2 PO6	Apply (L3) Analyze (L4) Thumb Rule	2 2 2
4				Understand	L2	PO1 PO2 PO6	Apply (L3) Analyze (L4) Thumb Rule	2 2 2
5				Understand	L2	PO1 PO2 PO6	Apply (L3) Analyze (L4) Thumb Rule	2 2 2

JUSTIFICATION STATEMENTS:

CO 1: Understand the current status of urban and rural housing and analyze the role of finance and planning in housing development.

Action Verb: Understand (L2)
PO1: Apply(L3)
CO 1 Action Verb is less than PO1 verb by one level; Therefore, correlation is moderate (2).
PO2: Analyze (L4)
CO 1 Action Verb is less than PO2 verb by one level; Therefore, correlation is moderate (2).
CO 1 Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO6 as moderate (2).

CO 2: Understand cost-effective construction techniques, including prefabrication and innovative roofing/flooring systems.

Action Verb: Understand (L2)
PO1: Apply(L3)
CO 2 Action Verb is less than PO1 verb by one level; Therefore, correlation is moderate (2).
PO2: Analyze (L4)
CO 2 Action Verb is less than PO2 verb by one level; Therefore, correlation is moderate (2).
CO 2 Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO6 as moderate (2).

CO 3: Understand alternative building materials and infrastructure services for cost-effective housing solutions

Action Verb: Understand (L2)
PO1: Apply(L3)
CO 3 Action Verb is less than PO1 verb by one level; Therefore, correlation is moderate (2).
PO2: Analyze (L4)
CO 3 Action Verb is less than PO2 verb by one level; Therefore, correlation is moderate (2).
CO 3 Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO6 as moderate (2).

CO 4: Understand rural housing techniques, including traditional mud housing, soil stabilization, and fire treatment for roofing

Action Verb: Understand (L2)
PO1: Apply(L3)
CO 4 Action Verb is less than PO1 verb by one level; Therefore, correlation is moderate (2).
PO2: Analyze (L4)
CO 4 Action Verb is less than PO2 verb by one level; Therefore, correlation is moderate (2).
CO 4 Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO6 as moderate (2).

CO 5: Understand housing solutions for disaster-prone areas by incorporating earthquake, cyclone, and flood-resistant strategies

Action Verb: Understand (L2)
PO1: Apply(L3)
CO 5 Action Verb is less than PO1 verb by one level; Therefore, correlation is moderate (2).
PO2: Analyze (L4)
CO 5 Action Verb is less than PO2 verb by one level; Therefore, correlation is moderate (2).
CO 5 Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO6 as moderate (2).

III YEAR I SEMESTER

Subject Code	Subject Name	L	T/CLC	P	CREDITS
23APE0102	EXPERIMENTAL STRESS ANALYSIS (PE – I)	2	1	0	3

Course Outcomes: After studying the course, students will be able to

CO1	Understand the principles and advantages of experimental stress analysis.
CO2	Understand the strain measurement using various strain gauge techniques.
CO3	Analyze strain rosettes using non-destructive testing methods for concrete.
CO4	Understand the fundamental principles of photoelasticity and its applications.
CO5	Apply two-dimensional photoelasticity methods for stress analysis in materials.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Understand	principles and advantages of experimental stress analysis			L2
2	Understand	strain measurement		using various strain gauge techniques.	L2
3	Analyze	strain rosettes		using non-destructive testing methods for concrete	L4
4	Understand	fundamental principles of photoelasticity and its applications			L2
5	Apply	two-dimensional photoelasticity methods for stress analysis		in materials	L3

UNIT-I

PRINCIPLES of EXPERIMENTAL APPROACH: Merits of Experimental Analysis Introduction, Uses of Experimental Stress Analysis Advantages of Experimental Stress Analysis, Different Methods – Simplification of Problems

UNIT-II

STRAIN MEASUREMENT USING STRAIN GAUGES Definition of Strain and Its Relation of Experimental Determinations Properties of Strain- Gauge Systems-Types of Strain Gauges –Mechanical, Acoustic and Optical Strain Gauges. Introduction to Electrical Strain Gauges - Inductance Strain Gauges – LVDT – Resistance Strain Gauges – Various Types –Gauge Factor – Materials of Adhesion Base

UNIT-III

STRAIN ROSSETTES and NON – DESTRUCTIVE TESTING of CONCRETE Introduction – The Three Elements Rectangular Rosette – The Delta Rosette Corrections for Transverse Strain Gauge. Ultrasonic Pulse Velocity Method –Application to Concrete. Hammer Test – Application to Concrete.

UNIT-IV

THEORY of PHOTOELASTICITY Introduction –Temporary Double Refraction – The Stress Optic Law –Effects of Stressed Modeling a Polar Scope for Various Arrangements – Fringe Sharpening. Brewster ‘s Stress Optic Law

UNIT-V

TWO-DIMENSIONAL PHOTOELASTICITY Introduction – Isochramic Fringe Patterns- Isoclinic Fringe Patterns Passage of Light Through Plane Polariscope and Circular Polariscope - Isoclinic Fringe Patterns – Compensation Techniques – Calibration Methods – Separation Methods – Scaling Model to Prototype Stresses – Materials for Photo – Elasticity Properties of Photo elastic Materials.

TEXTBOOKS:

1. Experimental stress analysis by J.W.Dally andW.F.Riley, College House Enterprises2005
2. Experimental stress analysis by Dr.SadhuSingh.khanna Publishers 4th edition

REFERENCES:

1. Experimental Stress analysis by U.C.Jindal, Pearson Pubilications 2012 edition

2. Experimental Stress Analysis by L.S.Srinath, MC.Graw Hill Company Publishers

WEB RESOURCES:

1. **https://archive.nptel.ac.in/courses/112/106/112106068/#**
2. **https://archive.nptel.ac.in/courses/112/106/112106198/#**

CORRELATION OF COS WITH THE POS & PSOS:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2			2							
CO2	3	2	2			2							
CO3	3	2	2			2							
CO4	3	2	2			2							
CO5	3	2	2			2							

CO-PO MAPPING JUSTIFICATION:

Unit No	Course Outcomes					Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
	Lesson Plan Hrs.	%	Correlation	CO's Action Verb	BTL			
1				Understand	L2	PO1 PO2 PO3 PO6	Apply (L3) Analyze (L4) Design (L6) Thumb Rule	3 2 1 2
2				Understand	L2	PO1 PO2 PO3 PO6	Apply (L3) Analyze (L4) Design (L6) Thumb Rule	3 2 1 2
3				Analyze	L4	PO1 PO2 PO3 PO6	Apply (L3) Analyze (L4) Design (L6) Thumb Rule	3 2 1 2
4				Understand	L2	PO1 PO2 PO3 PO6	Apply (L3) Analyze (L4) Design (L6) Thumb Rule	3 2 1 2
5				Apply	L3	PO1 PO2 PO3 PO6	Apply (L3) Analyze (L4) Design (L6) Thumb Rule	3 2 1 2

JUSTIFICATION STATEMENTS:

CO1: Understand the principles and advantages of experimental stress analysis.

Action Verb: Understand (L2)
PO1: Apply(L3)
CO1 Action Verb is less than PO1 verb by one level; Therefore, correlation is moderate (2).
PO2: Analyze (L4)
CO1 Action Verb is less than PO2 verb by one level; Therefore, correlation is moderate (2).
PO 3: Design (L6)
CO1 Action Verb is less than PO3 verb level; Therefore, correlation is low (1)
CO1 Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO6 as moderate (2).

CO2: Understand the strain measurement using various strain gauge techniques.

Action Verb: Understand (L2)
PO1: Apply(L3)
CO2 Action Verb is less than PO1 verb by one level; Therefore, correlation is moderate (2).
PO2: Analyze (L4)

CO2 Action Verb is less than PO2 verb by one level; Therefore, correlation is moderate (2).
PO 3: Design (L6)
CO2 Action Verb is less than PO3 verb level; Therefore, correlation is low (1)
CO2 Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO6 as moderate (2).

CO3: Analyze strain rosettes using non-destructive testing methods for concrete.
Action Verb: Analyze (L4)
PO1: Apply(L3)
CO3 Action verb is greater than PO1 verb. Therefore, the correlation is high (3)
PO2: Analyze (L4)
CO3 Action verb is equal to PO2 verb. Therefore, the correlation is high (3)
PO 3: Design (L6)
CO3 Action Verb is less than PO3 verb level; Therefore, correlation is low (1)
PO 4: Analysis (L4)
CO3 Action Verb is equal to PO4; Therefore, correlation is high (3)
CO3 Action Verb Analyze is of BTL 4. Using Thumb rule, L4 correlates PO6 as moderate (3).

CO4: Analyze strain rosettes using non-destructive testing methods for concrete.
Action Verb: Understand (L2)
PO1: Apply(L3)
CO4 Action Verb is less than PO1 verb by one level; Therefore, correlation is moderate (2).
PO2: Analyze (L4)
CO4 Action Verb is less than PO2 verb by one level; Therefore, correlation is moderate (2).
PO 3: Design (L6)
CO4 Action Verb is less than PO3 verb level; Therefore, correlation is low (1)
PO 4: Analysis (L4)
CO4 Action Verb is equal to PO4; Therefore, correlation is high (3)
CO4 Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO6 as moderate (2)

CO5: Apply two-dimensional photoelasticity methods for stress analysis in materials.
Action Verb: Apply (L3)
PO1: Apply(L3)
CO5 Action verb is equal to PO1 verb. Therefore, the correlation is high (3)
PO2: Analyze (L4)
CO5: Action Verb is low to PO2 verb. Therefore, the correlation is medium (2)
PO 3: Design (L6)
CO5 Action Verb is less than PO3 verb level; Therefore, correlation is low (1)
CO5 Action verb Apply is of BTL 3. Using Thumb rule, L3 correlates PO6 as moderate (2).

III YEAR I SEMESTER

Subject Code	Subject Name	L	T/CLC	P	CREDITS
23APE0103	ENVIRONMENTAL IMPACT ASSESSMENT (PE – I)	2	1	0	3

Course Outcomes: After studying the course, students will be able to

CO1	Understand the methodologies of EIA
CO2	Understand the impact of development activities and land use
CO3	Understand the risk and its impact on Vegetation and wild life
CO4	Understand the preparation of Environment Audit
CO5	Understand the various environmental acts

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Understand	Methodologies of EIA			L2
2	Understand	Impact of development activities and land use			L2
3	Understand	Risk and its impact on Vegetation and wild life			L2
4	Understand	Preparation of Environment Audit			L2
5	Understand	Environmental acts			L2

UNIT-I

CONCEPTS AND METHODOLOGIES OF EIA

Initial Environmental Examination, Elements of EIA, - Factors Affecting E-I-A Impact Evaluation and Analysis, Preparation of Environmental Base Map, Classification of Environmental Parameters- Criteria for The Selection of EIA Methodology, E I A Methods, Ad-Hoc Methods, Matrix Methods, Network Method Environmental Media Quality Index Method, Overlay Methods and Cost/Benefit Analysis.

UNIT-II

IMPACT OF DEVELOPMENTAL ACTIVITIES AND LAND USE

Introduction and Methodology for The Assessment of Soil and Ground Water, Delineation Of Study Area, Identification of Actives. Procurement of Relevant Soil Quality, Impact Prediction, Assessment of Impact Significance, Identification and Incorporation of Mitigation Measures. E I A in Surface Water, Air and Biological Environment: Methodology for The Assessment of Impacts on Surface Water Environment, Air Pollution Sources, Generalized Approach for Assessment of Air Pollution Impact.

UNIT-III

ASSESSMENT OF IMPACT ON VEGETATION, WILDLIFE AND RISK ASSESSMENT

Introduction - Assessment of Impact of Development Activities on Vegetation and Wildlife, Environmental Impact of Deforestation – Causes and Effects of Deforestation - Risk Assessment and Treatment of Uncertainty-Key Stages in Performing Environmental Risk Assessment-Advantages of Environmental Risk Assessment.

UNIT-IV

ENVIRONMENTAL AUDIT

Introduction - Environmental Audit &Environmental Legislation Objectives of Environmental Audit, Types of Environmental Audit, Audit Protocol, Stages of Environmental Audit, Onsite Activities, Evaluation of Audit Data and Preparation of Audit Report

UNIT-V

ENVIRONMENTAL ACTS AND NOTIFICATIONS

The Environmental Protection Act, The Water Preservation Act, The Air (Prevention &Control of Pollution Act), Wild Life Act - Provisions in The EIA Notification, Procedure for Environmental Clearance, Procedure for Conducting Environmental Impact Assessment Report- Evaluation of EIA Report. Environmental Legislation Objectives, Evaluation of Audit Data and Preparation of Audit Report. Post Audit Activities, Concept of ISO and ISO 14000.

TEXTBOOKS:

1. Environmental Impact Assessment Methodologies, by Y. Anjaneyulu, B. S. Publication, Hyderabad 2nd edition 2011
2. Environmental Impact Assessment, by Canter Larry W., McGraw-Hill education Edi (1996)

REFERENCES:

1. Environmental Engineering, by Peavy, H. S, Rowe, D. R, Tchobanoglous, G.Mc-Graw Hill International Editions, New York 1985.
2. Environmental Science and Engineering, by Suresh K. Dhaneja, S.K., Katania& Sons Publication, New Delhi
3. Environmental Science and Engineering, by J. Glynn and Gary W. Hein Ke, Prentice Hall Publishers.
4. Environmental Pollution and Control, by H. S. Bhatia, Galgotia Publication (P) Ltd, Delhi

WEB RESOURCES:

https://archive.nptel.ac.in/courses/124/107/124107160/

CORRELATION OF COS WITH THE POS & PSOS:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	1				2						2	2
CO2	2	1				2						2	2
CO3	2	1				2						2	2
CO4	2	1				2						2	2
CO5	2	1				2						2	2

CO-PO MAPPING JUSTIFICATION:

Unit No	Course Outcomes					Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
	Lesson Plan Hrs	%	Correlation	CO's Action Verb	BTL			
1				Understand	L2	PO1 PO2 PO6	Apply (L3) Analyze (L4) Thumb Rule	2 1 2
2				Understand	L2	PO1 PO2 PO6	Apply (L3) Analyze (L4) Thumb Rule	2 1 2
3				Understand	L2	PO1 PO2 PO6	Apply (L3) Analyze (L4) Thumb Rule	2 1 2
4				Understand	L2	PO1 PO2 PO6	Apply (L3) Analyze (L4) Thumb Rule	2 1 2
5				Understand	L2	PO1 PO2 PO6	Apply (L3) Analyze (L4) Thumb Rule	2 1 2

JUSTIFICATION STATEMENTS:

CO1: Understand the methodologies of EIA

Action Verb: Understand (L2)
PO1: Apply(L3)
CO1 Action Verb is less than PO1 verb by one level; Therefore, correlation is moderate (2).
PO2: Analyze (L4)
CO1 Action Verb is less than PO2 verb by two level; Therefore, correlation is low (1).
CO1 Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO6 as moderate (2).

CO2: Understand the impact of development activities and land use

Action Verb: Understand (L2)
PO1: Apply(L3)

CO2 Action Verb is less than PO1 verb by one level; Therefore, correlation is moderate (2).
PO2: Analyze (L4)
CO2 Action Verb is less than PO2 verb by two level; Therefore, correlation is low (1).
CO2 Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO6 as moderate (2).

CO3: Understand the risk and its impact on Vegetation and wild life
Action Verb: Understand (L2)
PO1: Apply(L3)
CO3 Action Verb is less than PO1 verb by one level; Therefore, correlation is moderate (2).
PO2: Analyze (L4)
CO3 Action Verb is less than PO2 verb by two level; Therefore, correlation is low (1).
CO3 Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO6 as moderate (2).

CO4: Understand the preparation of Environment Audit
Action Verb: Understand (L2)
PO1: Apply(L3)
CO4 Action Verb is less than PO1 verb by one level; Therefore, correlation is moderate (2).
PO2: Analyze (L4)
CO4 Action Verb is less than PO2 verb by two level; Therefore, correlation is low (1).
CO4 Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO6 as moderate (2).

CO5: Understand the various environmental acts
Action Verb: Understand (L2)
PO1: Apply(L3)
CO5 Action Verb is less than PO1 verb by one level; Therefore, correlation is moderate (2).
PO2: Analyze (L4)
CO5 Action Verb is less than PO2 verb by two level; Therefore, correlation is low (1).
CO5 Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO6 as moderate (2).

III YEAR I SEMESTER

Subject Code	Subject Name	L	T/CLC	P	CREDITS
23AOE0201	ELECTRICAL SAFETY PRACTICES AND STANDARDS (OE – I)	2	1	0	3

Course Outcomes: After studying the course, students will be able to

CO1	Understanding the Fundamentals of Electrical Safety -L2
CO2	Identifying and Applying Safety Components -L3
CO3	Analyzing Grounding Practices and Electrical Bonding-L4
CO4	Applying Safety Practices in Electrical Installations and Environments- L4
CO5	Evaluating Electrical Safety Standards and Regulatory Compliance -L5

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Understand	Fundamentals of Electrical Safety			L2
2	Identify	Applying Safety Components			L3
3	Analyze	Grounding Practices and Electrical Bonding			L4
4	Apply	Safety Practices in Electrical Installations and Environments			L4
5	Evaluate	Electrical Safety Standards and Regulatory Compliance			L5

UNIT-I

Introduction To Electrical Safety: Fundamentals of Electrical safety- Electric Shock -physiological effects of electric current- Safety requirements –Hazards of electricity-Arc-Blast-Causes for electrical failure.

UNIT-II

Safety Components: Introduction to conductors and insulators- voltage classification -safety against over voltages- safety against static electricity-Electrical safety equipment‘s – Fire extinguishers for electrical safety.

UNIT-III

Grounding: General requirements for grounding and bonding- Definitions- System grounding-Equipment grounding -The Earth-Earthingpractices-Determiningsafeapproachdistance-Determiningarchazardcategory.

UNIT-IV

Safety Practices: General first aid -Safety in handling hand held electrical appliances tools-Electrical safety in train stations-swimming pools, external lighting installations, medical locations – Case studies.

UNIT-V

Standards For Electrical Safety: Electricity Acts- Rules & regulations- Electrical standards-NFPA 70 E-OSHA standards-IEEE standards-National Electrical Code 2005 – National Electric Safety code NESC-Statutory requirements from electrical in spectorate

TEXTBOOKS:

1. MassimoA.G.Mitolo,―ElectricalSafetyofLow-VoltageSystems‖,McGrawHill,USA,2009.
2. MohamedEl-Sharkawi,―ElectricSafety-PracticeandStandards‖,CRCPress,USA,2014

REFERENCES:

1.Kenneth G. Mastrullo, Ray A. Jones, ―The Electrical Safety Program Book, Jones and Bartlett Publishers, London, 2nd Edition, 2011.
2.PalmerHickman, ― Electrical Safety-Related Work Practices‖, Jones & Bartlett Publishers, London, 2009.
3. Fordham Cooper, W.,― Electrical Safety Engineering‖, Butter worth and Company, London,1986.
4.John Cadic k, Mary Capelli – Schellp feffer, Dennis K.Neitzel,― Electrical Safety Handbook, McGraw-Hill, NewYork, USA, 4th edition, 2012.

WEB RESOURCES:

2. https://koha.srmap.edu.in/cgi-bin/koha/opac detail.pl?biblionumber=11522&shelfbrowse_itemnumber=23066

CORRELATION OF COS WITH THE POS & PSOS:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	1	–	–	–	1	–	–	–	–	1	1	2
CO2	3	3	–	–	–	2	–	–	–	–	2	2	3
CO3	3	–	1	–	3	3	–	–	–	–	3	3	3
CO4	3	2	–	–	3	2	–	–	–	–	2	2	3
CO5	3	3	2	–	3	3	1	–	–	–	2	3	3

CO-PO MAPPING JUSTIFICATION:

Unit No	Course Outcomes					Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
	Lesson Plan Hrs	%	Correlation	CO's Action Verb	BTL			
1				Understand	L2	PO1 PO2 PO6	Apply-L3 Analyse-L4 Analyse-L4	Medium-2 Low-1 Low-1
2				Identify	L3	PO1 PO2 PO6	Apply-L3 Analyse-L4 Analyse-L4	High-3 Medium-2 Medium-2
3				Analyze	L4	PO1 PO3 PO5 PO6	Apply-L3 Design-L6 Apply-L3 Analyse-L4	High-3 Low-1 High-3 High-3
4				Apply	L4	PO1 PO2 PO5 PO6	Apply-L3 Analyse-L4 Apply-L3 Analyse-L4	High-3 High-3 High-3 High-3
5				Evaluate	L5	PO1 PO2 PO3 PO5 PO6 PO7	Apply-L3 Analyse-L4 Design-L6 Apply-L3 Analyse-L4 Apply-L3	High-3 High-3 Medium-1 High-3 High-3 High-3

JUSTIFICATION STATEMENTS:

CO1: Understanding the Fundamentals of Electrical Safety
Action Verb: L2
CO1 Action Verb is Less than PO1 Action By1 Therefore The Correlation Is Medium-2
CO1 Action Verb is Less than PO2 Action By2 Therefore The Correlation Is Low-1
CO1 Action Verb is Less Than PO6 Action By2 Therefore The Correlation Is Low-1
CO2: Identifying and Applying Safety Components
Action Verb: L3
C02 Action Verb Is Equal To PO1 Therefore The Correlation Is High-3
C02 Action Verb Is Less than PO2 Action by one Therefore The Correlation Is Medium-2
C02 Action Verb Is Less than PO6 action by one Therefore The Correlation Is Medium-2

CO3: Analyzing Grounding Practices and Electrical Bonding
Action Verb: L4
CO3 Action Verb Is greater than PO1 action by one Therefore The Correlation Is High-3
CO3 Action Verb Is Less than PO3 Action by 2 Therefore The Correlation Is Low-1

CO3 Action Verb Is greater than PO5 Action by 1 Therefore The Correlation Is High-3
CO3 Action Verb Is Equal To PO6 Therefore The Correlation Is High-3
CO4: Applying Safety Practices in Electrical Installations and Environments
Action Verb: L4
CO4 Action Verb Is Greater Than PO1 Action By 1 Therefore The Correlation Is High-3
CO4 Action Verb Is Equal To PO2 Therefore The Correlation Is High-3
CO4 Action Verb Is Greater Than PO5 Action By 1 Therefore The Correlation Is High-3
CO4 Action Verb Is Equal To PO6 Therefore The Correlation Is High-3

CO5: Evaluating Electrical Safety Standards and Regulatory Compliance
Action Verb: L5
CO5 Action Verb Is Greater Than PO1 Action By 2 Therefore The Correlation Is High-3
CO5 Action Verb Is Greater Than PO2 Action By 1 Therefore The Correlation Is High-3
CO5 Action Verb Is less Than PO3 Action By One Therefore The Correlation Is Medium-1
CO5 Action Verb Is Greater Than PO5 Action By 2therefore The Correlation Is High-3
CO5 Action Verb Is Greater Than PO6 Action By 1therefore The Correlation Is High-3
CO5 Action Verb Is Greater Than PO7 Action By 2 Therefore The Correlation Is High-3

III YEAR I SEMESTER

Subject Code	Subject Name	L	T/CLC	P	CREDITS
23AOE0301	SUSTAINABLE ENERGY TECHNOLOGIES (OE – I)	2	1	0	3

Course Outcomes: After studying the course, students will be able to

CO1	Analyze solar radiation data, PV module characteristics, and the environmental impact of solar power systems.
CO2	Evaluate the performance of various solar thermal collectors and select appropriate battery storage systems for PV applications.
CO3	Apply the principles of wind and biomass energy conversion to analyze the performance of renewable energy systems.
CO4	Analyze the operational principles and applications of geothermal, ocean energy, and fuel cell systems.
CO5	Design an off-grid solar PV power plant considering component selection, system integration, and economic aspects

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Analyze	Solar radiation data, PV module characteristics, and the environmental impact of solar power systems.			L4
2	Evaluate	The performance of various solar thermal collectors and select appropriate battery storage systems.	for PV applications.		L5
3	Apply	The principles of wind and biomass energy conversion.	to analyze the performance of renewable energy systems.		L3
4	Analyze	The operational principles and applications of geothermal, ocean energy, and fuel cell systems.			L4
5	Design	An off-grid solar PV power plant.	considering component selection, system integration, and economic aspects.		L6

UNIT-I

SOLAR RADIATION: Role and potential of new and renewable sources, the solar energy option, Environmental impact of solar power, structure of the sun, the solar constant, sun-earth relationships, coordinate systems and coordinates of the sun, extraterrestrial and terrestrial solar radiation, solar radiation on titled surface, instruments for measuring solar radiation and sun shine, solar radiation data, numerical problems.

SOLAR PV MODULES AND PV SYSTEMS: PV Module Circuit Design, Module Structure, Packing Density, Interconnections, Mismatch and Temperature Effects, Electrical and Mechanical Insulation, Lifetime of PV Modules, Degradation and Failure, PV Module Parameters, Efficiency of PV Module, Solar PV Systems-Design of Off Grid Solar Power Plant. Installation and Maintenance.

UNIT-II

STORAGE IN PV SYSTEMS: Battery Operation, Types of Batteries, Battery Parameters, Application and Selection of Batteries for Solar PV System, Battery Maintenance and Measurements, Battery Installation for PV System.

UNIT-III

SOLAR ENERGY COLLECTION: Flat plate and concentrating collectors, classification of concentrating collectors, orientation.

SOLAR ENERGY STORAGE AND APPLICATIONS: Different methods, sensible, latent heat and stratified storage, solar ponds, solar applications- solar heating/cooling technique, solar distillation and drying, solar cookers, central power tower concept and solar chimney.
UNIT-IV
WIND ENERGY: Sources and potentials, horizontal and vertical axis windmills, performance characteristics, betz criteria, types of winds, wind data measurement. **BIO-MASS:** Principles of bio-conversion, anaerobic/aerobic digestion, types of bio-gas digesters, gas yield, utilization for cooking, bio fuels, I.C. engine operation and economic aspects.
UNIT-V
GEOTHERMAL ENERGY: Origin, Applications, Types of Geothermal Resources, Relative Merits **OCEAN ENERGY:** Ocean Thermal Energy; Open Cycle & Closed Cycle OTEC Plants, Environmental Impacts, Challenges **FUEL CELLS:** Introduction, Applications, Classification, Different Types of Fuel Cells Such as Phosphoric Acid Fuel Cell, Alkaline Fuel Cell, PEM Fuel Cell, MC Fuel Cell.

TEXTBOOKS:

1. Solar Energy – Principles of Thermal Collection and Storage/Sukhatme S.P. and J.K.Nayak/TMH
2. Non-Conventional Energy Resources- Khan B.H/ Tata McGraw Hill, New Delhi, 2006

REFERENCES:

1. Principles of Solar Engineering - D.Yogi Goswami, Frank Krieth& John F Kreider / Taylor &Francis
2. Non-Conventional Energy - Ashok V Desai /New Age International (P) Ltd
3. Renewable Energy Technologies -Ramesh & Kumar /Narosa
4. Non-conventional Energy Source- G.D Roy/Standard Publishers

WEB RESOURCES:

https://nptel.ac.in/courses/112106318
https://youtube.com/playlist?list=PLyqSpQzTE6M-ZgdjYukayF6QevPv7WE-r&si=-mwIa2XSuSiNy13
https://youtube.com/playlist?list=PLyqSpQzTE6MZgdjYukayF6QevPv7WEr&si=Apfjx6oDfz1Rb_N3
https://youtu.be/zx04Kl8y4dE?si=VmOvp_OgqisILTAF

CORRELATION OF COS WITH THE POS & PSOS:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3		3								3	2
CO2	3	3	3									3	3
CO3	3	3										3	2
CO4	3	3		2								3	2
CO5		3	3		3	3						3	3

CO-PO MAPPING JUSTIFICATION:

Unit No	Course Outcomes					Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
	Lesson Plan Hrs	%	Correlation	CO's Action Verb	BTL			
1				Analyze	L4	PO1, PO2, PO4	Apply(L3) Analyze(L4) Analyze(L4)	3
2				Evaluate	L5	PO1, PO2, PO3	Apply(L3) Analyze(L4) Design(L6)	3
3				Apply	L3	PO1, PO2	Apply(L3) Analyze(L4)	3
4				Analyze	L4	PO1, PO2, PO4	Apply(L3) Analyze(L4) Analyze(L4)	3
5				Design	L6	PO2, PO3, PO5, PO6	Analyze(L4) Design(L6) Usage(L3) Design(L6)	3

JUSTIFICATION STATEMENTS:

CO1: Analyze solar radiation data, PV module characteristics, and the environmental impact of solar power systems.
Action Verb: Analyze (L4)
PO1, PO2 & PO4 Verbs: Apply (L3), Analyze (L4), Sustainability (L3)
The CO1 Action Verb 'Analyze' (L4) is at a higher cognitive level than PO1 and PO7 verbs and is equal to PO2's 'Analyze' (L4). This outcome requires analyzing complex data in the context of sustainable engineering. Therefore, the correlation is high (3).
CO2: Evaluate the performance of various solar thermal collectors and select appropriate battery storage systems for PV applications.
Action Verb: Evaluate (L5)
PO2 & PO3 Verbs: Analyze (L4), Design (L6)
The CO2 Action Verb 'Evaluate' (L5) is a higher-order skill that requires analysis (PO2) and is a critical component of designing solutions (PO3). The ability to make judgments based on criteria is fundamental to these POs. Therefore, the correlation is high (3).
CO3: Apply the principles of wind and biomass energy conversion to analyze the performance of renewable energy systems.
Action Verb: Apply (L3)
PO1 & PO2 Verbs: Apply (L3), Analyze (L4)
The CO3 Action Verb 'Apply' (L3) is at the same cognitive level as PO1's verb and is a prerequisite for PO2's 'Analyze' (L4). It involves applying fundamental engineering knowledge to solve problems. Therefore, the correlation is high (3).
CO4: Analyze the operational principles and applications of geothermal, ocean energy, and fuel cell systems.
Action Verb: Analyze (L4)
PO1, PO2 & PO4 Verbs: Apply (L3), Analyze (L4)
The CO4 Action Verb 'Analyze' (L4) is at a higher level than PO1's 'Apply' (L3) and is equal to the verbs for PO2 and PO4. It requires a detailed investigation of complex energy systems. Therefore, the correlation is high (3).
CO5: Design an off-grid solar PV power plant considering component selection, system integration, and economic aspects.
Action Verb: Design (L6)
PO2, PO3 & PO5 Verbs: Analyze (L4), Design (L6), Usage (L3)
The CO5 Action Verb 'Design' (L6) is at the same cognitive level as PO3's verb. This complex design task requires in-depth analysis of the problem (PO2) and the use of modern engineering tools (PO5). Therefore, the correlation is high (3).

III YEAR I SEMESTER

Subject Code	Subject Name	L	T/CLC	P	CREDITS
23AOE0401	ELECTRONIC CIRCUITS (OE – I)	2	1	0	3

Course Outcomes: After studying the course, students will be able to

CO1	**Understand** the operation of various semiconductor diodes and their applications
CO2	**Analyze** the BJT characteristics, biasing methods and stabilization techniques.
CO3	**Understand** the single and multi-stage amplifiers using simplified hybrid model.
CO4	**Evaluate** the parameters of feedback amplifiers and frequency of various oscillators.
CO5	**Analyze** the characteristics, operation of Operational amplifier and it's applications

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Understand	Operation of various semiconductor diodes and their applications.		Rectifiers, Clampers, Clippers, voltage regulators.	L2
2	Analyze	BJT characteristics, biasing methods and stabilization techniques.			L4
3	Understand	Single and multi-stage amplifiers using simplified hybrid model.		BJT, Coupled amplifiers	L2
4	Evaluate	Parameters of feedback amplifiers and frequency of various oscillators.			L5
5	Analyze	characteristics, operation of Operational amplifier and it's applications			L4

UNIT – I		16Hrs
Semiconductor Diode and Applications: Introduction, PN junction diode – structure, operation and VI characteristics, Half- wave, Full-wave and Bridge Rectifiers with and without Filters, Positive and Negative Clipping and Clamping circuits (Qualitative treatment only). Special Diodes: Zener and Avalanche Breakdowns, VI Characteristics of Zener diode, Zener diode as voltage regulator, Construction, operation and VI characteristics of Tunnel Diode, LED, Varactor Diode, Photo Diode .		
UNIT – II		17Hrs
Bipolar Junction Transistor (BJT): Principle of Operation, Common Emitter, Common Base and Common Collector Configurations, Transistor as a switch and Amplifier, Transistor Biasing and Stabilization - Operating point, DC & AC load lines, Biasing - Fixed Bias, Self Bias, Bias Stability, Bias Compensation using Diodes.		
UNIT – III		19 Hrs
Single stage amplifiers: Classification of Amplifiers - Distortion in amplifiers, Analysis of CE, CC and CB configurations with simplified hybrid model. **Multistage amplifiers:** Different Coupling Schemes used in Amplifiers - RC coupled amplifiers, Transformer Coupled Amplifier, Direct Coupled Amplifier; Multistage RC coupled BJT amplifier (Qualitative treatment only).		
UNIT – IV		20 Hrs
Feedback amplifiers: Concepts of feedback, Classification of feedback amplifiers, Effect of feedback on amplifier characteristics, Voltage Series, Voltage Shunt, Current Series and Current Shunt Feedback Configurations (Qualitative treatment only). **Oscillators:** Classification of oscillators, Condition for oscillations, RC Phase shift Oscillators, Generalized analysis of LC Oscillators-Hartley and Colpitts Oscillators, Wien Bridge Oscillator.		
UNIT – V		18 Hrs

Op-amp: Classification of IC'S, basic information of Op-amp, ideal and practical Op-amp, 741 op-amp and its features, modes of operation-inverting, non-inverting, differential. **Applications of op-amp :** Summing, scaling and averaging amplifiers, Integrator, Differentiator, phase shift oscillator and comparator.
Textbooks:
1. Electronics Devices and Circuits, J.Millman and Christos. C. Halkias, 3rd edition, Tata McGraw Hill, 2006. 2. Electronics Devices and Circuits Theory, David A. Bell, 5th Edition, Oxford University press. 2008.
Reference Books:
1. Electronics Devices and Circuits Theory, R.L.Boylestad, LousisNashelsky and K.Lal Kishore, 12th edition, 2006, Pearson, 2006. 2. Electronic Devices and Circuits, N.Salivahanan, and N.Suresh Kumar, 3rd Edition, TMH, 2012 3. Microelectronic Circuits, S.Sedra and K.C.Smith, 5th Edition, Oxford University Press.
Online Learning Resources:
nptel videos

CORRELATION OF COS WITH THE POS & PSOS:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	**2**	**3**										**2**	
CO2	**3**	**3**	**3**	**3**								**3**	
CO3	**2**	**3**		**1**	**3**							**2**	
CO4	**3**	**3**		**3**	**3**							**3**	
CO5	**3**	**3**		**3**								**2**	

CO-PO MAPPING JUSTIFICATION:

Unit No	Course Outcomes					Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
	Lesson Plan Hrs	%	Correlation	CO's Action Verb	BTL			
1	16	18%	2	Understand	L2	PO1, PO2	PO1: Apply (L3) PO2: Review(L2)	2 3
2	17	19%	2	Analyze	L4	PO1, PO2, PO3, PO4	PO1: Apply (L3) PO2: Identify (L3) PO3: Develop(L3) PO4: Analyze(L4)	3 3 3 3
3	19	21%	3	Understand	L2	PO1, PO2, PO4, PO5	PO1: Apply (L3) PO2:Review (L2) PO3:Analyze(L4) PO5: Select(L1)	2 3 1 3
4	20	22%	3	Evaluate	L5	PO1, PO2, PO4, PO5	PO1: Apply (L3) PO2:Identify(L3) PO4: Analyze(L4) PO5: Apply (L3)	3 3 3 3
5	18	20%	2	Analyze	L4	PO1, PO2, PO4	PO1: Apply (L3) PO2: Identify (L3) PO4: Analyze(L4)	3 3 3

JUSTIFICATION STATEMENTS:

CO1: Understand the operation of various semiconductor diodes and their applications.

Action Verb: Understand (L2)

PO1 Verbs: Apply (L3) CO1 Action Verb is less than PO1 verb by one level; Therefore, the correlation is moderate (2). PO2 Verbs: Review (L2) CO1 Action Verb is equal to PO2 verb; Therefore, the correlation is high (3).

CO2: Analyze the BJT characteristics, biasing methods and stabilization techniques.

Action Verb: Analyze(L4)

PO1 Verbs: Apply (L3) CO2 Action Verb is greater than PO1 verb; Therefore, the correlation is high (3). PO2 Verbs:

Identify (L3) CO2 Action Verb is greater than PO2 verb; Therefore, the correlation is high (3). PO3 Verbs: Develop (L3) CO2 Action Verb is greater than PO3 verb; Therefore, the correlation is high (3). PO4 Verbs: Analyze (L4) CO2 Action Verb is equal to PO4 verb; Therefore, the correlation is high (3).

CO3: Understand the single and multi-stage amplifiers using simplified hybrid model.

Action Verb: Understand (L2)

PO1 Verbs: Apply (L3),CO3 Action Verb is less than PO1 verb by one level; Therefore, correlation is moderate (2).
PO2 Verbs: Review (L2),CO3 Action Verb is equal to PO2 verb by same levels; therefore, correlation is High (3).
PO4 Verbs: Analyze-L4,CO3 Action Verb is less than PO4 verb by two levels; therefore, correlation is low (1).
PO5 Verbs: Select-L1,CO3 Action Verb is more than PO5 verb by one level; therefore, correlation is high (3).

CO4: Evaluate the parameters of feedback amplifiers and frequency of various oscillators.

Action Verb: Evaluate(L5)

PO1 Verbs: Apply (L3)CO4 Action Verb is high than PO1 verb by two levels ; Therefore, correlation is high (3). PO2 Verb: Identify (L3)CO4 Action Verb is high than PO2 verb by two levels ; Therefore, correlation is high (3). PO4 Verbs: Analyze(L4)CO4 Action Verb is higher than PO4 verb by one levels; therefore, correlation is high (3). PO5 Verbs: Apply (L3),CO4 Action Verb is higher than PO5 verb by two levels; Therefore, correlation is high (3). **CO5: Analyze** the characteristics, operation of Operational amplifiers and it's applications

Action Verb: Analyze(L4)

PO1 Verbs: Apply (L3)CO5 Action Verb is PO1 verb by two levels ; Therefore, correlation is high (3).
PO2 Verb: Identify (L3)CO5 Action Verb is high than PO2 verb by two levels ; Therefore, correlation is high (3).
PO4 Verbs: Analyze(L4)CO5 Action Verb is higher than PO4 verb by one levels; therefore, correlation is high (3).

III YEAR I SEMESTER

Subject Code	Subject Name	L	T/CLC	P	CREDITS
23AOE0501	JAVA PROGRAMMING (OE – I)	2	1	0	3

Course Outcomes: After studying the course, students will be able to

CO1	**Understand** the Java language components and how to apply in applications
CO2	**Apply** the concepts of OOP's fundamentals like classes, Methods and class libraries to develop applications
CO3	**Analyze** the concepts of arrays, inheritance and interfaces to develop efficient java applications
CO4	**Evaluate** the concepts of packages, file I/O, by using access control, and exception handling mechanisms to solve real world scenarios
CO5	**Create** the GUI applications by using concepts like multi-threading, Java FX, JDBC

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Understand	the Java language components		How to apply in applications	L2
2	Apply	the concepts of OOP's fundamentals	like classes, methods and class libraries	to develop applications	L3
3	Analyze	the concepts of arrays, inheritance and interfaces		to develop efficient java applications	L4
4	Evaluate	the concepts of packages , file I/O	by using access control, and exception handling mechanisms	to solve real world scenarios	L5
5	Create	The GUI applications, JDBC applications	by using concepts like multi-threading, Java FX, JDBC		L6

UNIT – I		**7 Hrs**
Object Oriented Programming: Basic concepts, Principles, Program Structure in Java: Introduction, Writing Simple Java Programs, Elements or Tokens in Java Programs, Java Statements, Command Line Arguments, User Input to Programs, Escape Sequences Comments, Programming Style. Data Types, **Variables, and Operators :**Introduction, Data Types in Java, Declaration of Variables, Data Types, Type Casting, Scope of Variable Identifier, Literal Constants, Symbolic Constants, Formatted Output with printf() Method, Static Variables and Methods, Attribute Final, **Introduction to Operators**, Precedence and Associativity of Operators, Assignment Operator (=), Basic Arithmetic Operators, Increment (++) and Decrement (- -) Operators, Ternary Operator, Relational Operators, Boolean Logical Operators, Bitwise Logical Operators. **Control Statements:** Introduction, if Expression, Nested if Expressions, if–else Expressions, Ternary Operator?:, Switch Statement, Iteration Statements, while Expression, do–while Loop, for Loop, Nested for Loop, For–Each for Loop, Break Statement, Continue Statement.		
UNIT – II		**12 Hrs**
Classes and Objects: Introduction, Class Declaration and Modifiers, Class Members, Declaration of Class Objects, Assigning One Object to Another, Access Control for Class Members, Accessing Private Members of Class, Constructor Methods for Class, Overloaded Constructor Methods, Nested Classes, Final Class and Methods, Passing Arguments by Value and by Reference, Keyword this. **Methods:** Introduction, Defining Methods, Overloaded Methods, Overloaded Constructor Methods, Class Objects as Parameters in Methods, Access Control, Recursive Methods, Nesting of Methods, Overriding Methods, Attributes Final and Static.		
UNIT – III		**19 Hrs**
Arrays: Introduction, Declaration and Initialization of Arrays, Storage of Array in Computer Memory, Accessing Elements of Arrays, Operations on Array Elements, Assigning Array to Another Array, Dynamic Change of Array Size, Sorting of Arrays, Search for Values in Arrays, Class Arrays, Two-dimensional Arrays, Arrays of Varying Lengths, Three-dimensional Arrays, Arrays as Vectors. **Inheritance:** Introduction, Process of Inheritance, Types of Inheritances, Universal Super ClassObject Class, Inhibiting Inheritance of Class Using Final, Access Control and Inheritance, Multilevel Inheritance, Application of Keyword Super, Constructor Method and Inheritance, Method Overriding, Dynamic Method Dispatch, Abstract Classes, Interfaces and Inheritance. **Interfaces:** Introduction, Declaration of Interface, Implementation of Interface, Multiple Interfaces, Nested Interfaces, Inheritance of Interfaces, Default Methods in Interfaces, Static Methods in Interface, Functional Interfaces, Annotations.		
UNIT – IV		**19 Hrs**

Packages and Java Library: Introduction, Defining Package, Importing Packages and Classes into Programs, Path and Class Path, Access Control, Packages in Java SE, Java.lang Package and its Classes, Class Object, Enumeration, class Math, Wrapper Classes, Auto-boxing and Autounboxing, Java util Classes and Interfaces, Formatter Class, Random Class, Time Package, Class Instant (java.time.Instant), Formatting for Date/Time in Java, Temporal Adjusters Class, Temporal Adjusters Class. **Exception Handling:** Introduction, Hierarchy of Standard Exception Classes, Keywords throws and throw, try, catch, and finally Blocks, Multiple Catch Clauses, Class Throwable, Unchecked Exceptions, Checked Exceptions. **Java I/O and File:** Java I/O API, standard I/O streams, types, Byte streams, Character streams, Scanner class, Files in Java(Text Book 2)

UNIT – V **19 Hrs**

String Handling in Java: Introduction, Interface Char Sequence, Class String, Methods for Extracting Characters from Strings,Comparison, Modifying, Searching; Class String Buffer. **Multithreaded Programming:** Introduction, Need for Multiple Threads Multithreaded Programming for Multi-core Processor, Thread Class, Main Thread Creation of New Threads, Thread States, Thread Priority-Synchronization, Deadlock and Race Situations, Inter thread Communication - Suspending, Resuming, and Stopping of Threads. Java Database Connectivity: Introduction, JDBC Architecture, Installing MySQL and MySQL Connector/J, JDBC Environment Setup, Establishing JDBC Database Connections, ResultSet Interface **Java FX GUI:** Java FX Scene Builder, Java FX App Window Structure, displaying text and image, event handling, laying out nodes in scene graph, mouse events (Text Book 3)

Textbooks:

1. JAVA one step ahead, Anitha Seth, B.L.Juneja, Oxford.
2. Joy with JAVA, Fundamentals of Object Oriented Programming, DebasisSamanta, MonalisaSarma, Cambridge, 2023.
3. JAVA 9 for Programmers, Paul Deitel, Harvey Deitel, 4th Edition, Pearson.

Reference Books:

1. The complete Reference Java, 11thedition, Herbert Schildt,TMH
2. Introduction to Java programming, 7th Edition, Y Daniel Liang, Pearson

Online Resources:

1. https://nptel.ac.in/courses/106/105/106105191/
2.https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_012880464547618816347_shared/overview

Mapping of course outcomes with program outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	1										1	1
CO2		3	3	2	3					2	2	1	1
CO3	3	3	1	2	2							1	1
CO4	3	3		3	3							1	1
CO5		3	3		3					3	3	1	1

CO-PO MAPPING JUSTIFICATION:

Unit No.	CO					Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO11)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Correlation	Co's Action verb	BTL			
1	7	9.2%	2	CO1: Understand	L2	PO1 PO2	PO1: Apply(L3) PO2: Analyze(L4)	2 1
2	12	15.6%	2	CO2: Apply	L3	PO2 PO3 PO4 PO5 PO10 PO11	PO2: Review (L2) PO3: Develop (L3) PO4: Analyze(L4) PO5: Apply(L3) PO10: Thumb Rule PO11: Thumb Rule	3 3 2 3 2 2
3	19	25%	3	CO3: Analyze	L4	PO1 PO2 PO3 PO4 PO5	PO1: Apply(L3) PO2: Analyze(L4) PO3: Design(L6) PO4: Interpret(L5) PO5: SSelect(L5)	3 3 1 2 2
4	19	25%	3	CO4: Evaluate	L5	PO1 PO2 PO4 PO5	PO1: Apply(L3) PO2: Analyze (L4) PO4: Analyze(L4) PO5: Select(L3)	3 3 3 3
5	19	25%	3	CO5: Create	L6	PO2 PO3 PO5 PO10 PO11	PO2: Formulate (L6) PO3: Design (L6) PO5: Create(L6) PO10: Thumb Rule PO11: Thumb rule	3 3 3 3 3
	76	100 %						

Justification Statements:

CO1: Understand the Java language components and how to apply in applications.
Action Verb: Understand(L2)
PO1 Verb: Apply(L3)
CO1 Action verb is less than PO1 verb by one level. Therefore, the correlation is medium (2)
PO2 Verb: Analyze(L4)
CO1 Action verb is less than PO2 verb by two levels. Therefore, the correlation is low (1)
CO2: Apply the concepts of OOP's fundamentals like classes, Methods and class libraries to develop applications
Action Verb: Apply (L3)
PO2: Review (L2)
CO2 Action verb is same level as PO1 verb. Therefore, the correlation is High (3)
PO3: Develop (L3)
CO2 Action verb is same level as PO3 verb. Therefore, the correlation is High (3)
PO4: Analyze(L4)
CO2 Action verb is less than PO4 verb by one level. Therefore, the correlation is moderate (2)
PO5: Apply(L3)
CO2 Action verb is less than PO5 verb by three level. Therefore, the correlation is High (3)
PO10: Thumb Rule
Create some Java programs to solve real world problems. Therefore, the correlation is moderate (2)
PO11: Thumb Rule
Learn java programs to solve. Therefore, the correlation is moderate (2)
CO3: Analyze the concepts of arrays, inheritance and interfaces to develop efficient java applications.
Action Verb: Analyze(L4)
PO1: Apply (L3)
CO3 Action verb is Greater than PO1. Therefore, the correlation is high (3)
PO2: Analyze (L4)
CO3 Action verb is same level as PO2. Therefore, the correlation is high (3)
PO3: Design (L6)
CO3 Action verb is less than PO3 verb by two level. Therefore, the correlation is low (1)
PO4: Interpret (L5)
CO3 Action verb is less than PO4 verb by one level. Therefore, the correlation is medium (2)
PO5: Select (L5)
CO3 Action verb is less than PO4 verb by one level. Therefore, the correlation is medium (2)
CO4: Evaluate the concepts of packages, access control, file I/O, and exception handling mechanisms to solve real world scenarios
Action Verb: Evaluate(L5)
PO1: Apply(L3)
CO4 Action verb is Greater than PO1. Therefore, the correlation is high (3)
PO2: Analyze (L4)
CO4 Action verb is Greater than PO2. Therefore, the correlation is high (3)
PO4: Analyze (L4)
CO4 Action verb is Greater than PO4. Therefore, the correlation is high (3)
PO5: Select (L3)
CO4 Action verb is Greater than PO5. Therefore, the correlation is high (3)
CO5: Create GUI applications by using concepts like multi-threading, Java FX, JDBC
Action Verb: Create (L6)
PO2: Formulate (L6)
CO5 Action verb is same level as PO2. Therefore, the correlation is high (3)
PO3: Design (L6)
CO5 Action verb is same level as PO3. Therefore, the correlation is high (3)
PO5: Create (L6)
CO5 Action verb is same level as PO5. Therefore, the correlation is high (3)
PO10: Thumb Rule
Java is used to design simple and enterprise applications so need for project management. Therefore, the correlation is high (3)
PO11: Thumb Rule
It is a programming language so new version available so we need to learn. Therefore, the correlation is high (3)

III YEAR I SEMESTER

Subject Code	Subject Name	L	T/CLC	P	CREDITS
23AOE0502	INTRODUCTION TO ARTIFICIAL INTELLIGENCE (OE – I)	2	1	0	3

Course Outcomes: After studying the course, students will be able to

CO1	**Understand** the foundational concepts and use the searching techniques for solving searching problems
CO2	**Apply** the AI techniques to solve problems of game playing, theorem proving, and machine learning
CO3	**Understand** the syntax and semantics of First-Order Logic (FOL) and differentiate it from propositional logic.
CO4	**Understand** the concepts of state space representation, exhaustive search, heuristic search together with the time and space complexities
CO5	**Analyze** the semantics and structure of Bayesian networks for efficient representation of conditional probabilities.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Understand	the foundational concepts	Use the searching techniques for solving searching problems		L2
2	Apply	the AI techniques to solve problems of game playing, theorem proving, and machine learning			L3
3	Understand	the syntax and semantics of First-Order Logic (FOL) and differentiate it from propositional logic.			L2
4	Understand	the concepts of state space representation, exhaustive search, heuristic search together with the time and space complexities			L2
5	Analyze	the semantics and structure of Bayesian networks		for efficient representation of conditional probabilities.	L4

UNIT – I	**10 Hrs**
Introduction to AI - Intelligent Agents, Problem-Solving Agents, **Searching for Solutions** - Breadth-first search, Depth-first search, Hill-climbing search, Simulated annealing search, Local Search in Continuous Spaces.	
UNIT – II	**13 Hrs**
Games - Optimal Decisions in Games, Alpha–Beta Pruning, Defining Constraint Satisfaction Problems, Constraint Propagation, Backtracking Search for CSPs, Knowledge-Based Agents, **Logic-** Propositional Logic, Propositional Theorem Proving: Inference and proofs, Proof by resolution, Horn clauses and definite clauses	
UNIT – III	**10 Hrs**
First-Order Logic - Syntax and Semantics of First-Order Logic, Using First Order Logic, Knowledge Engineering in First-Order Logic. Inference in First-Order Logic: Propositional vs. First-Order Inference, Unification, Forward Chaining, Backward Chaining, Resolution. **Knowledge Representation:** Ontological Engineering, Categories and Objects, Events.	
UNIT – IV	**11 Hrs**
Planning - Definition of Classical Planning, Algorithms for Planning with State Space Search, Planning Graphs, other Classical Planning Approaches, Analysis of Planning approaches. Hierarchical Planning.	
UNIT – V	**11 Hrs**
Probabilistic Reasoning: Acting under Uncertainty, Basic Probability Notation Bayes' Rule and Its Use, Probabilistic Reasoning, Representing Knowledge in an Uncertain Domain, The Semantics of Bayesian Networks, Efficient Representation of Conditional Distributions, Approximate Inference in Bayesian Networks, Relational and First- Order Probability	

Textbooks:

1. Artificial Intelligence: A Modern Approach, Third Edition, Stuart Russell and Peter Norvig, Pearson Education

Reference Books:

1. Artificial Intelligence, 3rd Edn., E. Rich and K. Knight (TMH)
2. Artificial Intelligence, 3rd Edn., Patrick Henny Winston, Pearson Education.
3. Artificial Intelligence, Shivani Goel, Pearson Education.
4. Artificial Intelligence and Expert systems – Patterson, Pearson Education

Mapping of course outcomes with program outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	3											
CO2	3	2	3	2	3							2	2
CO3	2	3	2		2		1				1	3	3
CO4	2	3										2	2
CO5	3	3	3	3	3	3							3

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

Correlation matrix

Unit No.	CO					Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO11)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Correlation	Co's Action verb	BTL			
1	10	19%	2	CO1: Understand	L2	PO1 PO2	PO1: Apply(L3) PO2: Review(L2)	2 3
2	13	25%	3	CO2: Apply	L3	PO1 PO2 PO3 PO4 PO5	PO1: Apply(L3) PO2: Analyze (L4) PO3: Develop (L3) PO4: Analyze (L4) PO5:Apply(L3)	3 2 3 2 3
3	10	19%	2	CO3: Understand	L2	PO1 PO2 PO3 PO5 PO7 PO11	PO1: Apply(L3) PO2: Review(L2) PO3: Develop(L3) PO5: Apply(L3) PO7: Thumb Rule PO11: Thumb Rule	2 3 2 2 1 1
4	11	17%	3	CO4: Understand	L2	PO1 PO2	PO1: Apply(L3) PO2: Review(L2)	2 3
5	11	20%	3	CO5: Analyze	L4	PO1 PO2 PO3 PO4 PO5 PO6	PO1: Apply (L3) PO2: Analyze (L4) PO3: Develop (L3) PO4: Analyze (L4) PO5: Apply(L3) PO6: Thumb Rule	3 3 3 3 3 3
	53	100 %						

Justification Statements:

CO1: **Understand** the foundational concepts and use the searching techniques for solving searching problems
Action Verb: Understand(L2)
PO1 : Apply(L3)
CO1 Action verb is less than PO1 verb by one level. Therefore the correlation is medium (2)
PO2 : Review(L2)
CO1 Action verb is same level as PO2 verb. Therefore the correlation is high (3)
CO2: Apply the AI techniques to solve problems of game playing, theorem proving, and machine learning **Action Verb: Apply (L3)**
PO1: Apply(L3)
CO2 Action verb is same level as PO1 verb. Therefore the correlation is high (3)
PO2: Analyze (L4)
CO2 Action verb is less than PO2 verb by one level. Therefore the correlation is medium(2)
PO3: Develop (L3)
CO2 Action verb is same level as PO3 verb. Therefore the correlation is high (3)
PO4: Analyze (L4)
CO2 Action verb is less than PO4 verb by one level. Therefore the correlation is medium(2)

PO5:Apply(L3)
CO2 Action verb is same level as PO5 verb. Therefore the correlation is high (3)
CO3: Understand the syntax and semantics of First-Order Logic (FOL) and differentiate it from propositional logic.
Action Verb: Understand [L2)
PO1 Verb: Apply(L3)
CO1 Action verb is less than PO1 verb by one level. Therefore, the correlation is moderate (2)
PO2 Verb: Review(L2)
CO1 Action verb is same level as PO2 verb. Therefore, the correlation is high (3)
PO3: Develop(L3)
CO2 Action verb is less than PO3 verb by one level. Therefore, the correlation is moderate (2)
PO5: Apply(L3)
CO2 Action verb is less than PO5 verb by one level. Therefore, the correlation is moderate (2)
PO7: Thumb rule
The ethical knowledge is used to perform operations . Hence the correlation is high (3)
PO11: Thumb rule
For some of AI applications, AI concepts are used to create robots designs. Therefore the correlation is medium (2)
CO4: Understand the concepts of state space representation, exhaustive search, heuristic search together with the time and space complexities
Action Verb: Understand (L2)
PO1: Apply(L3)
CO4 Action verb is less than PO1 verb by one level. Therefore, the correlation is moderate (2)
PO2: Review(L2)
CO4 Action verb is same level as PO2 verb. Therefore, the correlation is high (3)
CO5: Analyze the semantics and structure of Bayesian networks for efficient representation of conditional probabilities.
Action Verb : Analyze(L4)
PO1:Apply(L3)
CO5 Action verb is greater than PO1 verb. Therefore the correlation is high (3)
PO2:Analyze(L4)
CO5 Action verb is greater than PO2 verb. Therefore the correlation is high (3)
PO3: Develop(L3)
CO5 Action verb is greater than PO3 verb. Therefore the correlation is high (3)
PO6:Thumb Rule
Apply contextual knowledge is used for society to address the security issues so correlation is medium (2)
PO8: Thumb rule
Team work is required to create robots. Hence the correlation is medium (2)
PO11: Thumb rule
For some of AI applications, AI concepts are used to create robots designs. Therefore the correlation is medium (2)

III YEAR I SEMESTER

Subject Code	Subject Name	L	T/CLC	P	CREDITS
23AOE0503	QUANTUM TECHNOLOGIES AND APPLICATIONS (OE – I)	2	1	0	3

Course Outcomes: After studying the course, students will be able to

CO1	**Analyze** basic quantum principles like qubits, superposition, and entanglement..
CO2	**Understand** quantum computing concepts such as qubits, superposition, and entan glement.
CO3	**Apply** quantum communication protocols for secure data transmission**.**
CO4	**Analyze** quantum sensing technologies and their industrial applications**.**
CO5	**Evaluate** quantum materials, devices, and global initiatives in emerging quantum technologies

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Analyze	basic quantum principles		like qubits, superposition, and entanglement..	L4
CO2	Understand	quantum computing concepts such as qubits, superposition, and entanglement			L2
CO3	Apply	quantum communication protocols for secure data transmission			L3
CO4	Analyze	quantum sensing technologies and their industrial applications**.**			L4
CO5	Evaluate	quantum materials, devices, and global initiatives in emerging quantum technologies			L5

UNIT - I	**Fundamentals of Quantum Mechanics**	7 **Hrs**

- Classical vs Quantum Paradigm
- Postulates of Quantum Mechanics
- Wavefunction and Schrödinger Equation (Time-independent)
- Quantum states, Superposition, Qubits
- Measurement, Operators, and Observables
- Entanglement and Non-locality

UNIT - II	**Quantum Computing**	7 **Hrs**

- Qubits and Bloch Sphere
- Quantum Logic Gates: Pauli, Hadamard, CNOT, and Universal Gates
- Quantum Circuits
- Basic Algorithms: Deutsch-Jozsa. Gover’s, Shor’s (conceptual)
- Error Correction and Decoherence

UNIT - III	**Quantum Communication and Cryptography**	**7Hrs**

- Teleportation & No-Cloning
- BB84 Protocol
- Quantum Networks & Repeaters
- Classical vs Quantum Cryptography
- Challenges in Implementation

UNIT - IV	**Quantum Sensors and Metrology**	7 **Hrs**

- Quantum Sensing: Principles and Technologies
- Quantum-enhanced Measurements
- Atomic Clocks, Gravimeters
- Magnetometers, NV Centers
- Industrial Applications

UNIT - V	**Quantum Materials and Emerging Technologies**	**7 Hrs**

- Quantum Materials: Superconductors, Topological Insulators
- Quantum Devices: Qubits, Josephson Junctions
- National Quantum Missions (India, EU, USA, China)
- Quantum Careers and Industry Initiatives

Textbooks:

1. Quantum Computation and Quantum Information" by Michael A. Nielsen and Isaac L. Chuang (Cambridge University Press)
2. "Quantum Mechanics: The Theoretical Minimum" by Leonard Susskind and Art Friedman (Basic Books)

Reference Books:

1. "Quantum Computing for Everyone" by Chris Bernhardt (MIT Press)
2. "Quantum Physics: A Beginner's Guide" by Alastair I.M. Rae
3. "An Introduction to Quantum Computing" by Phillip Kaye, Raymond Laflamme, and Michele MoscaIBM Quantum Experience and Qiskit Documentation (https://qiskit.org.)

Mapping of course outcomes with program outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3		3							
CO2	2	1		1	2	2					
CO3	3	3		2	1	2					
CO4	3	3	1	3	3	3					
CO5	3	3	2	3	3						

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

Correlation matrix

Unit No.	CO					Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO11)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Correlation	Co's Action verb	BTL			
1	9	20	2	CO1: **Analyze**	L4	PO1 PO2 PO4	PO1: Apply(L3) PO2:Identify(L4) PO4:Analyze(L4)	3 3 3
2	9	20	2	CO2: Understand	L2	PO1 PO2 PO4 PO5 PO6	PO1: Apply(L3) PO2: Identify (L4) PO4: Analyze (L4) PO5: Apply (L3) PO6: Thumb rule	2 1 1 2 2
3	9	20	2	CO3: Apply	L3	PO1 PO2 PO4 PO5 PO6	PO1: Apply(L3) PO2: Apply (L2) PO4: Analyze(L4) PO5:Apply(L6) PO6:Thumb Rule	3 3 2 1 2
4	9	20	2	CO4: Analyze	L4	PO1 PO2 PO3 PO4 PO5 PO6	PO1: Apply(L3) PO2: Analyze (L4) PO3:Design(L6) PO4:Analyze(L4) PO5:Apply(L3) PO6:Thumb Rule	3 3 1 3 3 3
5	9	20	2	CO5: Evaluate	L5	PO1 PO2 PO3 PO4 PO5	PO1: Apply(L3) PO2: Identify(L3) PO3: Design (L6) PO4: Evaluate(L5) PO5: Utilize(L3)	3 3 2 3 3
	45	100						

Justification Statements :

CO1:. **Analyze** basic quantum principles like qubits, superposition, and entanglement..

Action Verb: Analyze (L4)

PO1 Verb: Apply (L3)

CO1 Action verb is greater than PO1 verb. Therefore, the correlation is high (3)

PO2 Verb: Identify (L4)

CO1 Action verb is same as PO2 verb. Therefore, the correlation is high (3)

PO4 Verb: Analyze (L4)

CO1 Action verb is same as PO4 verb. Therefore, the correlation is high (3)

CO2: Understand quantum computing concepts such as qubits, superposition, and entan glement.

Action Verb: Understand (L2)

PO1: Apply (L3)

CO2 Action verb is less than as PO1 verb. Therefore, the correlation is moderate (2)

PO2: Identify(L4)

CO2 Action verb is less than PO2 verb. Therefore, the correlation is low (1)

PO4: Analyze (L4)

CO2 Action verb is less than PO4 verb. Therefore, the correlation is low (1)
PO5: Apply (L3)
CO2 Action verb is less than PO5 verb. Therefore, the correlation is moderate (2)
PO6: Thumb rule
CO2 Action verb is less than PO6 verb. Therefore, the correlation is moderate (2)

CO3: Apply quantum communication protocols for secure data transmission**.**
.
Action Verb: Apply (L3)
PO1: Apply (L3)
CO3 Action verb is same as PO1 verb. Therefore, the correlation is high (3)
PO2: Apply (L2)
CO3 Action verb is greater than as PO2 verb. Therefore, the correlation is high (3)
PO4: Analyze(L4)
CO3 Action verb is less than PO4 verb. Therefore, the correlation is moderate (2)
PO5: Apply (L6)
CO3 Action verb is less than PO5 verb. Therefore, the correlation is low (1)
PO6: Since this topic involves **evaluating performance**, **comparing complexity classes**, and **analyzing algorithm efficiency(2)**

CO4: Analyze quantum sensing technologies and their industrial applications**.**
Action Verb: Analyze (L4)
PO1: Apply (L3)
CO4 Action verb is greater than PO1 verb. Therefore, the correlation is high (3)
PO2: Analyze (L4)
CO4 Action verb is same as PO2 verb. Therefore, the correlation is high (3)
PO3: Design(L6)
CO4 Action verb is less than as PO3 verb. Therefore, the correlation is low (1)
PO4:Analyze(L4)
CO4 action verb is same as PO4 verb. Therefore, the correlation is high (3)
PO5: Apply(L3)
CO3 Action verb is greater than PO5 verb. Therefore, the correlation is high (3)
PO6: Thumb Rule
CO4 Action verb is greater than as PO6 verb. Therefore, the correlation is high (3)

CO5: Evaluate quantum materials, devices, and global initiatives in emerging quantum technologies
Action Verb: Evaluate (L5)
PO1: Apply (L3)
CO5 Action verb is greater than PO1 . Therefore, the correlation is high(3)
PO2: Identify (L2)
CO5 Action verb is greater than PO2 verb. Therefore, the correlation is low (3)
PO3: Design (L6)
CO5 Action verb is less than as PO3 verb. Therefore, the correlation is moderate (2)
PO4: Evaluate(L3)
CO5 Action verb is greater than PO4 verb. Therefore, the correlation is high (3)
PO5: Utitlize (L3)
CO5 Action verb is greater than PO5 verb. Therefore, the correlation is high(3)

III YEAR I SEMESTER

Subject Code	Subject Name	L	T/CLC	P	CREDITS
23AOE9901	MATHEMATICS FOR MACHINE LEARNING AND AI (OE – I)	2	1	0	3

Course Outcomes: After studying the course, students will be able to

CO1	Apply linear algebra concepts to ML techniques like PCA and regression
CO2	Analyze probabilistic models and statistical methods for AI applications
CO3	Apply optimization techniques for machine learning algorithms
CO4	Apply vector calculus and transformations in AI-based models.
CO5	Evaluate graph-based AI models using mathematical representations

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Apply	linear algebra concepts	to ML techniques like PCA and regression.		L3
2	Analyze	probabilistic models and statistical methods	for AI applications.		L4
3	Apply	optimization techniques	for machine learning algorithms.		L3
4	Apply	vector calculus and transformations	in AI-based models.		L3
5	Evaluate	graph-based AI models	using mathematical representations.		L5

UNIT-I

UNIT I: Linear Algebra for Machine Learning
Review of Vector spaces, basis, linear independence, Vector and matrix norms, Matrix factorization techniques, Eigen values, eigenvectors, diagonalization, Singular Value Decomposition (SVD) and Principal Component Analysis (PCA).

UNIT-II

UNIT II: Probability and Statistics for AI
Probability distributions: Gaussian, Binomial, Poisson. Bayes‘ Theorem, Maximum Likelihood Estimation (MLE), and Maximum a Posteriori (MAP).Entropy and Kullback-Leibler (KL) Divergence in AI, Cross entropy loss, Markov chains.

UNIT-III

UNIT III: Optimization Techniques for ML
Multivariable calculus: Gradients, Hessians, Jacobians. Constrained optimization: Lagrange multipliers and KKT conditions. Gradient Descent and its variants (Momentum, Adam) Newton‘s method, BFGS method.

UNIT-IV

UNIT IV: Vector Calculus & Transformations
Vector calculus: Gradient, divergence, curl. Fourier Transform & Laplace Transform in ML applications.

UNIT-V

UNIT V: Graph Theory for AI
Graph representations: Adjacency matrices, Laplacian matrices. Bayesian Networks & Probabilistic Graphical Models. Introduction to Graph Neural Networks (GNNs).

Textbooks:

1. Mathematics for Machine Learning by Marc Peter Deisenroth, A. Aldo Faisal, Cheng Soon Ong, Cambridge University Press, 2020.
2. Pattern Recognition and Machine Learning by Christopher Bishop, Springer.

Reference Books:

1. Gilbert Strang, Linear Algebra and Its Applications, Cengage Learning, 2016.
2. Jonathan Gross, Jay Yellen, Graph Theory and Its Applications, CRC Press, 2018.

Web References:

- MIT– Mathematics for Machine Learning https://ocw.mit.edu
- Stanford CS229 – Machine Learning Course https://cs229.stanford.edu/
- Deep AI – Mathematical Foundations for AI https://deepai.org

Mapping of COs to POs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
1	3										
2		3									
3	3										
4	3										
5			3								

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

CO-PO mapping justification:

CO	**Percentage of contact hours over the total planned contact hours**			**CO**		**Program Outcome (PO)**	**PO(s): Action verb and BTL**	**Level of Correlation (0-3)**
	Lesson Plan (Hrs)	**%**	**correlation**	**Verb**	**BTL**			
1				**Apply**	**L3**	PO1	**Apply**	3
2				**Analyze**	**L4**	PO2	**Analyze**	3
3				**Apply**	**L3**	PO1	**Apply**	3
4				**Apply**	**L3**	PO1	**Apply**	3
5				**Evaluate**	**L5**	PO3	**Evaluate**	3

CO1: Apply linear algebra concepts to ML techniques like PCA and regression.
Action Verb: Apply(L3)
PO1 Verbs: Apply (L3)
CO1 Action Verb is equal toPO1 verb ; Therefore correlation is high (3).
CO2: Analyze probabilistic models and statistical methods for AI applications.
Action Verb: Analyze (L4)
PO2 Verbs: Analyze (L4)
CO2 Action Verb is equal to PO2 verb; Therefore correlation is high (3).
CO3: Apply optimization techniques for machine learning algorithms.
Action Verb: Apply **(L3)**
PO1 Verb: Apply (L3)
CO3 Action Verb level is equal to PO1 verb; Therefore correlation is high (3).
CO4: Apply vector calculus and transformations in AI-based models.
Action Verb: Apply (L3)
PO1 Verb: Apply (L3)
CO4 Action Verb level is equal to PO1 verb; Therefore correlation is high (3).
CO5: Evaluate graph-based AI models using mathematical representations.
Action Verb: Evaluate(L5)
PO3 Verb: Evaluate (L6)
CO5 Action verb is equal to PO3 verb; therefore the correlation is high (3).

III YEAR I SEMESTER

Subject Code	Subject Name	L	T/CLC	P	CREDITS
23AOE9906	MATERIALS CHARACTERIZATION TECHNIQUES (OE – I)	2	1	0	3

Course Outcomes: After studying the course, students will be able to

CO1	Understand the crystal structure and crystal size by using X-ray Diffraction (XRD) technique.
CO2	Analyze the basic principles of Scanning Electron Microscopy (SEM).
CO3	Analyze the fundamentals of Transmission Electron Microscope (TEM).
CO4	Apply the various spectroscopic techniques for engineering applications.
CO5	Analyze the electric and magnetic properties of a specimen using various characterization techniques.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Understand	The crystal structure and crystal size by using X-ray Diffraction (XRD) technique.			L2
2	Analyze	The various spectroscopic techniques for engineering applications.			L4
3	Analyze	The fundamentals of Transmission Electron Microscope (TEM).			L4
4	Apply	The various spectroscopic techniques for engineering applications.			L3
5	Analyze	The electric and magnetic properties of a specimen using various characterization techniques.			L4

UNIT-I

UNIT I Structure analysis by Powder X-Ray Diffraction
Introduction, Bragg's law of diffraction, Intensity of Diffracted beams, Factors affecting Diffraction, Intensities, Structure of polycrystalline Aggregates, Determination of crystal structure, Crystallite size by Scherer and Williamson-Hall (W-H) Methods, Small angle X-ray scattering (SAXS) (in brief).

UNIT-II

UNIT II Structure analysis by Powder X-Ray Diffraction
Introduction, Bragg's law of diffraction, Intensity of Diffracted beams, Factors affecting Diffraction, Intensities, Structure of polycrystalline Aggregates, Determination of crystal structure, Crystallite size by Scherer and Williamson-Hall (W-H) Methods, Small angle X-ray scattering (SAXS) (in brief).

UNIT-III

UNIT III Microscopy Technique -3 - Transmission Electron Microscopy (TEM)
Construction and Working principle, Resolving power and Magnification, Bright and dark fields, Diffraction and image formation, Specimen preparation, Selected Area Diffraction, Applications of Transmission Electron Microscopy, Difference between SEM and TEM, Advantage and Limitations of Transmission Electron Microscopy.

UNIT-IV

UNIT IV Spectroscopy techniques
Principle, Experimental arrangement, Analysis and advantages of the spectroscopic techniques – (i) UV-Visible spectroscopy (ii) Raman Spectroscopy, (iii) Fourier Transform infrared (FTIR) spectroscopy, (iv) X-ray photoelectron spectroscopy (XPS).

UNIT-V

UNIT V Electrical & Magnetic Characterization techniques
Electrical Properties analysis techniques (DC conductivity, AC conductivity) Activation Energy, Effect of Magnetic field on the electrical properties (Hall Effect). Magnetization measurement by induction method, Vibrating sample Magnetometer (VSM) and SQUID.

Textbooks:

1. Material Characterization: Introduction to Microscopic and Spectroscopic Methods – Yang Leng – John Wiley & Sons (Asia) Pvt. Ltd. 2013.

2. Microstructural Characterization of Materials - David Brandon, Wayne D Kalpan, John Wiley & Sons Ltd., 2008.

Reference Books:

1. Fundamentals of Molecular Spectroscopy – IV Ed. – Colin Neville BanwellandElaine M. McCash, Tata McGraw-Hill, 2008.
2. Elements of X-ray diffraction – Bernard Dennis Cullity& Stuart R Stocks, Prentice Hall , 2001 – Science.
3. Practical Guide to Materials Characterization: Techniques and Applications - Khalid Sultan – Wiley – 2021.
4. Materials Characterization Techniques -Sam Zhang, Lin Li, Ashok Kumar -CRC Press - 2008

NPTEL courses link :

1. https://nptel.ac.in/courses/115/103/115103030/
2. https://nptel.ac.in/content/syllabus_pdf/113106034.pdf
3. https://nptel.ac.in/noc/courses/noc19/SEM1/noc19-mm08/

CORRELATION OF COS WITH THE POS & PSOS:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2												
CO2	3												
CO3	3				3								
CO4	3												
CO5	3	3											

CO-PO MAPPING JUSTIFICATION:

Unit No	Course Outcomes					Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
	Lesson Plan Hrs	%	Correlation	CO's Action Verb	BTL			
1				Understand	L2	PO1	PO1: Apply (L3)	2
2				Analyze	L4	PO1	PO1: Apply (L3)	3
3				Analyze	L4	PO1, PO5	PO1, PO5: Apply (L3)	3
4				Apply	L3	PO1	PO1: Apply (L3)	3
5				Analyze	L4	PO1, PO2	PO1, PO2: Apply (L3)	3

JUSTIFICATION STATEMENTS:

CO1: Understand the crystal structure and crystal size by using X-ray Diffraction (XRD) technique.
Action Verb: Understand (L2)
PO1 Verbs: Apply (L3)
CO1 Action Verb level is less than PO1 verb by one level; Therefore, correlation is moderate (2).
CO2: Analyze the basic principles of Scanning Electron Microscopy (SEM).
Action Verb: Analyze (L4)
PO1 Verbs: Apply (L3)
CO2 Action Verb level is greater than PO1 verb by one level; Therefore, correlation is high (3).
CO3: Analyze the fundamentals of Transmission Electron Microscope (TEM).
Action Verb: Analyze (L4)
PO1 and PO5 Verbs: Apply (L3)
CO3 Action Verb level is greater than PO1 and PO5 verbs by one level; Therefore correlation is high (3).
CO4: Apply the various spectroscopic techniques for engineering applications.
Action Verb: Apply (L3)
PO1 Verb: Apply (L3)
CO4 Action Verb is equal to PO1 verb; Therefore, correlation is high (3).
CO5: Analyze the electric and magnetic properties of a specimen using various characterization techniques.
Action Verb: Analyze (L4)
PO1 and PO2 Verb: Apply (L3)
CO5 Action verb is greater than PO1 and PO2 verbs by one level; therefore, the correlation is high (3).

III YEAR I SEMESTER

Subject Code	Subject Name	L	T/CLC	P	CREDITS
23AOE9911	CHEMISTRY OF ENERGY SYSTEMS (OE – I)	2	1	0	3

Course Outcomes: After studying the course, students will be able to

CO1	Understand the problems based on electrode potential and concept of batteries.
CO2	Apply fuel technology in various energy and engineering contexts.
CO3	Analyze the advantages of photoelectric catalytic process such as high efficiency, low environmental impact and renewable energy applications.
CO4	Apply the electrochemical principles to photo voltaic cell, solar power and solar cells.
CO5	Analyze various methods for storage of hydrogen fuel.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Understand	the problems based on electrode potential and concept of batteries			L2
2	Apply	fuel technology in various energy and engineering contexts			L3
3	Analyze	the advantages of photoelectric catalytic process such as high efficiency, low environmental impact and renewable energy applications.			L4
4	Apply	the electrochemical principles to photo voltaic cell, solar power and solar cells.			L3
5	Analyze	various methods for storage of hydrogen fuel.			L4

UNIT-I
UNIT-1: Electrochemical Systems: Galvanic cell, Nernst equation, standard electrode potential, application of EMF, electrical double layer, polarization, Batteries- Introduction , Lithium-Manganese dioxide, Nickel-Hydrogen, Silver-Zinc batteries and their applications.
UNIT-II
UNIT-2: Fuel Cells: Fuel cell- Introduction, Basic design of fuel cell, working principle, Classification of fuel cells, Polymer electrolyte membrane (PEM) fuel cells, Solid-oxide fuel cells (SOFC), Fuel cell efficiency and applications.
UNIT-III
UNIT-3: Photo and Photo electrochemical Conversions: Photochemical cells Introduction and applications of photochemical reactions, specificity of photo electrochemical cell, advantage of photoelectron catalytic conversions and their applications.
UNIT-IV
UNIT-4: Solar Energy: Introduction and prospects, photovoltaic (PV) technology, concentrated solar power (CSP), Solar cells and applications.
UNIT-V
UNIT-5: Hydrogen Storage: Hydrogen storage and delivery: State-of-the art, Established technologies, Chemical and Physical methods of hydrogen storage, Compressed gas storage, Liquid hydrogen storage, Other storage methods, Hydrogen storage in metal hydrides, metal organic frameworks (MOF), Metal oxide porous structures, hydrogel , and Organic hydrogen carriers.

Text books

1. Physical chemistry by Ira N. Levine
2. Essentials of Physical Chemistry, Bahl and Bahl and Tuli.
3. Inorganic Chemistry, Silver and Atkins

Reference Books:

1. Fuel Cell Hand Book 7th Edition, by US Department of Energy (EG&G technical services And corporation)
2. Hand book of solar energy and applications by ArvindTiwari and Shyam.
3. Solar energy fundamental, technology and systems by Klaus Jagar et.al.
4. Hydrogen storage by Levine Klebonoff

CORRELATION OF COS WITH THE POS & PSOS:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3												
CO2	3												
CO3	3												
CO4	3												
CO5	3												

CO-PO MAPPING JUSTIFICATION:

Unit No	Course Outcomes					Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
	Lesson Plan Hrs	%	Correlation	CO's Action Verb	BTL			
1				Understand	L2	PO1	PO1: Apply (L3)	2
2				Apply	L3	PO1	PO1: Apply (L3)	3
3				Analyze	L3	PO1	PO1: Apply (L3)	3
4				Apply	L4	PO1	PO1: Apply (L3)	3
5				Analyze	L4	PO1	PO1: Apply (L3)	3

JUSTIFICATION STATEMENTS:

CO1: Understand the problems based on electrode potential and concept of batteries
Action Verb: Understand (L2)
PO1 Verbs: Apply (L3)
CO1 Action Verb is less than PO1 verb by one level; Therefore correlation is moderate (2).

CO2: Apply fuel technology in various energy and engineering contexts
Action Verb: Apply (L3)
PO1 Verbs: Apply (L3)
CO2 Action Verb is equal to PO1 verb; Therefore correlation is high (3).

CO3: Analyze the advantages of photoelectric catalytic process such as high efficiency, low environmental impact and renewable energy applications
Action Verb: Analyze (L4)
PO1 Verb: Apply (L3)
CO3 Action Verb is less than PO1 verb; Therefore correlation is high (3).

CO4: Apply the electrochemical principles to photo voltaic cell, solar power and solar cells
Action Verb: Apply (L3)
PO1 Verb: Apply (L3)
CO3 Action Verb level is equal to PO1 verb; Therefore correlation is high (3).

CO5 Analyze various methods for storage of hydrogen fuel
Action Verb: Analyze (L4)
PO1 Verb: Analyze (L4)
CO5 Action Verb level is equal to PO1 verb; Therefore correlation is high (3).

III YEAR I SEMESTER

Subject Code	Subject Name	L	T/CLC	P	CREDITS
23AOE9915	ENGLISH FOR COMPETITIVE EXAMINATIONS (OE – I)	2	1	0	3

Course Outcomes: After studying the course, students will be able to

CO1	Understand the basics of English grammar to develop proficiency in language skills
CO2	Apply the grammatical structures in sentences for an effective communication
CO3	Apply the use of various concepts in grammar and vocabulary in everyday use and competitive exams
CO4	Analyze **unfamiliar passages to** draw **logical conclusions, thereby** enhancing **reading comprehension and vocabulary skills**
CO5	Create effective writing forms like essays and precise writing by using grammar and structure rules.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Understand	the basics of English grammar to develop proficiency in language skills.			L2
2	Apply	the grammatical structures in sentences for an effective communication			L3
3	Apply	the use of various concepts in grammar and vocabulary in everyday use and competitive exams		in everyday use and competitive exams	L3
4	Analyze	**Analyze** unfamiliar passages to **draw** logical conclusions, thereby **enhancing** reading comprehension and vocabulary skills			L4
5	Create	effective writing forms like essays and precise writing by using grammar and structure rules.	by using grammar and structure rules.		L6

UNIT - I	**GRAMMAR-1**	Lecture Hrs
Nouns-classification-errors-Pronouns-types-errors-Adjectives-types-errors-Articles-definite-indefinite-Degrees of Comparison-Adverbs-types- errors-Conjunctions-usage-repositions-usage-Tag Questions, types-identifying errors- Practice		
UNIT - II	**GRAMMAR-2**	Lecture Hrs
Verbs-tenses- structure-usages- negatives- positives- time adverbs-Sequence of tenses--If Clause-Voice-active voice and passive voice- reported Speech-Agreement- subject and verb-Modals-Spotting Errors-Practices		
UNIT - III	**VERBAL ABILITY**	Lecture Hrs
Sentence completion-Verbal analogies-Word groups-Instructions-Critical reasoning-Verbal deduction-Select appropriate pair-Reading Comprehension-Paragraph-Jumbles-Selecting the proper statement by reading a given paragraph.		
UNIT - IV	**READING COMPREHENSION AND VOCUBULARY**	Lecture Hrs
Competitive Vocabulary :Word Building – Memory techniques-Synonyms, Antonyms, Affixes-Prefix &Suffix-One word substitutes-Compound words-Phrasal Verbs-Idioms and Phrases-Homophones-Linking Words-Modifiers-Intensifiers - Mastering Competitive Vocabulary- Cracking the unknowing passage-speed reading techniques- Skimming & Scanning-types of answering–Elimination methods		
UNIT - V	**WRITING FOR COMPETITIVE EXAMINATIONS**	Lecture Hrs
Punctuation- Spelling rules- Word order-Sub Skills of Writing- Paragraph meaning-salient features-types - Note-making, Note-taking, summarizing-precise writing- Paraphrasing-Expansion of proverbs-Essay writing-types		

Textbooks:

1. **Wren & Martin, *English for Competitive Examinations,* S.Chand & Co, 2021**
2. *Objective English for Competitive Examination,* Tata McGraw Hill, New Delhi, 2014.

Reference Books:

1. Hari Mohan Prasad, *Objective English for Competitive Examination,* Tata McGraw Hill, New Delhi, 2014.
2. Philip Sunil Solomon, *English for Success in Competitive Exams*, Oxford 2016
3. Shalini Verma , *Word Power Made Handy*, S Chand Publications
4. Neira, Anjana Dev & Co. *Creative Writing: A Beginner's Manual.* Pearson Education India, 2008.
5. Abhishek Jain,Vocabulary Learning Techniques Vol.I&II,RR Global Publishers 2013.
6. Michel Swan, *Practical English Usage*,Oxford,2006.

Online Resources

1. **https://www.grammar.cl/english/parts-of-speech.htm**
2. **https://academicguides.waldenu.edu/writingcenter/grammar/partsofspeech**
3. **https://learnenglish.britishcouncil.org/grammar/english-grammar-reference/active- passive-voice**
4. **https://languagetool.org/insights/post/verb-tenses/**
5. **https://www.britishcouncil.in/blog/best-free-english-learning-resources-british-council**
6. **https://www.careerride.com/post/social-essays-for-competitive-exams-586.aspx**

CORRELATION OF COS WITH THE POS & PSOS:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1									2				
CO2									2				
CO3									2				
CO4									3				
CO5									3				

CO-PO MAPPING JUSTIFICATION:

Unit No	Course Outcomes					Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
	Lesson Plan Hrs	%	Correlation	CO's Action Verb	BTL			
1							Thumb Rule	2
2							Thumb Rule	2
3							Thumb Rule	2
4							Thumb Rule	3
5							Thumb Rule	3

JUSTIFICATION STATEMENTS:

CO1: Understand the basics of English grammar and its importance **Action Verb: Understand (L2)**
CO1 Action Verb Understand is of BTL 2. Using Thumb rule, L2 correlates PO6 to PO11 as moderate (2).

CO2: Apply the use of grammatical structures in sentences
CO2 Action Verb Apply is of BTL 3. Using Thumb rule, L3 correlates PO6 to PO11 as moderate (2)

CO3: Apply the use of various concepts in grammar and vocabulary in everyday use competitive exams
CO3 Action Verb Apply is of BTL 3. Using Thumb rule, L3 correlates PO6 to PO11 as moderate (2).

CO4: **Analyze** unfamiliar passages to **draw** logical conclusions, thereby **enhancing** reading comprehension and vocabulary skills

Action Verb: Analyze (L4)
CO4 Action Verb Analyze is of BTL 4. Using Thumb rule, L4 correlates PO6 to PO11 as high (3).

CO5: Create effective writing forms like essays and precise writing by using grammar and structure rules.

Action Verb: Create(L6)
CO5 Action Verb Create is of BTL 6. Using Thumb rule, L5 correlates PO6 to PO11 as high (3).

III YEAR I SEMESTER

Subject Code	Subject Name	L	T/CLC	P	CREDITS
23AOEMB01	ENTREPRENEURSHIP AND NEW VENTURE CREATION (OE – I)	2	1	0	3

Course Outcomes: After studying the course, students will be able to

CO1	Understand the entrepreneurial mind – set for venture creation and Intrapreneurial Leadership.
CO2	Analyze the process of problem-opportunity identification through design thinking, and validating with the potential customer.
CO3	Understand Prototype Development and validate MVP of their venture idea.
CO4	Evaluate the financial and market viability of a venture by conducting financial and marketing feasibility.
CO5	Understand an investible pitch deck of their practice venture to attract stakeholders.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Understand	an entrepreneurial mind – set		for venture creation and Entrepreneurial Leadership	L2
2	Analyze	the process of problem-opportunity identification	Through design thinking, and validating with the potential customer.		L4
3	Understand	Proto type Development and validate MVP of their venture idea			L2
4	Evaluate	the financial and market viability of a venture	by conducting financial and marketing feasibility.		L5
5	Understand	an investible pitch deck of their practice venture		to attract stakeholders	L2

UNIT-I

UNIT-I: Entrepreneurship Fundamentals and context Meaning and concept, attributes and mindset of entrepreneurial and intrapreneurial leadership, role models in each and their role in economic development. An understanding of how to build entrepreneurial mindset, skill sets, attributes and networks while on campus.

UNIT-II

Unit II: Problem & Customer Identification Understanding and analyzing the macro-Problem and Industry perspective - technological, socioeconomic and urbanization trends and their implication on new opportunities - Identifying passion - identifying and defining problem using Design thinking principles - Analyzing problem and validating with the potential customer - Understanding customer segmentation, creating and validating customer personas.

UNIT-III

Unit III: Solution design, Prototyping & Opportunity Assessment and Sizing Understanding Customer Jobs-to-be-done and crafting innovative solution design to map to customer‘s needs and create a strong value proposition - Understanding prototyping and Minimum Viable product (MVP) - Developing a feasibility prototype with differentiating value, features and benefits - Assess relative market position via competition analysis - Sizing the market and assess scope and potential scale of the opportunity.

UNIT-IV

UNIT-IV: Business & Financial Model, Go-to-Market Plan Introduction to Business model and types, Lean approach, 9 block lean canvas model, riskiest assumptions to Business models. Importance of Build - Measure – Lean approach. Business planning: components of Business plan- Sales plan, People plan and financial plan. Financial Planning: Types of costs, preparing a financial plan for profitability using financial template, understanding basics of Unit economics and analyzing financial performance.

Introduction to Marketing and Sales, Selecting the Right Channel, creating digital presence, building customer acquisition strategy. Choosing a form of business organization specific to your venture, identifying sources of funds: Debt & Equity Map the Start-up Life-cycle to Funding Options
UNIT-V
UNIT-V: Scale Outlook and Venture Pitch readiness Understand and identify potential and aspiration for scale vis-à-vis your venture idea. Persuasive Storytelling and its key components. Build an Investor ready pitch deck

Textbooks:

1. Robert D.Hisrich, Michael P.Peters, Dean A. Shepherd, Sabyasachi Sinha. Entrepreneurship,McGrawHill,11thEdition(2020)
2. Ries E, The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses.CrownBusiness,(2011).
3. Oster walder, A., & Pigneur, Y. Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers. John Wiley & Sons.(2010).

References:

1. Simon Sinek, *Start with Why,* Penguin Books limited.(2011)
2. BrownTim,*Change by Design Revised &Updated: HowDesign Thinking*
3. *Transforms Organizations and Inspires Innovation,*HarperBusiness.(2019)
4. NamitaThapar(2022)The Dolphin and the Shark:Stories on Entrepreneurship , Penguin Books Limited
5. Saras D.Sarasvathy, (2008) Effectuation:Elements of Entrepreneurial Expertise, Elgar Publishing Ltd.

CORRELATION OF COS WITH THE POS & PSOS:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2												
CO2			3										
CO3				3									
CO4	3												
CO5									2				

CO-PO MAPPING JUSTIFICATION:

Unit No	Course Outcomes					Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
	Lesson Plan Hrs	%	Correlation	CO's Action Verb	BTL			
1	10	14.93	2	Understand	L2	PO1	Apply (L3)	2
2	12	17.91	2	Analyze	L4	PO3	Apply (L3)	3
3	12	17.91	2	Create	L6	PO4	Apply (L3)	3
4	18	26.86	3	Evaluate	L5	PO1	Apply (L3)	3
5	15	22.38	3	Understand	L2	PO9	Thumb Rule	2

JUSTIFICATION STATEMENTS:

CO1: Understand an entrepreneurial mind – set for venture creation and Intrapreneurial Leadership.
Action Verb: Understand (L2) PO1 Verb: Apply(L3)
CO1 Action verb is less than PO1 verb by one level. Therefore the correlation is medium (2)
CO2: Analyze the process of problem-opportunity identification through design thinking, and validating with the potential customer.
Action Verb: Analyze (L4) PO3: Apply (L3)
CO2 Action verb is more than PO3 verb. Therefore the correlation is High (3)
CO3: Understand Prototype Development and validate MVP of their venture idea.
Action Verb: Understand (L2) PO4: Apply (L3)
CO3 Action verb is less than PO4 verb by one level. Therefore the correlation is medium (2)
CO4: Evaluate the financial and market viability of a venture by conducting financial marketing feasibility.
Action Verb: Evaluate (L5) PO1: Apply (L3)
CO4 Action verb is more than PO1 verb by two levels. Therefore the correlation is High (3)
CO5: Understand an investible pitch deck of their practice venture to attract stakeholders.
Action Verb: Understand (L2) PO9: Thumb Rule
As using thumb rule, correlates with PO9. Therefore the correlation is medium (2)

III YEAR I SEMESTER

Subject Code	Subject Name	L	T/CLC	P	CREDITS
23APC0117	GEOTECHNICAL ENGINEERING LAB	0	0	3	1.5

Course Outcomes: After studying the course, students will be able to

CO1	Analyze index properties of soils.
CO2	Evaluate the filed density, Optimum Moisture Content (OMC) and Maximum Dry Density (MDD) of soils
CO3	Evaluate permeability characteristics of soil
CO4	Analyze the shear strength and compressibility of soil
CO5	Evaluate the bearing ratio by using CBR method for soil.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Analyze	index properties		of soils.	L4
2	Evaluate	the filed density, Optimum Moisture Content (OMC) and Maximum Dry Density (MDD) Dry Density (MDD)		of soils	L5
3	Evaluate	permeability characteristics		of soil	L5
4	Analyze	the shear strength and compressibility		of soil	L5
5	Evaluate	the bearing ratio	by using CBR method	for soil	L5

LIST OF EXPERIMENTS

1. **Determination of Index Properties**
   a. Specific Gravity of Soil
   b. Grain Size Distribution – Sieve Analysis
   c. Grain Size Distribution - Hydrometer Analysis
   d. Liquid Limit and Plastic Limit Tests
   e. Shrinkage Limit and Differential Free Swell Tests
2. **Determination of In-Situ Density and Compaction Characteristics**
   a. Field Density Test (Sand Replacement Method)
   b. Determination of Moisture–Density Relationship Using Standard Proctor Compaction Test.
3. **Determination of Engineering Properties**
   a. Permeability Determination (Constant Head Method)
   b. Permeability Determination (Falling Head Methods)
   c. Determination of Co-Efficient of Consolidation
   d. Direct Shear Test in Cohesion Less Soil
   e. Unconfined Compression Test in Cohesive Soil
   f. Laboratory Vane Shear Test in Cohesive Soil
   g. Tri-Axial Compression Test in Cohesion Less Soil
   h. California Bearing Ratio Test

NOTE: Any 10 of the above Experiments

TEXTBOOKS:

1. Lambe T.W., ―Soil Testing for Engineers‖, John Wiley and Sons, New York, 1951. Digitized 2008.
2. IS Code of Practice (2720) Relevant Parts, as amended from time to time, Bureau of Indian Standards, New Delhi.

REFERENCES:

1. ―Saibaba Reddy, E. Ramasastri, K. ―Measurement of Engineering Properties of Soils‖, New age International (P) limited publishers, New Delhi, 2008.
2. G.Venkatappa Rao and Goutham.K. Potable, ―Geosynthetics Testing – A laboratory Manual‖, Sai Master Geoenvironmental Services Pvt. Ltd., 1st Edition 2008.
3. BrajaM Das., ―Soil Mechanics: Laboratory Manual‖, Oxford University Press, eighth edition, 2012

WEB RESOURCES:

https://nptel.ac.in/courses/105101160

CORRELATION OF COS WITH THE POS & PSOS:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	3		3		3							
CO2	2	2	2	2		3					3		
CO3	2	2	2	2		3					3		
CO4	2	3		3		3							
CO5	2	2	2	2		3					3		

CO-PO MAPPING JUSTIFICATION:

CO	CO		Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
	Verb	BTL			
1	Analyze	L4	PO1 PO2 PO4 PO6	Apply (L3) Analyze (L4) Analyze (L4) Thumb Rule	2 3 3 3
2	Evaluate	L5	PO1 PO2 PO3 PO4 PO6 PO11	Apply (L3) Analyze (L4) Design (L6) Analysis (L4) Thumb Rule Thumb Rule	2 2 2 2 3 3
3	Evaluate	L5	PO1 PO2 PO3 PO4 PO6 PO11	Apply (L3) Analyze (L4) Design (L6) Analysis (L4) Thumb Rule Thumb Rule	2 2 2 2 3 3
4	Analyze	L4	PO1 PO2 PO4 PO6	Apply (L3) Analyze (L4) Analyze (L4) Thumb Rule	2 3 3 3
5	Evaluate	L5	PO1 PO2 PO3 PO4 PO6 PO11	Apply (L3) Analyze (L4) Design (L6) Analysis (L4) Thumb Rule Thumb Rule	2 2 2 2 3 3

JUSTIFICATION STATEMENTS:

CO1: Analyze index properties of soils.
Action Verb: Analyze (L4)
PO1: Apply(L3)
CO 1 Action verb is greater than PO1 verb. Therefore, the correlation is moderate (2)
PO2: Analyze (L4)
CO 1 Action verb is equal to PO2 verb. Therefore, the correlation is high (3)
PO 4: Analysis (L4)
CO 1 Action Verb is equal to PO4; Therefore, correlation is high (3)
CO 1 Action Verb Analyze is of BTL 4. Using Thumb rule, L4 correlates PO6 as high (3).

CO2: Evaluate the filed density, Optimum Moisture Content (OMC) and Maximum Dry Density (MDD) of soils
Action Verb: Evaluate (L5)
PO1: Apply (L3)
CO 2 Action verb is greater than PO1 verb; Therefore, correlation is moderate (2).
PO2: Analyze (L4)
CO 2 Action verb is greater than PO2 verb by one level; Therefore, correlation is moderate (2).
PO3: Design
CO 2 Action verb is less than PO3 verb by one level; Therefore, correlation is moderate (2).

PO4: Design
CO 2 Action verb is less than PO3 verb by one level; Therefore, correlation is moderate (2).
PO6: Action verb Evaluate is of BTL 5. Using Thumb rule, L5 correlates PO6 as High (3)
PO11: Action verb Evaluate is of BTL 5. Using Thumb rule, L5 correlates PO11 as High (3)

CO3: Evaluate permeability characteristics of soil
Action Verb: Evaluate (L5)
PO1: Apply (L3)
CO 3 Action verb is greater than PO1 verb; Therefore, correlation is moderate (2).
PO2: Analyze (L4)
CO 3 Action verb is greater than PO2 verb by one level; Therefore, correlation is moderate (2).
PO3: Design
CO 3 Action verb is less than PO3 verb by one level; Therefore, correlation is moderate (2).
PO4: Design
CO 3 Action verb is less than PO3 verb by one level; Therefore, correlation is moderate (2).
PO6: Action verb Evaluate is of BTL 5. Using Thumb rule, L5 correlates PO6 as High (3)
PO11: Action verb Evaluate is of BTL 5. Using Thumb rule, L5 correlates PO11 as High (3)

CO 4: Analyze the shear strength and compressibility of soil
Action Verb: Analyze (L4)
PO1: Apply(L3)
CO 4 Action verb is greater than PO1 verb. Therefore, the correlation is moderate (2).
PO2: Analyze (L4)
CO 4 Action verb is equal to PO2 verb. Therefore, the correlation is high (3)
PO 4: Analysis (L4)
CO 4 Action Verb is equal to PO4; Therefore, correlation is high (3)
CO 4 Action Verb Analyze is of BTL 4. Using Thumb rule, L4 correlates PO6 as high (3).

CO 5: Evaluate the bearing ratio by using CBR method for soil.
Action Verb: Evaluate (L5)
PO1: Apply (L3)
CO 5 Action verb is greater than PO1 verb; Therefore, correlation is moderate (2).
PO2: Analyze (L4)
CO 5 Action verb is greater than PO2 verb by one level; Therefore, correlation is moderate (2).
PO3: Design
CO 5 Action verb is less than PO3 verb by one level; Therefore, correlation is moderate (2).
PO4: Design
CO 5 Action verb is less than PO3 verb by one level; Therefore, correlation is moderate (2).
PO6: Action verb Evaluate is of BTL 5. Using Thumb rule, L5 correlates PO6 as High (3)
PO11: Action verb Evaluate is of BTL 5. Using Thumb rule, L5 correlates PO11 as High (3)

III YEAR I SEMESTER

Subject Code	Subject Name	L	T/CLC	P	CREDITS
23APC0118	FLUID MECHANICS HYDRAULIC MACHINES LAB	0	0	3	1.5

Course Outcomes: After studying the course, students will be able to

CO1	Analyze the behavior of fluid flow in pipes by Bernoulli's equation.
CO2	Evaluate discharge coefficients for various flow measurement devices and analyze flow behavior.
CO3	Evaluate head losses due to friction and minor losses in pipe flow systems.
CO4	Analyze the impact of jets on vanes and its significance in hydraulic machinery.
CO5	Analyze the performance of turbines and pumps under different conditions and recommend optimal operating parameters.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Analyze	Behavior of fluid flow in pipes	Bernoulli's equation		L4
2	Evaluate	Discharge coefficients for various flow	flow measurement	for various pipe fittings.	L5
3	Evaluate	Head losses due to friction	pipe flow systems	through the closed conduits	L5
4	Analyze	The impact of jets on vanes and its significance	impact of jets on vanes		L4
5	Analyze	The performance of turbines and pumps	optimal operating parameters		L4

LIST OF EXPERIMENTS

1. Verification of Bernoulli‘s Equation
2. Determination of Coefficient of Discharge for A Small Orifice By A Constant Head Method
3. Calibration of Venturimeter/ Orifice Meter
4. Calibration of Triangular / Rectangular/Trapezoidal Notch
5. Determination of Minor Losses in Pipe Flow
6. Determination of Friction Factor of A Pipeline
7. Determination of Energy Loss in Hydraulic Jump
8. Determination of Manning‘s and Chezy‘s Constants for Open Channel Flow.
9. Impact of Jet On Vanes
10. Performance Characteristics of Pelton Wheel Turbine
11. Performance Characteristics of Francis Turbine
12. Performance Characteristics of Kaplan Turbine
13. Performance Characteristics of A Single Stage / Multistage Centrifugal Pump

Note: Minimum 10 out of the above are to be conducted.

TEXTBOOKS:

1. Desmukh T. S., A lab manual on Fluid Mechanics and Hydraulic Machines, Laxmi Publications
2. Dr. S.K. Panigrahi, Ms. L. Mohanty, Fluid Mechanics and Hydraulic Machines Laboratory Manual ,S.K.KATARIA&SONS ,Educational Publisher.

REFERENCES:

1. Dr. N. Kumara Swamy, Fluid Mechanics and Machinery Laboratory Manual, Chart or Publications
2. D. Sathish, Fluid Mechanics and Machinery Lab Manual, BP International Publications

WEB RESOURCES:

https://archive.nptel.ac.in/courses/112/106/112106311/

CORRELATION OF COS WITH THE POS & PSOS:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	2	2		3					2	3	2
CO2	2	3	3	2		3					1	3	2
CO3	2	3	2	2		2					1	3	2
CO4	2	3	3	2		2					1	3	2
CO5	2	2	2	1							2	2	2

CO-PO MAPPING JUSTIFICATION:

CO	CO		Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
	Verb	BTL			
1	Analyze	L4	PO1 PO2 PO3 PO4 PO6 PO11	Apply (L3) Analyze (L4) Design (L6) Analyze (L4) Thumb Rule Thumb Rule	2 3 3 3 3 3
2	Evaluate	L5	PO1 PO2 PO3 PO4 PO6 PO11	Apply (L3) Analyze (L4) Design (L6) Analyze (L4) Thumb Rule Thumb Rule	2 3 3 3 3 3
3	Evaluate	L5	PO1 PO2 PO3 PO4 PO6 PO11	Apply (L3) Analyze (L4) Design (L6) Analyze (L4) Thumb Rule Thumb Rule	2 3 3 3 3 3
4	Analyze	L4	PO1 PO2 PO3 PO4 PO6 PO11	Apply (L3) Analyze (L4) Design (L6) Analyze (L4) Thumb Rule Thumb Rule	2 3 3 3 3 3
5	Analyze	L4	PO1 PO2 PO3 PO4 PO6 PO11	Apply (L3) Analyze (L4) Design (L6) Analyze (L4) Thumb Rule Thumb Rule	2 3 3 3 3 3

JUSTIFICATION STATEMENTS:

CO 1: Analyze the behavior of fluid flow in pipes by Bernoulli's equation.

Action Verb: Analyze (L4)
PO1: Apply(L3)
CO 1 Action verb is greater than PO1 verb. Therefore, the correlation is moderate (2)
PO2: Analyze (L4)
CO 1 Action verb is equal to PO2 verb. Therefore, the correlation is high (3)
PO3: Design (L6)
CO 1 Action verb is equal to PO2 verb. Therefore, the correlation is moderate (2)
PO 4: Analysis (L4)
CO 1 Action Verb is equal to PO4; Therefore, correlation is high (3)
CO 1 Action Verb Analyze is of BTL 4. Using Thumb rule, L4 correlates PO6 as high (3).

CO 1 Action Verb Analyze is of BTL 4. Using Thumb rule, L4 correlates PO11 as high (3).

CO 2: Evaluate discharge coefficients for various flow measurement devices and analyze flow behavior.

Action Verb: Evaluate (L5)
PO1: Apply (L3)
CO 2: Action verb is greater than PO1 verb; Therefore, correlation is moderate (2).
PO2: Analyze (L4)
CO 2 Action verb is greater than PO2 verb by one level; Therefore, correlation is moderate (2).
PO3: Design
CO 2 Action verb is less than PO3 verb by one level; Therefore, correlation is moderate (2).
PO4: Design
CO 2 Action verb is less than PO3 verb by one level; Therefore, correlation is moderate (2).
PO6: Action verb Evaluate is of BTL 5. Using Thumb rule, L5 correlates PO6 as High (3)
PO11: Action verb Evaluate is of BTL 5. Using Thumb rule, L5 correlates PO11 as High (3)

CO 3: Evaluate head losses due to friction and minor losses in pipe flow systems.

Action Verb: Evaluate (L5)
PO1: Apply (L3)
CO 3 Action verb is greater than PO1 verb; Therefore, correlation is moderate (2).
PO2: Analyze (L4)
CO 3 Action verb is greater than PO2 verb by one level; Therefore, correlation is moderate (2).
PO3: Design
CO 3 Action verb is less than PO3 verb by one level; Therefore, correlation is moderate (2).
PO4: Design
CO 3 Action verb is less than PO3 verb by one level; Therefore, correlation is moderate (2).
PO6: Action verb Evaluate is of BTL 5. Using Thumb rule, L5 correlates PO6 as High (3)
PO11: Action verb Evaluate is of BTL 5. Using Thumb rule, L5 correlates PO11 as High (3)

CO 4: Analyze the impact of jets on vanes and its significance in hydraulic machinery.

Action Verb: Analyze (L4)
PO1: Apply(L3)
CO 4 Action verb is greater than PO1 verb. Therefore, the correlation is moderate (2)
PO2: Analyze (L4)
CO 4 Action verb is equal to PO2 verb. Therefore, the correlation is high (3)
PO3: Design (L6)
CO 4 Action verb is equal to PO2 verb. Therefore, the correlation is moderate (2)
PO 4: Analysis (L4)
CO 4 Action Verb is equal to PO4; Therefore, correlation is high (3)
CO 4 Action Verb Analyze is of BTL 4. Using Thumb rule, L4 correlates PO6 as high (3).
CO 4 Action Verb Analyze is of BTL 4. Using Thumb rule, L4 correlates PO11 as high (3).

CO 5: Analyze the performance of turbines and pumps under different conditions and recommend optimal operating parameters.

Action Verb: Analyze (L4)
PO1: Apply(L3)
CO 45Action verb is greater than PO1 verb. Therefore, the correlation is moderate (2)
PO2: Analyze (L4)
CO 5 Action verb is equal to PO2 verb. Therefore, the correlation is high (3)
PO3: Design (L6)
CO 5 Action verb is equal to PO2 verb. Therefore, the correlation is moderate (2)
PO 4: Analysis (L4)
CO 5 Action Verb is equal to PO4; Therefore, correlation is high (3)
CO 5 Action Verb Analyze is of BTL 4. Using Thumb rule, L4 correlates PO6 as high (3).
CO 5 Action Verb Analyze is of BTL 4. Using Thumb rule, L4 correlates PO11 as high (3).

III YEAR I SEMESTER

Subject Code	Subject Name	L	T/CLC	P	CREDITS
23ASC0102	ESTIMATION, SPECIFICATIONS, COSTING AND VALUATION	0	1	2	2

Course Outcomes: After studying the course, students will be able to

CO1	Understand the types of estimates, estimation methods, and rate analysis through activity-based learning.
CO2	Apply wall-to-wall and centre line methods to prepare detailed estimates for single and two-storied buildings including all components.
CO3	Apply techniques to prepare abstract estimates and analyze data from detailed estimates of residential
CO4	Analyze the preparation of measurement books and bill generation procedures as per AP State Government norms.
CO5	Analyze valuation methods, cost escalation, and value analysis for civil engineering works through activity-based tasks.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Understand	Types of estimates, estimation methods, and rate analysis	Given estimation scenarios and rate data	Student explains concepts correctly with examples	L2
2	Apply	Detailed estimation techniques using wall-to-wall and center line methods	Given residential building plans	Prepare complete quantity estimates including all components	L3
3	Apply	Abstract estimate techniques and quantity summarization	Given detailed estimates	Generate abstract estimates with accurate total cost breakdown	L3
4	Analyze	Preparation of measurement book and bill formats	Using AP Govt. standard procedures and estimate data	Accurately document and interpret measurements and billing	L4
5	Analyze	Valuation, cost escalation, and value analysis methods	Based on a selected civil project	Perform cost-benefit and escalation analysis with justification	L4

LIST OF EXPERIMENTS

1. Activity Based On Learning Methods and Types of Estimates
2. Preparation of Detailed Estimate for A Single-Storied Residential Building Using Wall to Wall Method
3. Preparation of Detailed Estimate for A Single Storied Residential Building Using Centre Line Method for Earthwork, Foundations, Super Structure, Fittings Including Sanitary and Electrical Fittings &Paintings.
4. Preparation of Detailed Estimate for A Two Storied Residential Building Using Centre Line Method for Earthwork, Foundations, Super Structure, Fittings Including Sanitary and Electrical Fittings &Paintings.
5. Activity Based Learning of Estimate Data and Rate Analysis
6. Preparation of Abstract Estimate for The Detailed Estimate in Exercise No.3
7. Preparation of Abstract Estimate for The Detailed Estimate in Exercise No.4
8. Writing of Measurement Book and Bill Preparation as Per AP State Govt Procedure for Detailed Estimate in No. 3 and Abstract Estimate of No. 6
9. Writing of Detailed Specifications for Various Items of Estimate and Preparing A Model Tender Document for The Work Listed in No. 3 and 6
10. Activity Based Learning for Valuation of Buildings, Cost Escalation Procedures and Value Analysis for Any One Work

TEXTBOOKS:

1. B.N. Dutta - Estimating and Costing in Civil Engineering, CBS Publishers & Distributors, 28th Revised Edition (2020).
2. Rangwala - Estimating, Costing and Valuation, Charotar Publishing House, 2023.
3. D.D. Kohli& R.C. Kohli - A Textbook of Estimating and Costing (Civil), S. Chand Publishing, 2011.

REFERENCES:

1. M. Chakraborti - Estimating, Costing, Specification & Valuation in Civil Engineering, 29th Edition (2021).
2. Gurcharan Singh - Estimating, Costing and Valuation, Standard Publishers, 2018.
3. V.N. Vazirani& S.P. Chandola - Civil Engineering Estimating & Costing, Khanna Publishers, 4th Edition (2001).

WEB RESOURCES:

https://onlinecourses.swayam2.ac.in/nou20_cs11/preview
https://www.coursera.org/learn/construction-cost-estimating

CORRELATION OF COS WITH THE POS & PSOS:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2				2						2	
CO2	3	2		2		2						2	
CO3	3	2		2		2						2	
CO4	3	3	3	3		3						2	
CO5	3	3	3	3		3						2	

CO-PO MAPPING JUSTIFICATION:

CO	CO		Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
	Verb	BTL			
1	Understand	L2	PO1 PO2 PO6	Apply (L3) Analyze (L4) Thumb Rule	2 2 2
2	Apply	L3	PO1 PO2 PO4 PO6	Apply (L3) Analyze (L4) Analyze (L4) Thumb Rule	3 2 2 2
3	Apply	L3	PO1 PO2 PO4 PO6	Apply (L3) Analyze (L4) Analyze (L4) Thumb Rule	3 2 2 2
4	Analyze	L4	PO1 PO2 PO3 PO4 PO6	Apply (L3) Analyze (L4) Design (L6) Analyze (L4) Thumb Rule)	2 3 2 3 3
5	Analyze	L4	PO1 PO2 PO3 PO4 PO6	Apply (L3) Analyze (L4) Design (L6) Analyze (L4) Thumb Rule)	2 3 2 3 3

JUSTIFICATION STATEMENTS:

CO 1: Understand the types of estimates, estimation methods, and rate analysis through activity-based learning.
Action Verb: Understand (L2)

PO1: Apply(L3)
CO 1 Action Verb is less than PO1 verb by one level; Therefore, correlation is moderate (2).
PO2: Analyze (L4)
CO 1 Action Verb is less than PO2 verb by one level; Therefore, correlation is moderate (2).
CO 1 Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO6 as moderate (2).

CO 2: Apply wall-to-wall and centre line methods to prepare detailed estimates for single and two-storied buildings including all components.
Action Verb: Apply (L3)
PO1: Apply(L3)
CO 2 Action verb is equal to PO1 verb. Therefore, the correlation is high (3)
PO2: Analyze (L4)
CO 2 Action Verb is low to PO2 verb. Therefore, the correlation is medium (2)
PO4: Analyze (L4)
CO 2 Action Verb is low to PO2 verb. Therefore, the correlation is medium (2)
CO 2 Action verb Apply is of BTL 3. Using Thumb rule, L3 correlates PO6 as moderate (2).

CO 3: Apply techniques to prepare abstract estimates and analyze data from detailed estimates of residential
Action Verb: Apply (L3)
PO1: Apply(L3)
CO 3 Action verb is equal to PO1 verb. Therefore, the correlation is high (3)
PO2: Analyze (L4)
CO 3 Action Verb is low to PO2 verb. Therefore, the correlation is medium (2)
PO4: Analyze (L4)
CO 3 Action Verb is low to PO2 verb. Therefore, the correlation is medium (2)
CO 3 Action verb Apply is of BTL 3. Using Thumb rule, L3 correlates PO6 as moderate (2).

CO 4: Analyze the preparation of measurement books and bill generation procedures as per AP State Government norms
Action Verb: Analyze (L4)
PO1: Apply(L3)
CO 4 Action verb is greater than PO1 verb. Therefore, the correlation is moderate (2)
PO2: Analyze (L4)
CO 4 Action verb is equal to PO2 verb. Therefore, the correlation is high (3)
PO3: Design (L6)
CO 4 Action Verb is low to PO2 verb. Therefore, the correlation is medium (2)
PO 4: Analysis (L4)
CO 4 Action Verb is equal to PO4; Therefore, correlation is high (3)
CO 4 Action Verb Analyze is of BTL 4. Using Thumb rule, L4 correlates PO6 as high (3).

CO 5: Analyze valuation methods, cost escalation, and value analysis for civil engineering works through activity-based tasks
Action Verb: Analyze (L4)
PO1: Apply(L3)
CO 5 Action verb is greater than PO1 verb. Therefore, the correlation is moderate (2)
PO2: Analyze (L4)
CO 5 Action verb is equal to PO2 verb. Therefore, the correlation is high (3)
PO3: Design (L6)
CO 5 Action Verb is low to PO2 verb. Therefore, the correlation is medium (2)
PO 4: Analysis (L4)
CO 5 Action Verb is equal to PO4; Therefore, correlation is high (3)
CO 5 Action Verb Analyze is of BTL 4. Using Thumb rule, L4 correlates PO6 as high (3).

III YEAR I SEMESTER

Subject Code	Subject Name	L	T/CLC	P	CREDITS
23AES0404	TINKERING LAB	0	0	2	1

Course Outcomes: After studying the course, students will be able to

CO1	**Develop** arduino/ESP32 programming for basic circuits using breadboard/Tinkercad
CO2	**Analyze** the LDR interfacing circuits with arduino / ESP32 controllers.
CO3	**Analyze** the control of traffic light circuit, sensor-based servomotor and mobile app-based LED.
CO4	**Design** a walking robot and rocket using 3-Dimensional (3D) printing Technology.
CO5	**Create** a prototype for soil moisture monitor and redesign a motor bike using Design Thinking steps

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Develop	Arduino/ESP32 programming for basic circuits	breadboard/Tinkercad		L3
2	Analyze	The LDR interfacing circuits	Arduino / ESP32		L4
3	Analyze	The control of traffic light circuit, sensor-based servomotor and mobile app-based LED			L4
4	Design	A walking robot and rocket	3D Printing Technology		L6
5	Create	A prototype for soil moisture monitor and redesign a motor bike	Design Thinking steps		L6

LIST OF EXPERIMENTS

1) Make your own parallel and series circuits using breadboard for any application of your choice.
2) Design and 3D print a Walking Robot
3) Design and 3D Print a Rocket.
4) Temperature & Humidity Monitoring System (DHT11 + LCD)
5) Water Level Detection and Alert System
6) Automatic Plant Watering System
7) Bluetooth-Based Door Lock System
8) Smart Dustbin Using Ultrasonic Sensor
9) Fire Detection and Alarm System
10) RFID-Based Attendance System
11) Voice-Controlled Devices via Google Assistant
12) Heart Rate Monitoring Using Pulse Sensor
13) Soil Moisture-Based Irrigation
14) Smart Helmet for Accident Detection
15) Milk Adulteration Detection System
16) Water Purification via Activated Carbon
17) Solar Dehydrator for Food Drying
18) Temperature-Controlled Chemical Reactor
19) Ethanol Mini-Plant Using Biomass
20) Smart Fluid Flow Control (Solenoid + pH Sensor)
21) Portable Water Quality Tester
22) AI Crop Disease Detection
23) AI-based Smart Irrigation
24) ECG Signal Acquisition and Plotting
25) AI-Powered Traffic Flow Prediction
26) Smart Grid Simulation with Load Monitoring
27) Smart Campus Indoor Navigator

28) Weather Station Prototype
29) Firefighting Robot with Sensor Guidance
30) Facial Recognition Dustbin
31) Barcode-Based Lab Inventory System
32) Growth Chamber for Plants
33) Biomedical Waste Alert System
34) Soil Classification with AI
35) Smart Railway Gate
36) Smart Bin Locator via GPS and Load Sensors
37) Algae-Based Water Purifier
38) Contactless Attendance via Face Recognition

- **Note:** The students can also design and implement their own ideas, apart from the list of experiments mentioned above.
- **Note:** A minimum of 8 to 10 experiments must be completed by the students.

Students need to refer to the following links:

1) https://aim.gov.in/pdf/equipment-manual-pdf.pdf
2) https://atl.aim.gov.in/ATL-Equipment-Manual/
3) https://aim.gov.in/pdf/Level-1.pdf
4) https://aim.gov.in/pdf/Level-2.pdf
5) https://aim.gov.in/pdf/Level-3.pdf

CORRELATION OF COS WITH THE POS & PSOS:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3				3							3	
CO2		3	3		1								3
CO3			1		1				3	3			
CO4			3	3	3								
CO5		3	3		3	3			3	3	3		3

CO-PO MAPPING JUSTIFICATION:

CO	CO		Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
	Verb	BTL			
1	CO1: Develop	L3	PO1 PO5	PO1: Apply(L3) PO5: Select(L1)	3 3
2	CO2: Analyze	L4	PO2 PO3 PO5	PO2: Review (L3) PO3: Develop(L3) PO5: Create (L6)	3 3 1
3	CO3: Analyze	L4	PO3 PO5 PO9 PO10	PO3: Design (L6) PO5: Create(L6) PO9: Thumb rule PO10: Thumb rule	1 1 3 3
4	CO4: Design	L6	PO3 PO4 PO5	PO3: Analyze(L4) PO4: Design(L6) PO5: Create(L6)	3 3 3
5	CO5: Create	L6	PO2 PO3 PO5 PO6 PO9 PO10 PO11	PO2: Review(L2) PO3: Analyze(L4) PO5:Create(L6) PO6:Thumb rule PO9:Thumb rule PO10:Thumb rule PO11: Thumb rule	3 3 3 3 3 3 3

JUSTIFICATION STATEMENTS:

CO1: Develop Arduino/ESP32 programming for basic circuits using breadboard/Tinkercad

Action Verb: **Develop (L3)**
PO1 Verb: Apply (L3) CO1 Action verb is equal as PO1 verb. Therefore, the correlation is high (3)
PO5 Verb: Select (L1) CO1 Action verb is greater than as PO5 verb. Therefore, the correlation is high (3)
CO2: Analyze the LDR interfacing circuits with Arduino / ESP32 controllers.
Action Verb: Analyze (L4)
PO2 Verb: Review (L3) CO2 Action verb is greater than PO2 verb. Therefore, the correlation is high (3)
PO3 Verb: Develop (L3) CO2 Action verb is greater than PO3 verb. Therefore, the correlation is high (3)
PO5 Verb: Create (L6) CO2 Action verb is lesser than as PO5 verb by two levels Therefore, the correlation is low (1)
CO3: Analyze the control of traffic light circuit, sensor-based servomotor and mobile app-based LED.
Action Verb: Analyze (L4)
PO3 Verb: Design (L6) CO3 Action verb is lesser than PO3 verb by two levels. Therefore, the correlation is low (1)
PO5 Verb: Create (L6) CO3 Action verb is lesser than PO5 verb by two levels Therefore, the correlation is low (1)
PO9: Thumb rule CO3 using Thumb rule, correlates with PO9 as high (3)
PO10: Thumb rule CO3 using Thumb rule, correlates with PO10 as high (3)
CO4: Design a walking robot and rocket using 3-Dimensional (3D) printing Technology.
Action Verb: Design (L6)
PO3 Verb: Analyze (L4) CO4 Action verb is greater than PO3 verb. Therefore, the correlation is high (3)
PO4 Verb: Design (L6) CO4 Action verb is equal to PO4 verb. Therefore, the correlation is high (3)
PO5 Verb: Create (L6) CO4 Action verb is equal to as PO5 verb. Therefore, the correlation is high (3)
CO5: Create a prototype for soil moisture monitor and redesign a motor bike using Design Thinking steps
Action Verb: Create (L6) PO2 Verb: Review (L2)
CO5 Action verb is greater than PO2 verb. Therefore, the correlation is high (3)
PO3 Verb: Analyze (L4) CO5 Action verb is greater than PO3 verb. Therefore, the correlation is high (3)
PO5 Verb: Create (L6) CO5 Action verb is equal to PO5 verb. Therefore, the correlation is high (3)
PO6 Verb: Thumb rule CO5 using Thumb rule, correlates with PO6 as high (3)
PO9: Thumb rule CO5 using Thumb rule, correlates with PO9 as high (3)
PO10: Thumb rule CO5 using Thumb rule, correlates with PO10 as high (3)
PO11: Thumb rule CO5 using Thumb rule, correlates with PO11 as high (3)

B.Tech. – III Year II Semester

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits	Scheme of Examination (Max. Marks)		
				L	T/CLC	P	C	CIE	SEE	Total
1	PC	23APC0119	Design of Steel Structures	2	1	0	3	30	70	100
2	PC	23APC0120	Highway Engineering	2	1	0	3	30	70	100
3	PC	23APC0121	Environmental Engineering	2	1	0	3	30	70	100
4	PE	23APE0104	Design of Earthquake Resistant Structures	2	1	0	3	30	70	100
	PE	23APE0105	Open Channel Flow							
	PE	23APE0106	Foundation Engineering							
5	PE	23APE0107	Air Pollution & Control	2	1	0	3	30	70	100
	PE	23APE0108	Watershed Management							
	PE	23APE0109	Advanced Structural Analysis							
6	OE		Open Elective-II	2	1	0	3	25	75	100
7	PC	23APC0122	Highway Engineering Lab	0	0	3	1.5	30	70	100
8	PC	23APC0123	Environmental Engineering Lab	0	0	3	1.5	30	70	100
9	SC	23ASC0103	**Skill oriented course** Building Information Modelling	0	1	2	2	30	70	100
10	MC	23AMC9902	**Mandatory Non Credit course** Technical paper writing & IPR	2	0	0	-	30	-	30
11	SC	23ASC0104	**Workshop** (One Week Technical Workshop in physical mode related to domain during Third Year)	0	0	0	-	-	-	-
Total Credits				**14**	**7**	**8**	**23**	**295**	**635**	**930**

OPEN ELECTIVE – II

S.No.	Course Code	Course Name	Offered by the Dept.
1	23AOE0202	Renewable Energy Sources	EEE
2	23APE0322	Automation and Robotics	ME
3	23AOE0402	Digital Electronics	ECE
4	23AOE0504	Operating Systems	CSE & ALLIED? IT
5	23AOE0505	Machine Learning	
6	23AOE9902	Advanced Operation Research	MATHEMATICS
7	23AOE9903	Mathematical Foundation of Quantum Technologies	
8	23AOE9907	Physics Of Electronic Materials And Devices	PHYSICS
9	23AOE9912	Chemistry Of Polymers And Applications	CHEMISTRY
10	23AOE9916	Academic Writing and Public Speaking	HUMANITIES

III YEAR II SEMESTER

Subject Code	Subject Name	L	T/CLC	P	CREDITS
23APC0119	DESIGN OF STEEL STRUCTURES	2	1	0	3

Course Outcomes: After studying the course, students will be able to

CO1	Design of bolt, welded connections along with prying action according to IS Codes
CO2	Design of Tension and Compression members according to IS Codes
CO3	Design of Beams, Built Up members and column base according to IS Codes
CO4	Design of Industrial structural members according to IS codes
CO5	Design of Continuous Beams and Portal Frames Using Plastic Design Approach.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Design	bolt, welded connections along with prying action	according to IS Codes		L6
2	Design	of Tension and Compression members	according to IS Codes		L6
3	Design	of Beams, Built Up members and column base	according to IS Codes		L6
4	Design	of Industrial structural members	according to IS Codes		L6
5	Design	of Continuous Beams and Portal Frames	according to IS Codes	Using Plastic Design Approach.	L6

UNIT-I

INTRODUCTION to STRUCTURAL STEEL and DESIGN of CONNECTIONS

General -Types of Steel -Properties of Structural Steel - I.S. Rolled Sections - Concept of Limit State Design - Design of Simple and Eccentric Bolted and Welded Connections - Types of Failure and Efficiency of Joint – Prying Action - Introduction to HSFG bolts

UNIT-II

DESIGN of TENSION and COMPRESSION MEMBERS

Behaviour and Design of Simple and Built-Up Members Subjected to Tension - Shear Lag Effect Design of Lug Angles - Tension Splice - Behaviour of Short and Long Columns - Euler's Column Theory Design of Simple and Built-Up Compression Members With Lacings and Battens

UNIT-III

DESIGN of BEAMS Design of Laterally Supported and Unsupported Beams - Design of Built - Up Beams - Design of Column Bases - Slab Base and Gusseted Base

UNIT-IV

INDUSTRIAL STRUCTURES

Design of Roof Trusses – Loads on Trusses – Purlin Design Using Angle and Channel Sections – Truss Design, Design of Joints and End Bearings- Introduction to Pre-Engineered Buildings. Design of girders.

UNIT-V

PLASTIC ANALYSIS and DESIGN

Introduction to Plastic Analysis - Theory of Plastic Analysis - Design of Continuous Beams and Portal Frames Using Plastic Design Approach.

TEXTBOOKS:

1. Duggal S.K., Design of Steel Structures, Tata McGraw Hill, Publishing Co. Ltd., New Delhi, 2010
2. Bhavikatti S.S, Design of Steel Structures, Ik International Publishing House, New Delhi, 2017.

REFERENCES:

1. Gambhir M L, Fundamentals of Structural Steel Design, McGraw Hill Education India Pvt Limited, 2013
2. Jack C. McCormac& Stephen F. Csernak - Structural Steel Design, Pearson, 7th Edition, 2023.
3. William T. Segui & Farid Soleimani - Steel Design, Cengage, 7th Edition, 2023.

4. Sarwar Alam Raz, Structural Design in Steel, New Age International Publishers, 2014
5. Subramanian N, Design of Steel Structures, Oxford University Press, New Delhi, 2016

WEB RESOURCES:

https://nptel.ac.in/courses/105105162

CORRELATION OF COS WITH THE POS & PSOS:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	3	2		3						2	
CO2	2	2	3	2		3						2	
CO3	2	2	3	2		3						2	
CO4	2	2	3	2		3						2	
CO5	2	2	3	2		3						2	

CO-PO MAPPING JUSTIFICATION:

Unit No	Course Outcomes					Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
	Lesson Plan Hrs	%	Correlation	CO's Action Verb	BTL			
1	16	20	3	Design	L6	PO1 PO2 PO3 PO4 PO6	Apply (L3) Analyze (L4) Design (L6) Analysis (L4) Thumb Rule	2 2 3 2 3
2	16	20	3	Design	L6	PO1 PO2 PO3 PO4 PO6	Apply (L3) Analyze (L4) Design (L6) Analysis (L4) Thumb Rule	2 2 3 2 3
3	16	20	3	Design	L6	PO1 PO2 PO3 PO4 PO6	Apply (L3) Analyze (L4) Design (L6) Analysis (L4) Thumb Rule	2 2 3 2 3
4	16	20	3	Design	L6	PO1 PO2 PO3 PO4 PO6	Apply (L3) Analyze (L4) Design (L6) Analysis (L4) Thumb Rule	2 2 3 2 3
5	16	20	3	Design	L6	PO1 PO2 PO3 PO4 PO6	Apply (L3) Analyze (L4) Design (L6) Analysis (L4) Thumb Rule	2 2 3 2 3

JUSTIFICATION STATEMENTS:

CO 1: Design of bolt, welded connections along with prying action according to IS Codes

Action Verb: Create or Design (L6)

PO1: Apply (L3)

CO 1: Action verb is greater than PO1 verb; Therefore, correlation is moderate (2).

PO2: Analyze (L4)

CO 1 Action verb is greater than PO2 verb; Therefore, correlation is moderate (2).

PO3: Design

CO 1 Action verb is equal to PO3 Therefore, correlation is high (3).

PO4: Analysis

CO 1 Action verb is less than PO3 verb; Therefore, correlation is moderate (2).

PO6: Action verb Design is of BTL 6. Using Thumb rule, L6 correlates PO6 as High (3)

CO 2: Design of Tension and Compression members according to IS Codes
Action Verb: Create or Design (L6)
PO1: Apply (L3)
CO 2: Action verb is greater than PO1 verb; Therefore, correlation is moderate (2).
PO2: Analyze (L4)
CO 2 Action verb is greater than PO2 verb; Therefore, correlation is moderate (2).
PO3: Design
CO 2 Action verb is equal to PO3 Therefore, correlation is high (3).
PO4: Analysis
CO 2 Action verb is less than PO3 verb; Therefore, correlation is moderate (2).
PO6: Action verb Design is of BTL 6. Using Thumb rule, L6 correlates PO6 as High (3)

CO 3: Design of Beams, Built Up members and column base according to IS Codes
Action Verb: Create or Design (L6)
PO1: Apply (L3)
CO 3: Action verb is greater than PO1 verb; Therefore, correlation is moderate (2).
PO2: Analyze (L4)
CO 3 Action verb is greater than PO2 verb; Therefore, correlation is moderate (2).
PO3: Design
CO 3 Action verb is equal to PO3 Therefore, correlation is high (3).
PO4: Analysis
CO 3 Action verb is less than PO3 verb; Therefore, correlation is moderate (2).
PO6: Action verb Design is of BTL 6. Using Thumb rule, L6 correlates PO6 as High (3)

CO 4: Design of Industrial structural members according to IS codes
Action Verb: Create or Design (L6)
PO1: Apply (L3)
CO 4: Action verb is greater than PO1 verb; Therefore, correlation is moderate (2).
PO2: Analyze (L4)
CO 4 Action verb is greater than PO2 verb; Therefore, correlation is moderate (2).
PO3: Design
CO 4 Action verb is equal to PO3 Therefore, correlation is high (3).
PO4: Analysis
CO 4 Action verb is less than PO3 verb; Therefore, correlation is moderate (2).
PO6: Action verb Design is of BTL 6. Using Thumb rule, L6 correlates PO6 as High (3)

CO 5: Design of Continuous Beams and Portal Frames Using Plastic Design Approach.
Action Verb: Create or Design (L6)
PO1: Apply (L3)
CO 5: Action verb is greater than PO1 verb; Therefore, correlation is moderate (2).
PO2: Analyze (L4)
CO 5 Action verb is greater than PO2 verb; Therefore, correlation is moderate (2).
PO3: Design
CO 5 Action verb is equal to PO3 Therefore, correlation is high (3).
PO4: Analysis
CO 5 Action verb is less than PO3 verb; Therefore, correlation is moderate (2).
PO6: Action verb Design is of BTL 6. Using Thumb rule, L6 correlates PO6 as High (3)

III YEAR II SEMESTER

Subject Code	Subject Name	L	T/CLC	P	CREDITS
23APC0120	HIGHWAY ENGINEERING	2	1	0	3

Course Outcomes: After studying the course, students will be able to

CO1	Understand planning and alignment of highway.
CO2	Apply concept of the geometric design for highway
CO3	Understand concept of traffic Engineering and its regulations
CO4	Understand the design principles of intersections.
CO5	Design of pavements as per Indian Road Congress standards.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Understand	Planning and alignment		Of Highway	L2
2	Apply	Concept of the geometric design		For Highway	L3
3	Understand	Concept of traffic Engineering and its regulations.			L2
4	Understand	Principles of intersections in lands		Using traffic volumes	L2
5	Design	Of Pavements	As per IRC standards		L6

UNIT-I

PLANNED HIGHWAY DEVELOPMENT in INDIA Highway development in India – Necessity for Highway Planning- Different Road Development Plans- Classification of Roads- Road Network Patterns – Highway Alignment- Factors affecting Alignment- Engineering Surveys – Drawings and Reports.

UNIT-II

GEOMETRIC DESIGN of HIGHWAYS Importance of Geometric Design- Design controls and Criteria- Highway Cross Section Elements- Sight Distance Elements- Stopping sight Distance, Overtaking Sight Distance and intermediate Sight Distance- Design of Horizontal Alignment- Design of Super elevation and Extra widening- Design of Transition Curves-Design of Vertical alignment -Gradients- Vertical curves.

UNIT-III

TRAFFIC ENGINEERING STUDIES Basic Parameters of Traffic-Volume, Speed and Density – Definitions and their inter relation – Highway capacity and level of service concept – factors affecting capacity and level of service - Traffic Volume Studies- Data Collection and Presentation-Speed studies- Data Collection and Presentation- - Road Accidents-Causes and Preventive measures- Accident Data Recording – Condition Diagram and Collision Diagrams.

UNIT-IV

INTERSECTION DESIGN Conflicts at Intersections- Channelization: Objectives –Traffic Islands and Design criteria- Types of At-Grade Intersections – Types of Grade-Separated Intersections- Rotary Intersection – Concept of Rotary and Design Criteria- Advantages and Disadvantages of Rotary Intersections.

UNIT-V

PAVEMENT DESIGN Types of Pavements – Difference Between Flexible and Rigid Pavements – Pavement Components – Sub Grade, Sub Base, Base and Wearing Course – Functions of Pavement Components – Design Factors – Flexible Pavement Design Methods – G.I Method, CBR Method, (As Per IRC 37-2002) –Design of Rigid Pavements – Critical Load Positions - Westergaard_S Stress Equations – Computing Radius of Relative Stiffness and Equivalent Radius of Resisting Section – Stresses in Rigid Pavements – Design of Expansion and Contraction Joints in CC Pavements. Design ofDowel Bars and Tie Bars.

TEXTBOOKS:

1. Highway Engineering – S.K.Khanna&C.E.G.Justo, Nemchand& Bros., 9th edition (2011).
2. Transportation Engineering, Volume I, C Venkatramaiah, Universities Press, 2015

REFERENCES:

1. Principles of Highway Engineering by L.R.Kadiyali, Khanna Publishers
2. Traffic Engineering and Transportation Planning by L.R.Kadiyali andLal- Khanna Publications 9th edition
3. Highway Engineering – Dr. S.K.Sharma, S.Chand Publishers 2014 edition

WEB RESOURCES:

https://nptel.ac.in/courses/105101087

CORRELATION OF COS WITH THE POS & PSOS:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	1				2						2	
CO2	3	2				2						2	2
CO3	2	1				2						2	2
CO4	2	1				2						2	2
CO5	3	3	3	3		3						2	2

CO-PO MAPPING JUSTIFICATION:

Unit No	Course Outcomes					Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
	Lesson Plan Hrs	%	Correlation	CO's Action Verb	BTL			
1	11/64	17	2	Understand	L2	PO1 PO2 PO6	Apply (L3) Analyze (L4) Thumb Rule	2 1 2
2	14/64	22	3	Apply	L3	PO1 PO2 PO6	Apply (L3) Analyze (L4) Thumb Rule	3 2 2
3	11/64	17	2	Understand	L2	PO1 PO2 PO6	Apply (L3) Analyze (L4) Thumb Rule	2 1 2
4	12/64	19	2	Understand	L2	PO1 PO2 PO6	Apply (L3) Analyze (L4) Thumb Rule	2 1 2
5	16/64	25	3	Design	L6	PO1 PO2 PO3 PO4 PO6	Apply (L3) Analyze (L4) Design (L6) Analysis (L4) Thumb Rule	3 3 3 3 3

JUSTIFICATION STATEMENTS:

CO1: Understand planning and alignment of highway.

Action Verb: Understand (L2)

PO1: Apply(L3) CO1 Action Verb is less than PO1 verb by one level; Therefore, correlation is moderate (2).

PO2: Analyze (L4) CO1 Action Verb is less than PO2 verb by two level; Therefore, correlation is Low (1).

CO1 Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO6 as moderate (2).

CO2: Apply concept of the geometric design for highway.

Action Verb: Apply (L3)

PO1: Apply(L3) CO2 Action verb is equal to PO1 verb. Therefore, the correlation is high (3)

PO2: Analyze (L4) CO2: Action Verb is low to PO2 verb. Therefore, the correlation is medium (2)

CO2 Action verb Apply is of BTL 3. Using Thumb rule, L3 correlates PO6 as moderate (2).

CO3: Understand concept of traffic Engineering and its regulations.

PO1: Apply(L3) CO3 Action Verb is less than PO1 verb by one level; Therefore, correlation is moderate (2).

PO2: Analyze (L4) CO3 Action Verb is less than PO2 verb by two level; Therefore, correlation is Low (1).

CO3 Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO6 as moderate (2).

CO4: Understand the design principles of intersections.

PO1: Apply(L3) CO4 Action Verb is less than PO1 verb by one level; Therefore, correlation is moderate (2).

PO2: Analyze (L4) CO4 Action Verb is less than PO2 verb by two level; Therefore, correlation is Low (1).

CO4 Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO6 as moderate (2).

CO5: Design of pavements as per IRC standards.

Action Verb: Create or Design (L6)

PO1: Apply (L3) CO5: Action verb is greater than PO1 verb; Therefore, correlation is moderate (2).

PO2: Analyze (L4) CO5 Action verb is greater than PO2 verb by one level; Therefore, correlation is moderate (2).

PO3: Design CO5 Action verb is equal to PO3 verb by one level; Therefore, correlation is high (3).

PO4: Analysis CO5 Action verb is less than PO3 verb; Therefore, correlation is moderate (2).

PO6: Action verb Design is of BTL 6. Using Thumb rule, L6 correlates PO6 as High (3)

III YEAR II SEMESTER

Subject Code	Subject Name	L	T/CLC	P	CREDITS
23APC0121	ENVIRONMENTAL ENGINEERING	2	1	0	3

Course Outcomes: After studying the course, students will be able to

CO1	Understand the various sources of water, methods of demand estimation, and key quality parameters.
CO2	Apply appropriate water treatment processes to ensure purification and safe supply of water.
CO3	Analyze the components and functioning of water storage, distribution systems, and their operations.
CO4	Design effective sewerage systems, stormwater drainage networks, and plumbing layouts.
CO5	Evaluate sewage treatment methods, sludge management practices, and water reuse strategies.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Understand	Sources, demand estimation, and quality parameters of water	Water source data and population figures		L2
2	Apply	Water treatment processes	Raw water quality and treatment requirements		L3
3	Analyze	Storage, distribution, and operation of water supply systems	Layout and demand		L4
4	Design	Sewerage systems, storm water drainage, and plumbing networks	Topography and population data		L6
5	Evaluate	Sewage treatment, sludge management, and water reuse methods	Treatment plant performance data		L5

UNIT-I

WATER SUPPLY Estimation of Surface and Subsurface Water Resources - Predicting Demand for Water- Impurities of Water and Their Significance - Physical, Chemical and Bacteriological Analysis - Waterborne Diseases - Standards for Potable Water. Intake of Water: Pumping and Gravity Schemes.

UNIT-II

WATER TREATMENT Objectives - Unit Operations and Processes - Principles, Functions, and Design of Water Treatment Plant Units, Aerators of Flash Mixers, Coagulation and Flocculation – Clarifloccuator- Plate and Tube Settlers – Pulsator Clarifier - Sand Filters - Disinfection - Softening, Removal of Iron and Manganese - Defluoridation- Softening - Desalination Process - Residue Management - Construction, Operation and Maintenance Aspects

UNIT-III

WATER STORAGE and DISTRIBUTION Storage and Balancing Reservoirs - Types, Location and Capacity. Distribution System: Layout, Hydraulics of Pipe Lines, Pipe Fittings, Valves Including Check and Pressure Reducing Valves, Meters, Analysis of Distribution Systems, Leak Detection, Maintenance of Distribution Systems, Pumping Stations and Their Operations - House Service Connections.

UNIT-IV

PLANNING and DESIGN of THE SEWERAGE SYSTEM Characteristics and Composition of Sewage - Population Equivalent - Sanitary Sewage Flow Estimation - Sewer Materials - Hydraulics of Flow in Sanitary Sewers - Sewer Design - Storm Drainage-Storm Runoff Estimation - Sewer Appurtenances - Corrosion in Sewers - Prevention and Control – Sewage Pumping-Drainage in Buildings - Plumbing Systems for Drainage

UNIT-V

SEWAGE TREATMENT and DISPOSAL Objectives - Selection of Treatment Methods - Principles, Functions, - Activated Sludge Process and Extended Aeration Systems - Trickling Filters - Sequencing Batch Reactor(SBR) - UASB - Waste Stabilization Ponds - Other Treatment Methods - Reclamation and Reuse of Sewage - Recent Advances in Sewage Treatment - Construction, Operation and Maintenance Aspects. - Discharge Standards-Sludge Treatment -Disposal of Sludge

TEXTBOOKS:

1. Environmental Engineering by H. S Peavy, D. R. Rowe, G. Tchobanoglous, McGraw Hill Education (India) Pvt Ltd, 2014
2. Environmental Engineering, I and II by BC Punmia, Std. Publications.

REFERENCES:

1. Environmental Engineering, I and II by SK Garg, Khanna Publications.
2. Environmental Pollution and Control Engineering CS Rao,Wiley Publications
3. Waste water engineering by Metcalf and Eddy, McGraw Hill, 2015.
4. Environmental Engineering by D. P. Sincero and G.A Sincero, Pearson 2015.
5. Water and Waste Water Technology by Mark J Hammar and Mark J. HammarJr.Wiley, 2007.

WEB RESOURCES:

https://nptel.ac.in/courses/103107084

CORRELATION OF COS WITH THE POS & PSOS:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2				2						2	
CO2	2	2				2						2	
CO3	2	2		2		3						2	1
CO4	2	2	3	2		3					3	3	2
CO5	2	2	2	2		3	3					2	2

CO-PO MAPPING JUSTIFICATION:

Unit No	Course Outcomes					Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
	Lesson Plan Hrs	%	Correlation	CO's Action Verb	BTL			
1				Understand	L2	PO1 PO2 PO6	Understand(L2) Apply (L3) Analyze (L4)	2 2 2
2				Apply	L3	PO1 PO2 PO6	Apply (L3) Analyze (L4) Apply (L3)	3 2 2
3				Analyze	L4	PO1 PO2 PO4 PO6	Apply (L3) Analyze (L4) Analyze (L4) Analyze (L4)	2 3 3 3
4				Design	L6	PO1 PO2 PO3 PO4 PO6	Apply (L3) Analyze (L4) Design (L6) Analyze (L4) Thumb Rule	2 2 2 2 3
5				Evaluate	L5	PO1 PO2 PO3 PO4 PO6 PO7 PO11	Apply (L3) Analyze (L4) Design (L6) Analyze (L4) Thumb Rule Thumb Rule Thumb Rule	2 2 3 2 3 3 3

JUSTIFICATION STATEMENTS:

CO 1: Understand the various sources of water, methods of demand estimation, and key quality parameters.

Action Verb: Understand (L2)

PO1: Apply(L3)

CO 1 Action Verb is less than PO1 verb by one level; Therefore, correlation is moderate (2).

PO2: Analyze (L4)

CO 1 Action Verb is less than PO2 verb by one level; Therefore, correlation is moderate (2).

CO 1 Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO6 as moderate (2).

CO 2: Apply appropriate water treatment processes to ensure purification and safe supply of water.
Action Verb: Apply (L3)
PO1: Apply(L3)
CO 2 Action verb is equal to PO1 verb. Therefore, the correlation is high (3)
PO2: Analyze (L4)
CO 2 Action Verb is low to PO2 verb. Therefore, the correlation is medium (2)
CO 2 Action verb Apply is of BTL 3. Using Thumb rule, L3 correlates PO6 as moderate (2).

CO 3: Analyze the components and functioning of water storage, distribution systems, and their operations.
Action Verb: Analyze (L4)
PO1: Apply(L3)
CO 3 Action verb is greater than PO1 verb. Therefore, the correlation is moderate (3)
PO2: Analyze (L4)
CO 3 Action verb is equal to PO2 verb. Therefore, the correlation is high (3)
PO 4: Analysis (L4)
CO 3 Action Verb is equal to PO4; Therefore, correlation is high (3)
CO 3 Action Verb Analyze is of BTL 4. Using Thumb rule, L4 correlates PO6 as high (3).

CO 4: Design effective sewerage systems, stormwater drainage networks, and plumbing layouts
Action Verb: Create or Design (L6)
PO1: Apply (L3)
CO 4 Action verb is greater than PO1 verb; Therefore, correlation is moderate (2).
PO2: Analyze (L4)
CO 4 Action verb is greater than PO2 verb; Therefore, correlation is moderate (2).
PO3: Design
CO 4 Action verb is equal to PO3 Therefore, correlation is high (3).
PO4: Analysis
CO 4 Action verb is less than PO3 verb; Therefore, correlation is moderate (2).
PO6: Action verb Design is of BTL 6. Using Thumb rule, L6 correlates PO6 as High (3)

CO 5: Evaluate sewage treatment methods, sludge management practices, and water reuse strategies.
Action Verb: Evaluate (L5)
PO1: Apply (L3)
CO 5: Action verb is greater than PO1 verb; Therefore, correlation is moderate (2).
PO2: Analyze (L4)
CO 5 Action verb is greater than PO2 verb by one level; Therefore, correlation is moderate (2).
PO3: Design
CO 5 Action verb is less than PO3 verb by one level; Therefore, correlation is moderate (2).
PO4: Design
CO 5 Action verb is less than PO3 verb by one level; Therefore, correlation is moderate (2).
PO6: Action verb Evaluate is of BTL 5. Using Thumb rule, L5 correlates PO6 as High (3)
PO7: Action verb Evaluate is of BTL 5. Using Thumb rule, L5 correlates PO7 as High (3)
PO11: Action verb Evaluate is of BTL 5. Using Thumb rule, L5 correlates PO11 as High (3)

III YEAR II SEMESTER

Subject Code	Subject Name	L	T/CLC	P	CREDITS
23APE0104	DESIGN OF EARTHQUAKE RESISTANT STRUCTURES (PE – II)	2	1	0	3

Course Outcomes: After studying the course, students will be able to

CO1	Understand the causes of earthquakes, seismic waves, and vibration characteristics of structures.
CO2	Apply the concepts of conceptual design and seismic load evaluation using equivalent lateral force methods.
CO3	Analyze earthquake-resistant design principles for RC frame buildings based on IS 1893 standards.
CO4	Evaluate the seismic performance and design strategies for masonry structures.
CO5	Design ductile detailing and structural wall systems for earthquake resistance as per IS 13920.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Understand	Causes of earthquakes and structural vibration behavior		identify ground motion	L2
2	Apply	Conceptual design and lateral force estimation	building plan and site category		L3
3	Analyze	Earthquake-resistant RC design as per IS 1893	Multi-storey RC frames under seismic loads	base shear and lateral force distribution	L4
4	Evaluate	Seismic behavior of masonry buildings			L5
5	Design	Ductile detailing and wall system layout for earthquake resistance			L6

UNIT-I

Engineering Seismology: Earthquake Phenomenon - Cause of Earthquakes-Faults- Plate Tectonics- Seismic Waves- Terms Associated With Earthquakes-Magnitude/Intensity of An Earthquake-Scales- Energy Released-Earthquake Measuring Instruments Seismogram - Seismoscope, Seismograph, - Strong Ground Motions- Seismic Zones of India.

Theory of Vibrations: Elements of A Vibratory System- Degrees of Freedom-Continuous System- Lumped Mass Idealization-Oscillatory Motion-Simple Harmonic Motion-Free Vibration of Single Degree of Freedom (SDOF) System- Undamped and Damped-Critical Damping-Logarithmic Decrement-Forced Vibrations-Harmonic Excitation-Dynamic Magnification Factor-Excitation By Rigid Based Translation for SDOF System-Earthquake Ground Motion.

UNIT-II

Conceptual Design: Introduction-Functional Planning-Continuous Load Path-Overall form-Simplicity and Symmetry-Elongated Shapes-Stiffness and Strength-Horizontal and Vertical Members-Twisting of Buildings-Ductility-Ductility Relationships-Flexible Buildings-Framing Systems-Choice of Construction Materials-Unconfined Concrete-Confined Concrete-Masonry-Reinforcing Steel.

Introduction to Earthquake Resistant Design: Seismic Design Requirements-Regular and Irregular Configurations-Basic Assumptions-Design Earthquake Loads-Basic Load Combinations-Permissible Stresses-Seismic Methods of Analysis-Factors in Seismic Analysis-Equivalent Lateral force Method.

UNIT-III

Reinforced Concrete Buildings: Principles of Earthquake Resistant Deign of RC Members- Structural Models for Frame Buildings - Seismic Methods of Analysis- Is Code Based Methods for Seismic Design - Vertical Irregularities - Plan Configuration Problems- Lateral Load Resisting Systems- Determination of Design Lateral forces as Per Is 1893 (Part-1):2016- Equivalent Lateral force Procedure- Lateral Distribution of Base Shear.

UNIT-IV

Masonry Buildings: Introduction- Elastic Properties of Masonry Assemblage- Categories of Masonry Buildings- Behaviour of Unreinforced and Reinforced Masonry Walls- Behaviour of Walls- Box Action and

Bands- Behaviour of Infill Walls- Improving Seismic Behaviour of Masonry Buildings- Load Combinations and Permissible Stresses- Seismic Design Requirements- Lateral Load Analysis of Masonry Buildings.
UNIT-V
Structural Walls and Non-Structural Elements: Strategies in The Location of Structural Walls- Sectional Shapes- Variations in Elevation- Cantilever Walls Without Openings – Failure Mechanism of Non-Structures- Effects of Non-Structural Elements On Structural System- Analysis of Non-Structural Elements- Prevention of Non-Structural Damage Ductility Considerations in Earthquake Resistant Design of RC Buildings: Introduction- Impact of Ductility- Requirements for Ductility- Assessment of Ductility- Factors Affecting Ductility- Ductile Detailing Considerations as Per Is 13920-2016 - Behaviour of Beams, Columns and Joints in RC Buildings During Earthquakes

TEXTBOOKS:

1. Earthquake Resistant Design of structures – S. K. Duggal, Oxford University Press
2. Earthquake Resistant Design of structures – PankajAgarwal and Manish Shrikhande, PrenticeHall of India Pvt. Ltd.

REFERENCES:

1. Seismic Design of Reinforced Concrete and Masonry Building – T. Paulay and M.J.N. Priestly,John Wiley & Sons.
2. Eartquake Resistant Design ofBuidling structures by VinodHosur, Wiley India Pvt. Ltd.
3. Elements of Mechanical Vibration by R.N.Iyengar, I.K.International Publishing House Pvt. Ltd.
4. Masory and Timber structures including earthquake Resistant Design –AnandS.Arya, Nemchand& Bros
5. Earthquake Tips – Learning Earthquake Design and Construction, C.V.R. Murthy
6. BIS Codes: 1. IS 1893(Part-1):2016 or Latest codes;. 2. IS 13920:2016. 3. IS 4326. 4. IS 456:2000 or latest.

WEB RESOURCES:

https://nptel.ac.in/courses/105107204

CORRELATION OF COS WITH THE POS & PSOS:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2				2							2
CO2	3		2									2	2
CO3	3	3	2		3							3	2
CO4		2		2								2	2
CO5	2		3		2							3	3

CO-PO MAPPING JUSTIFICATION:

Unit No	Course Outcomes					Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
	Lesson Plan Hrs	%	Correlation	CO's Action Verb	BTL			
1	13	20	2	Understand	L2	PO1 PO2 PO6	Apply (L3) Analyze (L4) Thumb Rule	2 2 2
2	13	20	3	Apply	L3	PO1 PO3	Apply (L3) Design (L6)	3 2
3	13	20	3	Analyze	L4	PO1 PO2 PO3 PO5	Apply (L3) Analyze (L4) Design (L6) Analysis (L4)	2 3 2 3
4	12	18.4	2	Evaluate	L5	PO2 PO4	Analyze (L4) Evaluation (L5)	2 2
5	12	18.4	3	Design	L6	PO1 PO3 PO5	Apply (L3) Design (L6) Analysis (L4)	2 3 2

JUSTIFICATION STATEMENTS:

CO 1: Understand the causes of earthquakes, seismic waves, and vibration characteristics of structures.
Action Verb: Understand (L2)
PO1: Apply(L3)
CO 1 Action Verb is less than PO1 verb by one level; Therefore, correlation is moderate (2).
PO2: Analyze (L4)
CO 1 Action Verb is less than PO2 verb by one level; Therefore, correlation is moderate (2).
CO 1 Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO6 as moderate (2).

CO 2: Apply the concepts of conceptual design and seismic load evaluation using equivalent lateral force methods.
Action Verb: Apply (L3)
PO1: Apply(L3)
CO 2 Action verb is equal to PO1 verb. Therefore, the correlation is moderate (2).
PO2: Analyze (L4)
CO 2 Action Verb is low to PO2 verb. Therefore, the correlation is medium (2)

CO 3: Analyze earthquake-resistant design principles for RC frame buildings based on IS 1893 standards.
Action Verb: Analyze (L4)
PO1: Apply(L3)
CO 3 Action verb is greater than PO1 verb. Therefore, the correlation is moderate (2)
PO2: Analyze (L4)
CO 3 Action verb is equal to PO2 verb. Therefore, the correlation is high (3)
PO 3: Design (L6)
CO 3 Action Verb is Low to PO4; Therefore, correlation is moderate (2)
PO5: Apply(L3)
CO 3 Action verb is greater than PO1 verb. Therefore, the correlation is moderate (2)

CO 4: Evaluate the seismic performance and design strategies for masonry structures.
Action Verb: Evaluate (L5)
PO2: Analyze (L4)
CO 4 Action verb is greater than PO2 verb by one level; Therefore, correlation is moderate (2).
PO4: Design
CO 4 Action verb is less than PO3 verb by one level; Therefore, correlation is moderate (2).

CO 5: Design ductile detailing and structural wall systems for earthquake resistance as per IS 13920.
Action Verb: Create or Design (L6)
PO1: Apply (L3)
CO 5 Action verb is greater than PO1 verb; Therefore, correlation is moderate (2).
PO3: Design
CO 5 Action verb is equal to PO3 Therefore, correlation is high (3).
PO5: Apply(L3)
CO 5 Action verb is greater than PO1 verb. Therefore, the correlation is moderate (2)

III YEAR II SEMESTER

Subject Code	Subject Name	L	T/CLC	P	CREDITS
23APE0105	OPEN CHANNEL FLOW (PE – II)	2	1	0	3

Course Outcomes: After studying the course, students will be able to

CO1	Apply the fundamental principles of fluid flow in pipelines and networks under steady and unsteady conditions.
CO2	Evaluate the uniform and varied flow in open channels using theoretical and computational approaches.
CO3	Analyze the impact of unsteady flow phenomena such as surges and dam breaks
CO4	Evaluate sediment transport processes and their influence on river morphology and hydraulic structures.
CO5	Create hydraulic models for flow measurement and physical modeling applications in fluid mechanics.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Apply	Fluid flow in pipelines and networks	under steady and unsteady conditions.		L3
2	Evaluate	Uniform and varied flow	in open channels	using theoretical and computational approaches.	L5
3	Analyze	the impact of unsteady flow phenomena such as surges and dam breaks	In open channels.		L4
4	Evaluate	Sediment transport processes and their influence	on river morphology and hydraulic structures.		L5
5	Create	Hydraulic models for flow measurement and physical modeling applications	in fluid mechanics.		L6

UNIT-I

HYDRAULICS of PIPELINES and PIPE NETWORKS Review of Fluid Mechanics. Reynolds Transport Theorem and Applications. Steady Flow Analysis of Pipe Network Systems. Unsteady Flows - Basic Equations of Water Hammer, Solution By Method of Characteristics. Network Analysis

UNIT-II

STEADY VARIED FLOWS in OPEN CHANNELS Basic Concepts of Uniform Flow. Specific Energy and Specific force Concepts. Dynamic Equation for Spatially Varied Flows. Flow Profile Computations. Introduction to Hec-Ras. Spatially Varied Flows and Rapidly Varied Flows – Applications.

UNIT-III

UNSTEADY FLOWS in OPEN CHANNELS Equations of Motion. Uniformly Progressive Wave. Rapidly Varied Unsteady Flow – Positive and Negative Surges. Dam Break Problem

UNIT-IV

SEDIMENT TRANSPORT Sediment Properties – Inception of Sediment Motion – Bed forms. Bed Load Suspended Load – total Sediment Transport. Design of Stable Channels and Regime Channels. Reservoir Sedimentation and Trap Efficiency.

UNIT-V

FLOW MEASUREMENTS and HYDRAULIC MODELING Sharp-Crested Weirs, Broad-Crested Weirs, Critical Depth Flumes. Recent Advancement in Open Channel Flow Measurements. Physical Modeling in Hydraulics. Dimensional Analysis. Modeling Closed Flows and Free Surface Flows. Distorted Models. Design of Physical Models.

TEXTBOOKS:

1. Flow in Open Channels, Subramanya K., Tata McGraw Hill Pub., N Delhi2015
2. Flow through Open Channels, Rajesh Srivastava, Oxford Univ. Press. N Delhi, 2011
3. Open Channel Hydraulics, Chow, V.T., Mc Graw HillInc. New York,1979

REFERENCES:

1. Open Channel Hydraulics, French, R.H., McGraw Hill Pub Co. NYork,1986
2. Open Channel Hydraulics, Terry Sturm, Tata McGraw Hill Pub. N Delhi,2011

WEB RESOURCES:

https://nptel.ac.in/courses/105/106/105106114/

CORRELATION OF COS WITH THE POS & PSOS:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2				2						2	
CO2	2	2	2	1		3						2	1
CO3	2	3		3		3						3	2
CO4	2	2	2	1		3						3	3
CO5	2	2	3	3		3						3	3

CO-PO MAPPING JUSTIFICATION:

Unit No	Course Outcomes					Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
	Lesson Plan Hrs	%	Correlation	CO's Action Verb	BTL			
1				Apply	L3	PO1 PO2 PO6	Apply (L3) Analyze (L4) Thumb Rule	3 2 2
2				Evaluate	L5	PO1 PO2 PO3 PO4 PO6	Apply (L3) Analyze (L4) Design (L6) Analysis (L4) Thumb Rule	2 2 2 1 3
3				Analyze	L4	PO1 PO2 PO4 PO6	Apply (L3) Analyze (L4) Analyze (L4) Thumb Rule	2 3 3 3
4				Evaluate	L5	PO1 PO2 PO3 PO4 PO6	Apply (L3) Analyze (L4) Design (L6) Analysis (L4) Thumb Rule	2 2 2 1 3
5				Design	L6	PO1 PO2 PO3 PO4 PO6	Apply (L3) Analyze (L4) Design (L6) Analysis (L4) Thumb Rule	2 2 3 2 3

JUSTIFICATION STATEMENTS:

CO 1: Apply the fundamental principles of fluid flow in pipelines and networks under steady and unsteady conditions.

Action Verb: Apply (L3)

PO1: Apply(L3)

CO 1 Action verb is equal to PO1 verb. Therefore, the correlation is high (3)

PO2: Analyze (L4)

CO 1: Action Verb is low to PO2 verb. Therefore, the correlation is medium (2)

CO 1 Action verb Apply is of BTL 3. Using Thumb rule, L3 correlates PO6 as moderate (2).

CO 2: Evaluate the uniform and varied flow in open channels using theoretical and computational approaches.
Action Verb: Evaluate (L5)
PO1: Apply (L3)
CO 2 Action verb is greater than PO1 verb; Therefore, correlation is moderate (2).
PO2: Analyze (L4)
CO 2 Action verb is greater than PO2 verb by one level; Therefore, correlation is moderate (2).
PO3: Design
CO 2 Action verb is less than PO3 verb by one level; Therefore, correlation is moderate (2).
PO4: Design
CO 2 Action verb is less than PO3 verb by two level; Therefore, correlation is Low (1).
PO6: Action verb Evaluate is of BTL 5. Using Thumb rule, L5 correlates PO6 as High (3)
CO 3: Analyze the impact of unsteady flow phenomena such as surges and dam breaks in open channels.
Action Verb: Analyze (L4)
PO1: Apply(L3)
CO 3 Action verb is greater than PO1 verb. Therefore, the correlation is moderate (2)
PO2: Analyze (L4)
CO 3 Action verb is equal to PO2 verb. Therefore, the correlation is high (3)
PO 4: Analysis (L4)
CO 3 Action Verb is equal to PO4; Therefore, correlation is high (3)
CO 3 Action Verb Analyze is of BTL 4. Using Thumb rule, L4 correlates PO6 as high (3).

CO 4: Evaluate sediment transport processes and their influence on river morphology and hydraulic structures.
Action Verb: Evaluate (L5)
PO1: Apply (L3)
CO 4: Action verb is greater than PO1 verb; Therefore, correlation is moderate (2).
PO2: Analyze (L4)
CO 4 Action verb is greater than PO2 verb by one level; Therefore, correlation is moderate (2).
PO3: Design
CO 4 Action verb is less than PO3 verb by one level; Therefore, correlation is moderate (2).
PO4: Design
CO 4 Action verb is less than PO3 verb by two level; Therefore, correlation is Low (1). (2).
PO6: Action verb Evaluate is of BTL 5. Using Thumb rule, L5 correlates PO6 as High (3)
CO 5: Create hydraulic models for flow measurement and physical modeling applications in fluid mechanics.
Action Verb: Create or Design (L6)
PO1: Apply (L3)
CO 5: Action verb is greater than PO1 verb; Therefore, correlation is moderate (2).
PO2: Analyze (L4)
CO 5 Action verb is greater than PO2 verb; Therefore, correlation is moderate (2).
PO3: Design
CO 5 Action verb is equal to PO3 Therefore, correlation is high (3).
PO4: Analysis
CO 5 Action verb is less than PO3 verb; Therefore, correlation is moderate (2).
PO6: Action verb Design is of BTL 6. Using Thumb rule, L6 correlates PO6 as High (3)

III YEAR II SEMESTER

Subject Code	Subject Name	L	T/CLC	P	CREDITS
23APE0106	FOUNDATION ENGINEERING (PE – II)	2	1	0	3

Course Outcomes: After studying the course, students will be able to

CO1	Understand the principles and methods of Soil Exploration
CO2	Analyze the slope stability using different failure theories and numerical methods
CO3	Apply classical earth pressure theories to check the stability of retaining walls
CO4	Evaluate the bearing capacity and settlement of shallow foundations.
CO5	Analyze the load-carrying capacity and settlement of Deep foundations

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Understand	the principles and methods		of Soil Exploration	L2
2	Analyze	slope stability	failure theories and numerical methods		L4
3	Apply	classical earth pressure theories	to check the stability of retaining walls	Of Soils	L3
4	Evaluate	the bearing capacity and settlement		of shallow foundations	L5
5	Analyze	the load-carrying capacity and settlement		of Deep foundations	L4

UNIT-I
SOIL EXPLORATION: Need – Methods of Soil Exploration – Boring and Sampling Methods – Field Tests – Penetration Tests – Plate Load Test – Pressure Meter – Planning of Programme and Preparation of Soil Investigation Report.
UNIT-II
EARTH SLOPE STABILITY: Infinite and Finite Earth Slopes - Types Of Failures – Factor Of Safety of Infinite Slopes Stability Analysis by Swedish Arc Method, Standard Method Of Slices, Friction Circle Method — Taylor's Stability Number- Stability Of Slopes Of Earth Dams Under Different Conditions.
UNIT-III
EARTH PRESSURE THEORIES: Rankine's Theory of Pressure - Earth Pressures In Layered Soils — Coulomb's Earth Pressure Theory — Rebhann's and Cullman's Graphical Method. **RETAINING WALLS**: Types Of Retaining Walls -Stability of Retaining Walls.
UNIT-IV
SHALLOW FOUNDATIONS: Types - Choice of Foundation Location of Depth Bearing Capacity — Terzaghi 'S, Meyerhoffs and Skempton's Methods **ALLOWABLE BEARING PRESSURE:** Safe Bearing Pressure Based on N- Value Allowable Bearing Pressure; Safe Bearing Capacity and Settlement from Plate Load Test Allowable Settlements of Structures — Estimation of Consolidation Of Settlement.
UNIT-V
PILE FOUNDATIONS: Types Of Piles — Load Carrying Capacity of Piles Based on Static Pile Formulae — Dynamic Pile Formulae — Pile Load Tests Load Carrying Capacity Of Pile Groups in Sands and Clays — Settlement of Pile Groups. **WELL FOUNDATIONS:** Types - Different Shapes of Wells - Components of Wells Functions And Forces on Well Foundation — Sinking of Wells Tilts and Shifts.

TEXTBOOKS:

1. Geotechnical Engineering by C.Venkataramaiah, New Age Publications (2002).
2. Soil Mechanics and Foundation Engineering by Arora, Standard Publishers and Distributors, Delhi 7th edition 2009

3. Soil Mechanics and Foundations by B.C.Punmia, Ashok Kumar Jain andArun Kumar Jain, Laxmi publications Pvt. Ltd., New Delhi 17th edition 2017.

REFERENCES:

1. Soil Mechanics and Foundation Engineering by Purushtoma Raj, Pearson Pubilications 2nd edition 2013
2. Principles of Foundation Engineering by Das, B.M., - (1999)–6th edition (Indian edition) Thomson Engineering
3. Foundation Engineering by Varghese,P.C., Prentice Hall of India., New Delhi.
4. Foundation Engineering by V.N.S.Murthy, CRC Press, New Delhi.

WEB RESOURCES:

https://nptel.ac.in/courses/105105176

CORRELATION OF COS WITH THE POS & PSOS:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2				2						3	
CO2	2	3		3		3						3	
CO3	3	2				2						3	
CO4	2	2	2	2		3					3	3	
CO5	2	3		3		3						3	

CO-PO MAPPING JUSTIFICATION:

Unit No	Course Outcomes					Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
	Lesson Plan Hrs	%	Correlation	CO's Action Verb	BTL			
1	12	18.18	3	Understand	L2	PO1 PO2 PO6	Apply (L3) Analyze (L4) Thumb Rule	2 2 2
2	12	18.18	2	Analyze	L4	PO1 PO2 PO4 PO6	Apply (L3) Analyze (L4) Analyze (L4) Thumb Rule	2 3 3 3
3	12	18.18	2	Apply	L3	PO1 PO2 PO6	Apply (L3) Analyze (L4) Thumb Rule	3 2 2
4	15	22.72	3	Evaluate	L5	PO1 PO2 PO3 PO4 PO6 PO11	Apply (L3) Analyze (L4) Design (L6) Analysis (L4) Thumb Rule Thumb Rule	2 2 2 2 3 3
5	15	22.72	3	Analyze	L4	PO1 PO2 PO4 PO6	Apply (L3) Analyze (L4) Analyze (L4) Thumb Rule	2 3 3 3

JUSTIFICATION STATEMENTS:

CO 1 Understand the principles and methods of Soil Exploration

Action Verb: Understand (L2)

PO1: Apply(L3)

CO 1 Action Verb is less than PO1 verb by one level; Therefore, correlation is moderate (2).

PO2: Analyze (L4)

CO 1 Action Verb is less than PO2 verb by one level; Therefore, correlation is moderate (2).

CO 1 Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO6 as moderate (2).

CO2: Analyze the slope stability using different failure theories and numerical methods

Action Verb: Analyze (L4)
PO1: Apply(L3)
CO 2 Action verb is greater than PO1 verb. Therefore, the correlation is moderate (2).
PO2: Analyze (L4)
CO 2 Action verb is equal to PO2 verb. Therefore, the correlation is high (3)
PO 4: Analysis (L4)
CO 2 Action Verb is equal to PO4; Therefore, correlation is high (3)
CO 2 Action Verb Analyze is of BTL 4. Using Thumb rule, L4 correlates PO6 high (3)

CO3: Apply classical earth pressure theories to check the stability of retaining walls
Action Verb: Apply (L3)
PO1: Apply(L3)
CO 3 Action verb is equal to PO1 verb. Therefore, the correlation is high (3)
PO2: Analyze (L4)
CO 3Action Verb is low to PO2 verb. Therefore, the correlation as moderate (2)
CO 3 Action verb Apply is of BTL 3. Using Thumb rule, L3 correlates PO6 as moderate (2).

CO4: Evaluate the bearing capacity and settlement of shallow foundations.
Action Verb: Evaluate (L5)
PO1: Apply (L3)
CO 4: Action verb is greater than PO1 verb; Therefore, correlation is moderate (2).
PO2: Analyze (L4)
CO 4 Action verb is greater than PO2 verb by one level; Therefore, correlation is moderate (2).
PO3: Design
CO 4 Action verb is less than PO3 verb by one level; Therefore, correlation is moderate (2).
PO4: Design
CO 4 Action verb is less than PO3 verb by one level; Therefore, correlation is moderate (2).
PO6: Action verb Evaluate is of BTL 5. Using Thumb rule, L5 correlates PO6 as High (3)
PO11: Action verb Evaluate is of BTL 5. Using Thumb rule, L5 correlates PO11 as High (3)

CO5: Analyze the load-carrying capacity and settlement of Deep foundations
Action Verb: Analyze (L4)
PO1: Apply(L3)
CO 5 Action verb is greater than PO1 verb. Therefore, the correlation is moderate (2).
PO2: Analyze (L4)
CO 5 Action verb is equal to PO2 verb. Therefore, the correlation is high (3)
PO 4: Analysis (L4)
CO 5 Action Verb is equal to PO4; Therefore, correlation is high (3)
CO 5 Action Verb Analyze is of BTL 4. Using Thumb rule, L4 correlates PO6 as high (3)

III YEAR II SEMESTER

Subject Code	Subject Name	L	T/CLC	P	CREDITS
23APE0107	AIR POLLUTION AND CONTROL (PE – III)	2	1	0	3

Course Outcomes: After studying the course, students will be able to

CO1	Understand the sources, classification, and global effects of air pollution.
CO2	Analyze meteorological parameters affecting air pollution dispersion.
CO3	Design control systems for particulate matter using appropriate removal techniques.
CO4	Apply suitable technologies for gaseous pollutant removal.
CO5	Evaluate Sources of vehicular and indoor air pollution and mitigation strategies

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Understand	Sources, classification and effects		of air pollution	L2
2	Analyse	Metrological parameters		in air pollution dispersion	L4
3	Design	control systems for particulate matter	appropriate removal techniques		L6
4	Apply	suitable technologies		for gaseous pollutant removal.	L3
5	Evaluate	Sources of vehicular and indoor air pollution	mitigation strategies		L5

UNIT-I

Air Pollution: Definition - Sources &Classification of Air Pollutants - Effects of Air Pollution On Humans, Plants and Materials- Global Effects - Air Quality and NAAQS - National Clean Air Programme- Sampling of Pollutants in Ambient Air - Stack Sampling

UNIT-II

Meteorology and Air Pollution: Factors Influencing Air Pollution, Wind Rose, Mixing Depths, Lapse Rates and Dispersion - Atmospheric Stability, Plume Rise and Dispersion, Prediction of Air Quality, Box Model - Gaussian Model - Dispersion Coefficient - Application of Tall Chimney for Pollutant Dispersion.

UNIT-III

Control of Particulate Pollutants: Properties of Particulate Pollution - Particle Size Distribution - Control Mechanism - Dust Removal Equipment - Design and Operation of Settling Chambers, Cyclones, Wet Dust Scrubbers, Fabric Filters &ESP.

UNIT-IV

Control of Gaseous Pollutants: Process and Equipment for The Removal By Chemical Methods - Design and Operation of Absorption and Adsorption Equipment - Combustion and Condensation Equipment.

UNIT-V

Automobile and Indoor Pollution: Vehicular Pollution – Sources and Types of Emission – Effect of Operating Conditions-Alternate Fuels and Emissions-Emission Controls and Standards, Strategies to Control Automobile Pollution– Causes of Indoor Air Pollution-Changes in Indoor Air Quality-Control and Air Cleaning Systems-Indoor Air Quality

TEXTBOOKS:

1. Rao, M. N. and Rao H. V. N., Air Pollution, Tata McGraw-Hill, New Delhi, 2007
2. Khare M, Sharma P, Kota, S.H, Sumanth C, Air Pollution Science Engineering and Management Fundamentals, CRC Press, 2024.
3. Noel, D. N., Air Pollution Control Engineering, Tata McGraw Hill Publishers, 1999.

REFERENCES:

1. Fundamentals of Air Pollution by Dr. B.S.N. Raju, Oxford & I.B.H
2. Air Pollution Control Engineering by Nevers, , McGraw-Hill, Inc., 2000.
3. Rao, C. S., Environmental Pollution Control Engineering, New Age International, New Delhi, 2006.
4. Mahajan S. P., Pollution Control in Process Industries, Tata McGraw-Hill Publishing Company, New Delhi, 1991.
5. Peavy H. S., Rowe D. R. andTchobanoglous G., Environmental Engineering, McGraw Hill, New York, 1985.

WEB RESOURCES:

https://archive.nptel.ac.in/courses/105/107/105107213/

CORRELATION OF COS WITH THE POS & PSOS:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2				2							
CO2	2	3		3		3							
CO3	2	2	2	3		3							
CO4	3	2				2							
CO5	2	2	2	2		3							

CO-PO MAPPING JUSTIFICATION:

Unit No	Course Outcomes					Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
	Lesson Plan Hrs	%	Correlation	CO's Action Verb	BTL			
1	10/60	16.6	2	Understand	L2	PO1 PO2 PO6	Apply (L3) Analyze (L4) Thumb Rule	3 2 2
2	12/60	20	2	Analyze	L4	PO1 PO2 PO4 PO6	Apply (L3) Analyze (L4) Analyze (L4) Thumb Rule	3 3 3 2
3	13/60	21.6	3	Design	L6	PO1 PO2 PO3 PO4 PO6	Apply (L3) Analyze (L4) Design (L6) Analysis (L4) Thumb Rule	2 2 2 3 3
4	13/60	21.6	3	Apply	L3	PO1 PO2 PO6	Apply (L3) Analyze (L4) Thumb Rule	3 2 2
5	12/60	20	2	Evaluate	L5	PO1 PO2 PO3 PO4 PO6	Apply (L3) Analyze (L4) Design (L6) Analysis (L4) Thumb Rule	2 2 2 2 3

JUSTIFICATION STATEMENTS:

CO1: Understand the sources, classification, and global effects of air pollution.

Action Verb: Understand (L2)

PO1: Apply (L3)

CO 1 Action Verb is less than PO1 verb by one level; Therefore, correlation is moderate (2).

PO2: Analyze (L4)

CO 1 Action Verb is less than PO2 verb by two level; Therefore, correlation is moderate (2).

CO 1 Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO6 as moderate (2).

CO 2: Analyze meteorological parameters affecting air pollution dispersion.

Action Verb: Analyze (L4)

PO1: Apply(L3)

CO 2 Action verb is greater than PO1 verb. Therefore, the correlation is moderate (2).

PO2: Analyze (L4)

CO 2 Action verb is equal to PO2 verb. Therefore, the correlation is high (3)

PO 4: Analysis (L4)

CO 2 Action Verb is equal to PO4; Therefore, correlation is high (3)

CO 2 Action Verb Analyze is of BTL 4. Using Thumb rule, L4 correlates PO6 as high (3)

CO3: Design control systems for particulate matter using appropriate removal techniques.

Action Verb: Create or Design (L6)

PO1: Apply (L3)

CO 3: Action verb is greater than PO1 verb; Therefore, correlation is moderate (2).

PO2: Analyze (L4)

CO 3 Action verb is greater than PO2 verb by one level; Therefore, correlation is moderate (2).

PO3: Design

CO 3 Action verb is equal to PO3 verb by one level; Therefore, correlation is moderate (2).

PO4: Analysis

CO 3 Action verb is less than PO3 verb; Therefore, correlation is high (3).

PO6: Action verb Evaluate is of BTL 6. Using Thumb rule, L6 correlates PO6 as High (3)

CO 4: Apply suitable technologies for gaseous pollutant removal.

Action Verb: Apply (L3)

PO1: Apply(L3)

CO 4 Action verb is equal to PO1 verb. Therefore, the correlation is high (3)

PO2: Analyze (L4)

CO 4 Action Verb is low to PO2 verb. Therefore, the correlation is medium (2)

CO 4 Action verb Apply is of BTL 3. Using Thumb rule, L3 correlates PO6 as moderate (2).

CO 5: Evaluate Sources of vehicular and indoor air pollution and mitigation strategies

Action Verb: Evaluate (L5)

PO1: Apply (L3)

CO 5: Action verb is greater than PO1 verb; Therefore, correlation is moderate (2).

PO2: Analyze (L4)

CO 5 Action verb is greater than PO2 verb by one level; Therefore, correlation is moderate (2).

PO3: Design

CO 5 Action verb is less than PO3 verb by one level; Therefore, correlation is moderate (2).

PO4: Design

CO 5 Action verb is less than PO3 verb by one level; Therefore, correlation is moderate (2).

PO6: Action verb Evaluate is of BTL 5. Using Thumb rule, L5 correlates PO6 as High (3)

III YEAR II SEMESTER

Subject Code	Subject Name	L	T/CLC	P	CREDITS
23APE0108	WATERSHED MANAGEMENT (PE – III)	2	1	0	3

Course Outcomes: After studying the course, students will be able to

CO1	Understand the concept of watershed management, stakeholder roles, pollution sources, and environmental guidelines for water quality
CO2	Analyze soil erosion processes, sediment yield, and wetland hydrology, including the role of water in wetland ecosystems
CO3	Analyze surface and groundwater interactions, wetland treatment efficiency, and hydrological models for integrated water resource management.
CO4	Apply water harvesting techniques, hydrologic modeling, and wetland design methods for sustainable watershed management.
CO5	Understand irrigation water management strategies, drought mitigation policies, and the role of water foot print in agricultural sustainability.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Understand	concept of watershed management, stakeholder roles, pollution sources, and environmental guidelines		for water quality	L2
2	Analyze	soil erosion processes, sediment yield, and wetland hydrology, including the role of water		in wetland ecosystems	L4
3	Analyze	surface and groundwater interactions, wetland treatment efficiency, and hydrological models		for integrated water resource management.	L4
4	Apply	water harvesting techniques, hydrologic modeling, and wetland design methods		for sustainable watershed management	L3
5	Understand	irrigation water management strategies, drought mitigation policies, and the role of water foot print		in agricultural sustainability.	L2

UNIT-I

Concept of Watershed, Introduction to Watershed Management, Different Stakeholders and Their Relative Importance, Watershed Management Policies and Decision Making, Watershed Management Practices in Arid and Semiarid Regions, Short Term and Long Term Strategic Planning, Types and Sources of Pollution, Environmental Guidelines for Water Quality, Perspective On Recycle and Reuse

UNIT-II

Morphometry, Soil Erosion - Erosion - Factors Affecting Erosion, Effects of Erosion on Land Fertility and Land Capability, Soil Erosion Modelling, Erosivity and Erodibility - Sediment Yield and Sedimentation- Wetland Definitions and The Role of Water in Wetland Structure and Function, Introduction to Wetland Water Budgets and Hydro-Period Components of The Water Budget: Inflows, Outflows, and Storage, Precipitation and Runoff, Evapotranspiration;

UNIT-III

Surface Water Flows: Structures and Channels, Groundwater-Surface Water Exchange in Wetlands, Surface Water Flows Ii and Wetland Hydrology Case Studies, Flow and Mixing in Wetlands Wetland Water Quality Information: Nutrients, Organic/Inorganic Contaminants, Sediments and Colloids, Wetland Transport Models I: Plug Flow, Cstrs and Cstrs in Series; Intro to Method of Moments.

UNIT-IV

Wetland Hydrologic Assessment: Physical and Biological Processes, Anthropogenic and Climate Change Impacts On Wetland Hydrology, Modeling Wetland Hydrology, Hydraulics, and Hydrodynamics, Introduction to Wetland Treatment Systems Design - Water Harvesting: Rainwater Harvesting, Catchment Harvesting, Harvesting Structures - Model Watershed – Government and Ngo Projects.
UNIT-V
Rain Water Management. Planning and Operation of Irrigation Systems. Conjunctive Use of Water. Participatory Irrigation Management and Integrated Water Resources Management (IWRM), Water Management Policy During Droughts. Predicting Effect of Water Shortage on Crops. Introduction to Water Footprint of Crops and Its Applications. Blue, Green and Grey Water Foot Print.

TEXTBOOKS:

1. T. O. Randhir, Watershed Management: Issues and Approaches, IWA Publishing, 2006
2. J. V. S. Murty, Watershed Management, New Age International, 2013

REFERENCES:

1. D. K. Majumdar, Irrigation Water Management, Prentice Hall, 2014
2. K. N. Brooks, P. F. Folliott, J. A. Magner, Hydrology and the Management of Watersheds, Wiley-Blackwell, Fourth edition, 2012
3. E. M. Tideman, Watershed Management: Guidelines for Indian Conditions, Omega Scientific Publishers, 1996
4. R. Rajora, Integrated Watershed Management: Field Manual for Equitable, Productive and Sustainable Development, Rawat Publications, 2019

WEB RESOURCES:

https://nptel.ac.in/courses/105101010
https://nptel.ac.in/courses/126105334

CORRELATION OF COS WITH THE POS & PSOS:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2				2							
CO2	2	3		3		3							
CO3	2	3		3		3							
CO4	3	2				2							
CO5	2	2				2							

CO-PO MAPPING JUSTIFICATION:

Unit No	Course Outcomes					Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
	Lesson Plan Hrs	%	Correlation	CO's Action Verb	BTL			
1				Understand	L2	PO1 PO2 PO6	Apply (L3) Analyze (L4) Thumb Rule	2 2 2
2				Analyze	L4	PO1 PO2 PO4 PO6	Apply (L3) Analyze (L4) Analyze (L4) Thumb Rule	2 3 3 3
3				Analyze	L4	PO1 PO2 PO4 PO6	Apply (L3) Analyze (L4) Analyze (L4) Thumb Rule	2 3 3 3
4				Apply	L3	PO1 PO2 PO6	Apply (L3) Analyze (L4) Thumb Rule	3 2 2
5				Understand	L2	PO1 PO2 PO6	Apply (L3) Analyze (L4) Thumb Rule	2 2 2

JUSTIFICATION STATEMENTS:

CO1: **Understand the concept of watershed management, stakeholder roles, pollution sources, and environmental guidelines for water quality**
Action Verb: Understand (L2)
PO1: Apply(L3)
CO1 Action Verb is less than PO1 verb by one level; Therefore, correlation is moderate (2).
PO2: Analyze (L4)
CO1 Action Verb is less than PO2 verb by one level; Therefore, correlation is moderate (2).
CO1 Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO6 as moderate (2).

CO2: **Analyze soil erosion processes, sediment yield, and wetland hydrology, including the role of water in wetland ecosystems**
Action Verb: Analyze (L4)
PO1: Apply(L3)
CO2 Action verb is greater than PO1 verb. Therefore, the correlation is moderate (3)
PO2: Analyze (L4)
CO2 Action verb is equal to PO2 verb. Therefore, the correlation is high (3)
PO 4: Analysis (L4)
CO2 Action Verb is equal to PO4; Therefore, correlation is high (3)
CO2 Action Verb Analyze is of BTL 4. Using Thumb rule, L4 correlates PO6 as high (3).

CO3: **Analyze surface and groundwater interactions, wetland treatment efficiency, and hydrological models for integrated water resource management.**
Action Verb: Analyze (L4)
PO1: Apply(L3)
CO3 Action verb is greater than PO1 verb. Therefore, the correlation is moderate (3)
PO2: Analyze (L4)
CO3 Action verb is equal to PO2 verb. Therefore, the correlation is high (3)
PO 4: Analysis (L4)
CO3 Action Verb is equal to PO4; Therefore, correlation is high (3)
CO3 Action Verb Analyze is of BTL 4. Using Thumb rule, L4 correlates PO6 as high (3).

CO4: **Apply water harvesting techniques, hydrologic modeling, and wetland design methods for sustainable watershed management.**
Action Verb: Apply (L3)
PO1: Apply(L3)
CO4 Action verb is equal to PO1 verb. Therefore, the correlation is high (3)
PO2: Analyze (L4)
CO4: Action Verb is low to PO2 verb. Therefore, the correlation is medium (2)
CO4 Action verb Apply is of BTL 3. Using Thumb rule, L3 correlates PO6 as moderate (2).

CO5: Understand the concept of watershed management, stakeholder roles, pollution sources, and environmental guidelines for water quality
Action Verb: Understand (L2)
PO1: Apply(L3)
CO5 Action Verb is less than PO1 verb by one level; Therefore, correlation is moderate (2).
PO2: Analyze (L4)
CO5 Action Verb is less than PO2 verb by one level; Therefore, correlation is moderate (2).
CO5 Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO6 as moderate (2)

III YEAR II SEMESTER

Subject Code	Subject Name	L	T/CLC	P	CREDITS
23APE0109	ADVANCED STRUCTURAL ANALYSIS (PE – III)	2	1	0	3

Course Outcomes: After studying the course, students will be able to

CO1	Analyze the three and two hinged arches for different loading conditions
CO2	Analyze the frames using moment distribution method
CO3	Analyze the beams and frames using Kani's method
CO4	Analyze the beams using flexibility method
CO5	Analyze the beams using Stiffness methods

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Analyze	the three and two hinged arches	for different loading conditions		L4
2	Analyze	the frames		using moment distribution method	L4
3	Analyze	the frames and beams		using Kani's method	L4
4	Analyze	the beams		using flexibility method	L4
5	Analyze	the beams		using Stiffness methods	L4

UNIT-I

ARCHES: Three Hinged and Two Hinged Arches, Elastic Theory of Arches– Eddy's Theorem –Determination of Horizontal Thrust, Bending Moment, Normal Thrust and Radial Shear–Effect of Temperature-Determination of Horizontal Thrust Bending Moment, Normal Thrust and Radial Shear–Rib Shortening and Temperature Stresses.

UNIT-II

MOMENT DISTRIBUTION METHOD for FRAMES: -Analysis of Single Bay Single Storey Portal Frame Including Sides Way–Substitute Frame Analysis by Two Cycle Method.

UNIT-III

KANI`S METHOD: - Analysis of Continuous Beams with and Without Settlement of Supports-Single Bay Single Storey Portal Frames with and Without Side Sway.

UNIT-IV

FLEXIBILITY METHODS: Flexibility Methods- Introduction-Application to Continuous Beams Including Support Settlements—Analysis of Single Bay Single Storey Portal Frames Without and With Side Sway.

UNIT-V

STIFFNESS METHODS: Stiffness Methods – Introduction – Application to Continuous Beams Including Support Settlements – Analysis of Single Bay Single Storey Portal Frames Without and With Side Sway.

TEXTBOOKS:

1. Analysis of structures by Vazrani & Ratwani– Khanna Publications.
2. Theory of structures by Ramamuratam, jain book depot, New Delhi.

REFERENCES:

1. Structural analysis by R.S.Khurmi, S.Chand Publications, New Delhi.
2. Basic Structural Analysis by K.U.Muthuetal ., I.K. International Publishing House Pvt .Ltd
3. Theoryof Structures by Gupta SP, GSPundit and R Gupta,Vol II, Tata McGraw Hill Publications Company
4. D. S. Prakash Rao,―Structural Analysis: A Unified Approach‖, Universities Press

WEB RESOURCES:

https://archive.nptel.ac.in/courses/105/106/105106050/

CORRELATION OF COS WITH THE POS & PSOS:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	3		3		3						2	3
CO2	2	3		3		3						2	3
CO3	2	3		3		3						2	3
CO4	2	3		3		3						2	3
CO5	3	2				2						2	3

CO-PO MAPPING JUSTIFICATION:

Unit No	Course Outcomes					Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
	Lesson Plan Hrs	%	Correlation	CO's Action Verb	BTL			
1	17	20	3	Analyze	L4	PO1 PO2 PO4 PO6	Apply (L3) Analyze (L4) Analyze (L4) Thumb Rule	2 3 3 3
2	17	20	3	Analyze	L4	PO1 PO2 PO4 PO6	Apply (L3) Analyze (L4) Analyze (L4) Thumb Rule	2 3 3 3
3	17	20	3	Analyze	L4	PO1 PO2 PO4 PO6	Apply (L3) Analyze (L4) Analyze (L4) Thumb Rule	2 3 3 3
4	17	20	3	Analyze	L4	PO1 PO2 PO4 PO6	Apply (L3) Analyze (L4) Analyze (L4) Thumb Rule	2 3 3 3
5	17	20	3	Analyze	L4	PO1 PO2 PO4 PO6	Apply (L3) Analyze (L4) Analyze (L4) Thumb Rule	2 3 3 3

JUSTIFICATION STATEMENTS:

CO1: Analyze the two and three hinged arches for different loading conditions.
Action Verb: Analyze (L4)
PO1: Apply(L3) CO1 Action verb is greater than PO1 verb. Therefore, the correlation is moderate (2)
PO2: Analyze (L4) CO1 Action verb is equal to PO2 verb. Therefore, the correlation is high (3)
PO 4: Analysis (L4) CO1 Action Verb is equal to PO4; Therefore, correlation is high (3)
CO1 Action Verb Analyze is of BTL 4. Using Thumb rule, L4 correlates PO6 as high (3).

CO2: Analyze the frames using moment distribution method
Action Verb: Analyze (L4)
PO1: Apply(L3) CO2 Action verb is greater than PO1 verb. Therefore, the correlation is moderate (2)
PO2: Analyze (L4) CO2 Action verb is equal to PO2 verb. Therefore, the correlation is high (3)
PO 4: Analysis (L4) CO2 Action Verb is equal to PO4; Therefore, correlation is high (3)
CO2 Action Verb Analyze is of BTL 4. Using Thumb rule, L4 correlates PO6 as high (3).

CO3: Analyze the beams and frames using Kani's method
Action Verb: Analyze (L4)
PO1: Apply(L3) CO3 Action verb is greater than PO1 verb. Therefore, the correlation is h moderate (2)
PO2: Analyze (L4) CO3 Action verb is equal to PO2 verb. Therefore, the correlation is high (3)
PO 4: Analysis (L4) CO3 Action Verb is equal to PO4; Therefore, correlation is high (3)
CO3 Action Verb Analyze is of BTL 4. Using Thumb rule, L4 correlates PO6 as high (3).

CO4: Analyze the beams using flexibility method
Action Verb: Analyze (L4)
PO1: Apply(L3) CO4 Action verb is greater than PO1 verb. Therefore, the correlation is moderate (2)
PO2: Analyze (L4) CO4 Action verb is equal to PO2 verb. Therefore, the correlation is high (3)
PO 4: Analysis (L4) CO4 Action Verb is equal to PO4; Therefore, correlation is high (3)
CO4 Action Verb Analyze is of BTL 4. Using Thumb rule, L4 correlates PO6 as high (3).

CO5: Analyze the beams using stiffness method
Action Verb: Analyze (L4)
PO1: Apply(L3) CO5 Action verb is greater than PO1 verb. Therefore, the correlation is moderate (2)
PO2: Analyze (L4) CO5 Action verb is equal to PO2 verb. Therefore, the correlation is high (3)
PO 4: Analysis (L4) CO5 Action Verb is equal to PO4; Therefore, correlation is high (3)
CO5 Action Verb Analyze is of BTL 4. Using Thumb rule, L4 correlates PO6 as high (3).

III YEAR II SEMESTER

Subject Code	Subject Name	L	T/CLC	P	CREDITS
23AOE0202	RENEWABLE ENERGY SOURCES (OE – II)	2	1	0	3

Course Outcomes: After studying the course, students will be able to

CO1	Understand solar radiation concepts, solar angles, and solar energy collection and storage methods.
CO2	Analyze the working principles, technologies, characteristics, and configurations of solar PV systems.
CO3	Analyze the components, design, and performance factors of wind energy conversion systems.
CO4	Understand Geothermal energy sources, applications, and their potential in India.
CO5	Understand the working principles, technologies, and limitations of ocean, biomass, and fuel cell energy systems.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Understand	Solar radiation concepts, solar angles, and solar energy collection and storage methods			L2
2	Analyze	Working principles, technologies, characteristics, and configurations of solar PV systems			L4
3	Analyze	Components, design, and performance factors of wind energy conversion systems			L4
4	Understand	Geothermal energy sources, applications, and potential in India			L2
5	Understand	Working principles, technologies, and limitations of ocean, biomass, and fuel cell energy systems			L2

SYLLABUS

UNIT-I

TITLE: Solar Energy

Solar radiation - beam and diffuse radiation, solar constant, Sun at Zenith, attenuation and measurement of solar radiation, local solar time, derived solar angles, sunrise, sunset and day length. Flat plate collectors, concentrating collectors, storage of solar energy-thermal storage.

UNIT-II

TITLE: PV Energy Systems

Introduction, The PV effect in crystalline silicon basic principles, the film PV, Other PV technologies, Solar PV modules from solar cells, mismatch in series and parallel connections design and structure of PV modules, Electrical characteristics of silicon PV cells and modules, Stand-alone PV system configuration, Grid connected PV systems.

UNIT-III

TITLE: Wind Energy

Principle of wind energy conversion; Basic components of wind energy conversion systems; wind mill components, various types and their constructional features; design considerations of horizontal and vertical axis wind machines: analysis of aerodynamic forces acting on wind mill blades; wind data and energy estimation and site selection considerations.

UNIT-IV

TITLE : **Geothermal Energy**

Estimation and nature of geothermal energy, geothermal sources and resources like hydrothermal, geo- pressured hot dry rock, magma. Advantages, disadvantages and application of geothermal energy, prospects of geothermal energy in India.

UNIT-V

TITLE: Miscellaneous Energy Technologies

Ocean Energy: Tidal Energy-Principle of working, Operation methods, advantages and limitations. Wave Energy-Principle of working, energy and power from waves, wave energy conversion devices, advantages and limitations.

Bio mass Energy: Biomass conversion technologies, Biogas generation plants, Classification, advantages and disadvantages, constructional details, site selection, digester design consideration.

Fuel cell: Principle of working of various types of fuel cells and their working, performance and limitations.

Text books:	
1	G. D. Rai, ―Non-Conventional Energy Sources‖, 4th Edition, Khanna Publishers, 2000.
2	Chetan Singh Solanki ―Solar Photovoltaics fundamentals, technologies and applications‖ 2nd Edition PHI Learning Private Limited. 2012.
Reference books:	
1	Stephen Peake, ―Renewable Energy Power for a Sustainable Future‖, Oxford International Edition, 2018.
2	S. P. Sukhatme, ―Solar Energy‖, 3rd Edition, Tata Mc Graw Hill Education Pvt. Ltd, 2008.
3	B H Khan, ― Non-Conventional Energy Resources‖, 2nd Edition, Tata Mc Graw Hill Education Pvt Ltd, 2011.
4	S. Hasan Saeed and D.K.Sharma, ―Non-Conventional Energy Resources‖, 3rd Edition, S.K.Kataria& Sons, 2012.
5	G. N. Tiwari and M.K.Ghosal, ―Renewable Energy Resource: Basic Principles and Applications‖, Narosa Publishing House, 2004.
Web Resources:	
1	https://nptel.ac.in/courses/103103206
2	https://nptel.ac.in/courses/108108078

CORRELATION OF COS WITH THE POS & PSOS:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	1		1		1						3	2
CO2	3	3	1			3						3	3
CO3	3	3	1			3						3	3
CO4	2					1						2	2
CO5	2					1						2	2

CO-PO MAPPING JUSTIFICATION:

Unit No	Course Outcomes					Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
	Lesson Plan Hrs	%	Correlation	CO's Action Verb	BTL			
1				Understand	L2	PO1, PO2, PO4, PO6	PO1:Apply(L3) PO2:Analyze(L4) PO4:Analyze(L4) PO6: Analyze(L4)	2 1 1 1
2				Analyze	L4	PO1, PO2, PO3, PO6	PO1:Apply(L3) PO2:Analyze(L4) PO3:Design(L6) PO6:Analyze(L4)	3 3 1 3
3				Analyze	L4	PO1, PO2, PO3, PO6	PO1:Apply(L3) PO2:Analyze(L4) PO3:DesignL6) PO6:Analyze(L4)	3 3 1 3
4				Understand	L2	PO1, PO6	PO1:Apply(L3) PO6:Analyze(L4)	2 1
5				Understand	L2	PO1, PO6	PO1:Apply(L3) PO6:Analyze(L4)	2 1

JUSTIFICATION STATEMENTS:

CO1: Understand solar radiation concepts, solar angles, and solar energy collection and storage methods.
Action Verb: Understand (L2)
PO1Verbs: Apply (L3)
CO1 ActionVerb is less than PO1 verb by one level; Therefore, correlation is Moderate (2).
PO2 Verbs: Analyze (L4)
CO1 ActionVerb is Less than PO2 verb by two level; Therefore, correlation is low (1).
PO4 Verbs: Analyze (L4)
CO1 ActionVerb is Less than PO2 verb by two level; Therefore, correlation is low (1).
PO6 Verbs: Analyze (L4)
CO1 ActionVerb is Less than PO2 verb by two level; Therefore, correlation is low (1).

CO2: Analyze the working principles, technologies, characteristics, and configurations of solar PV systems.
Action Verb: Analyze (L4)
PO1Verbs: Apply (L3)
CO2 ActionVerb is Greater than PO1 verb by one level; Therefore, correlation is High (3).
PO2 Verbs: Analyze (L4)
CO2 ActionVerb is Same to PO2 verb ; Therefore, correlation is High (3).
PO3Verbs: Design (L6)
CO2 ActionVerb is Less than PO2 verb by two level; Therefore, correlation is low (1).
PO6 Verbs:Analyze (L4)
CO2 ActionVerb is Same to PO6 verb ; Therefore, correlation is High (3).

CO3: Analyze the components, design, and performance factors of wind energy conversion systems.
Action Verb: Analyze (L4)
PO1Verbs: Apply (L3)
CO3 ActionVerb is Greater than PO1 verb by one level; Therefore, correlation is High (3).
PO2 Verbs: Analyze (L4)
CO3 ActionVerb is Same to PO2 verb ; Therefore, correlation is High (3).
PO3Verbs: Design (L6)
CO3 ActionVerb is Less than PO2 verb by two level; Therefore, correlation is low (1).
PO6 Verbs:Analyze (L4)
CO3 ActionVerb is Same to PO6 verb ; Therefore, correlation is High (3).

CO4: Understand Geothermal energy sources, applications, and their potential in India.
Action Verb: Understand (L2)
PO1Verbs: Apply (L3)
CO4 ActionVerb is less than PO1 verb by one level; Therefore, correlation is Moderate (2).
PO6 Verbs: Analyze (L4)
CO4 ActionVerb is less than PO2 verb by two level; Therefore, correlation is low (1).

CO5: Understand the working principles, technologies, and limitations of ocean, biomass, and fuel cell energy systems.
Action Verb: Understand (L2)
PO1Verbs: Apply (L3)
CO4 ActionVerb is less than PO1 verb by one level; Therefore, correlation is Moderate (2).
PO6 Verbs: Analyze (L4)
CO4 ActionVerb is less than PO2 verb by two level; Therefore, correlation is low (1).

III YEAR II SEMESTER

Subject Code	Subject Name	L	T/CLC	P	CREDITS
23APE0322	**AUTOMATION AND ROBOTICS (OE – II)**	2	1	0	3

Course Outcomes: After studying the course, students will be able to

CO1	Explain the need, types, and elements of automation systems and analyze different levels of automation strategies in industry.
CO2	Demonstrate the operation of automated flow lines and apply methods for assembly line balancing and optimization.
CO3	Identify robotic components and describe their configuration, degrees of freedom, and industrial applications in various processes.
CO4	Apply transformation techniques and D-H notation to solve problems in robot kinematics and evaluate actuator and sensor selection.
CO5	Analyze robot dynamics using Jacobians and Euler formulations and develop suitable trajectories for obstacle-free motion.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Understand	structure and functions of automated		manufacturing systems	L2
2	Analyze	automated flow lines with or without buffer storage		assembly line balancing	L3
3	Understand	robot configurations	production efficiency		L2
4	Apply	kinematic and dynamic modeling		real-world industrial scenario	L3
5	Create	program, and implement robotic systems		Manufacturing.	L6

UNIT-I

Introduction to Automation: Introduction to Automation, Need, Types, Basic elements of an automated system, Manufacturing Industries, Types of production, Functions in manufacturing, Organization and information processing in manufacturing, Automation strategies and levels of automation, Hardware components for automation and process control, mechanical feeders, hoppers, orienters, high speed automatic insertion devices.

UNIT-II

Automated flow lines: Automated flow lines, Part transfer methods and mechanisms, types of Flow lines, flow line with/without buffer storage, Quantitative analysis of flow lines. Assembly line balancing: Assembly process and systems assembly line, line balancing methods, ways of improving line balance, flexible assembly lines.

UNIT-III

Introduction to Industrial Robotics: Introduction to Industrial Robotics, Classification of Robot Configurations, functional line diagram, degrees of freedom. Components common types of arms, joints grippers, factors to be considered in the design of grippers. Robot actuators and Feedback components: Actuators, Pneumatic, Hydraulic actuators, Electric & Stepper motors, comparison. Position sensors - potentiometers, resolvers, encoders - velocity sensors, Tactile sensors, Proximity sensors.

UNIT-IV

Manipulator Kinematics: Manipulator Kinematics, Homogenous transformations as applicable to rotation and transition - D-H notation, Forward inverse kinematics. Manipulator Dynamics: Differential transformations, Jacobians, Lagrange - Euler and Newton – Euler formations. Trajectory Planning: Trajectory Planning and avoidance of obstacles path planning, skew motion, joint integrated motion - straight line motion.

UNIT-V

Robot Programming: Robot Programming, Methods of programming - requirements and features of programming languages, software packages. Problems with programming languages. Robot Application in

Manufacturing: Material Transfer - Material handling, loading and unloading - Process - spot and continuous arc welding & spray painting - Assembly and Inspection.

Text Books:

1. Automation, Production systems and CIM, M.P. Groover /4thEdition, Pearson education (2016)
2. Industrial Robotics - M.P. Groover, TMH (1996)

Reference Books:

1. Robotics, Fu K S, McGraw Hill, 4th edition, 2010.
2. An Introduction to Robot Technology, P. Coiffet and M. Chaironze, Kogam Page Ltd. 1983 London.
3. Robotic Engineering, Richard D. Klafter, Prentice Hall
4. Robotics, Fundamental Concepts and analysis – Ashitave Ghosal, Oxford Press, 1/e, 2006

Robotics and Control, Mittal R K & Nagrath I J, TMH

CORRELATION OF COS WITH THE POS & PSOS:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3				3							
CO2	3	3											
CO3	3	3			3	2							
CO4	3	3	3		2								
CO5	3	3			3	1							

CO-PO MAPPING JUSTIFICATION:

Unit No	Course Outcomes					Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
	Lesson Plan Hrs	%	Correlation	CO's Action Verb	BTL			
1				Understand	L2	PO1 PO2 PO6	Apply (L3) Identify (L3) Develop (L3)	2 2 2
2				Analyze	L3	PO1 PO2	Apply (L3) Identify (L3)	3 3
3				Understand	L2	PO1 PO2 PO5 PO6	Apply (L3) Identify (L3) Select (L1) Apply (L3)	2 2 3 2
4				Apply	L3	PO1 PO2 PO3 PO5	Apply (L3) Identify (L3) Create (L6) Create (L6)	3 3 3 3
5				Create	L6	PO1 PO2 PO5 PO6	Apply (L3) Identify (L3) Create (L6) Apply (L3)	3 3 3 3

JUSTIFICATION STATEMENTS:

CO1: Understand the structure and functions of automated manufacturing systems for efficient production.
Action Verb: Understand (L2)
PO1 Verb: **Apply (L3)**
CO1 Action verb is same level as PO1 verb. Therefore, the correlation is high (3)
PO2 Verb: **Identify (L3)**
CO1: Action verb is same level (greater) as PO2 verb. Therefore, the correlation is high (3)
PO6 Verb: **Develop (L3)**
CO1 Action verb is same level as PO6 verb. Therefore, the correlation is high (3)
CO2: Analyze automated flow lines with or without buffer storage, perform quantitative evaluations, assembly line balancing techniques.
Action Verb: Understand (L2)

PO1 Verb: **Apply (L3)**
CO2: Action verb is same level (greater) as PO1 verb. Therefore, the correlation is high (3)
PO2 Verb: **Identify (L3)**
CO2: Action verb is same level (greater) as PO2 verb. Therefore, the correlation is high (3)
CO3: Understand robot configurations and select suitable actuators and sensors to optimize production efficiency and flexibility.
Action Verb: **Creating (L6)**
PO1 Verb: **Apply (L3)**
CO3: Action verb is same level (greater) as PO1 verb. Therefore, the correlation is high (3)
PO2 Verb: **Identify (L3)**
CO3: Action verb is same level (greater) as PO2 verb. Therefore, the correlation is high (3)
PO5 Verb: **select (L6)**
CO3: Action verb is same level as PO3 verb. Therefore, the correlation is high (3)
PO6 Verb: **Apply (L3)**
CO3: Action verb is same level (greater) as PO1 verb. Therefore, the correlation is high (3)

CO4: Apply kinematic and dynamic modeling using D-H notation and select appropriate hardware and control strategies for real-world industrial scenario.
Action Verb: **Evaluate (L5)**
PO1 Verb: **Apply (L3)**
CO2: Action verb is same level (greater) as PO1 verb. Therefore, the correlation is high (3)
PO2 Verb: **Identify (L3)**
CO2: Action verb is same level (greater) as PO2 verb. Therefore, the correlation is high (3)
PO3 Verb: **Creating (L6)**
CO3: Action verb is same level as PO3 verb. Therefore, the correlation is high (3)
PO5 Verb: **Creating (L6)**
CO3: Action verb is same level as PO5 verb. Therefore, the correlation is high (3)
CO5: Create program, and implement robotic systems to perform manufacturing tasks.
Action Verb: **Creating (L6)**
PO1 Verb: **Apply (L3)**
CO2: Action verb is same level (greater) as PO1 verb. Therefore, the correlation is high (3)
PO2 Verb: **Identify (L3)**
CO2: Action verb is same level (greater) as PO2 verb. Therefore, the correlation is high (3)
PO5 Verb: **Creating (L6)**
CO3: Action verb is same level as PO3 verb. Therefore, the correlation is high (3)
PO6 Verb: **apply (L3)**

CO3: Action verb is same level as PO6 verb. Therefore, the correlation is high (3)

III YEAR II SEMESTER

Subject Code	Subject Name	L	T/CLC	P	CREDITS
23AOE0402	DIGITAL ELECTRONICS (OE – II)	2	1	0	3

Course Outcomes: After studying the course, students will be able to

CO1	Understand the logic gates and minimization of Boolean functions using K-Maps
CO2	Analyze the design procedure of Arithmetic circuits and code conversions using logic gates
CO3	Analyze the design concepts of combinational logic circuits using logic gates.
CO4	Analyze the design aspects of sequential logic circuits using flip flops.
CO5	Understand various programmable logic devices and digital ICs.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	the logic gates and minimization of Boolean functions using K-Maps.	using K-Maps		L2
CO2	Analyze	the design procedure of Arithmetic circuits and code conversions using gates.	using logic gates.		L4
CO3	Analyze	the design concepts of combinational logic circuits	using logic gates.		L4
CO4	Analyze	the design aspects of sequential logic circuits using flip flops.	using flip flops.		L4
CO5	Understand	various programmable logic devices and digital ICs.			L2

UNIT - I		21Hrs
Logic Simplification and Combinational Logic Design: Review of Boolean Algebra and De Morgan's Theorem, SOP & POS forms, Canonical forms, Introduction to Logic Gates, Ex-OR, Ex-NOR operations, Minimization of Switching Functions: Karnaugh map method, Logic function realization: AND-OR, OR-AND and NAND/NOR realizations.		
UNIT - II		12Hrs
Introduction to Combinational Design 1: Binary Adders, Subtractors and BCD adder, Code converters - Binary to Gray, Gray to Binary, BCD to excess3, BCD to Seven Segment display		
UNIT - III		19Hrs
Combinational Logic Design 2: Decoders, Encoders, Priority Encoder, Multiplexers, Demultiplexers, Comparators, Implementations of Logic Functions using Decoders and Multiplexers.		
UNIT - IV		12Hrs
Sequential Logic Design: Latches, Flip-flops, S-R, D, T, JK and Master-Slave JK FF, Edge triggered FF, set up and hold times, Ripple counters, Shift registers		
UNIT - V		11Hrs
Programmable Logic Devices: ROM, Programmable Logic Devices (PLA and PAL). **Digital IC's:** Decoder (74x138), Priority Encoder (74x148), multiplexer (74x151) and de- multiplexer (74x155), comparator (74x85).		
Textbooks:		
1. Digital Design, M.Morris Mano & Michel D. Ciletti, 5th Edition, Pearson Education, 1999. 2. Switching theory and Finite Automata Theory, ZviKohavi and NirahK.Jha, 2nd Edition, Tata McGraw Hill, 2005.		
Reference Books:		
1. Fundamentals of Logic Design, Charles H Roth,Jr., 5th Edition, Brooks/cole Cengage Learning, 2004		
Online Learning Resources:		
Nptel videos		

Mapping of Course Outcomes with Program Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	1									2	
CO2	3	3	3	3									2	2
CO3	3	3	3	3									2	2
CO4	3		3	3									3	2
CO5	2	2	2										2	3

Correlation matrix

Unit No.	CO					(PO)	PO(s) : Action Verb and BTL(for PO1 to PO12)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Correlation	Co's Action verb	BTL			
1	14	18%	2	Understand	L2	PO1 PO2 PO3 PO4	PO1: Apply (L3) PO2: Identify (L3) PO3: Develop (L3) PO4: Analyze (L4)	2 2 2 1
2	18	23%	4	Analyze	L4	PO1 PO2 PO3 PO4	PO1: Apply (L3) PO2: Identify (L3) PO3: Develop (L3) PO4: Analyze(L4)	3 3 3 3
3	14	18%	4	Analyze	L4	PO1 PO2 PO3 PO4	PO1: Apply (L3) PO2: Identify (L3) PO3: Develop (L3) PO4: Analyze(L4)	3 3 3 3
4	16	21%	4	Analyze	L4	PO1 PO3 PO4	PO1: Apply (L3) PO3: Develop (L3) PO4: Analyze(L4)	3 3 3
5	16	20%	2	Understand	L2	PO1 PO2 PO3	PO1: Apply (L3) PO2: Identify (L3) PO3: Develop (L3)	2 2 2
	76	100%						

Justification Statements:

CO1: Understand the logic gates and minimization of Boolean functions using K-Maps.

Action Verb: Understand (L2)

PO1 Verbs: Apply (L3) CO1 Action Verb is less than PO1 verb by one level; Therefore, correlation is moderate (2).
PO2 Verbs: Identify (L3) CO1 Action Verb is less than PO2 verb by one level; Therefore, correlation is moderate (2).
PO3 Verbs: Develop (L3) CO1 Action Verb is less than PO3 verb by one level; Therefore, correlation is moderate (2).
PO4 Verbs: Analyze (L4) CO1 Action verb is less than PO4 verb by two levels. Therefore, the correlation is low (1)

CO2: Analyze the design procedure of Arithmetic circuits and code conversions using logic gates.

Action Verb: Analyze (L4)

PO1 Verbs: Apply (L3) CO2 Action verb is more than PO1 verb by one level. Therefore, the correlation is high (3)
PO2 Verbs: Identify (L3) CO2 Action verb is more than PO2 verb by one level. Therefore, the correlation is high (3)
PO3 Verbs: Develop (L3) CO2 Action verb is more than PO3 verb by one level. Therefore, the correlation is high (3)
PO4 Verbs: Analyze (L4) CO2 Action Verb is equal to PO4 verb; Therefore, correlation is high (3).

CO3: Analyze the design concepts of combinational logic circuits using logic gates.

Action Verb: Analyze (L4)

PO1 Verbs: CO3 Action verb is more than PO1 verb by one level. Therefore, the correlation is high (3).
PO2 Verbs: CO3 Action verb is more than PO2 verb by one level. Therefore, the correlation is high (3).
PO3 Verb: CO3 Action verb is more than PO3 verb by one level. Therefore, the correlation is high (3).
PO4 Verbs: CO3 Action Verb is equal to PO4 verb, therefore correlation is high (3).

CO4: Analyze the design aspects of sequential logic circuits using flip flops.

Action Verb: Analyze (L4)

PO1 Verbs: Apply (L3) CO4 Action verb is more than PO1 verb by one level. Therefore, the correlation is high (3).
PO2 Verb: Identify (L3) CO4 Action verb is more than PO3 verb by one level. Therefore, the correlation is high (3).
PO4 Verb: Develop (L3) CO4 Action Verb is equal to PO4 verb; Therefore, correlation is high (3).

CO5: Understand various programmable logic devices and digital ICs.

Action Verb: Understand (L2)

PO1 Verb: CO5 Action Verb is less than PO1 verb by one level; Therefore, correlation is moderate (2).
PO2 verb: CO5 Action Verb is less than PO2 verb by one level; Therefore, correlation is moderate (2).
PO3 verb: CO5 Action Verb is less than PO3 verb by one level; Therefore, correlation is moderate (2).

III YEAR II SEMESTER

Subject Code	Subject Name	L	T/CLC	P	CREDITS
23AOE0504	OPERATING SYSTEMS (OE – II)	2	1	0	3

Course Outcomes: After studying the course, students will be able to

CO1	**Understand** the basic concepts of Operating Systems and its services
CO2	**Apply** the concepts of process synchronization and CPU scheduling by drawing Gantt chart
CO3	**Analyze** the memory management and its allocation policies.
CO4	**Apply** the different conditions for deadlock handling and solve various disk scheduling algorithms.
CO5	**Understand** the various System Security and Protection mechanisms.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	**Understand**	the basic concepts of Operating Systems and its services			L2
CO2	**Apply**	the concepts of process synchronization and CPU scheduling	by drawing Gantt chart		L3
CO3	**Analyze**	the memory management and its allocation policies			L4
CO4	**Apply**	the different conditions		for deadlock handling	L3
CO5	**Understand**	The various System Security and Protection mechanisms.			L2

UNIT – I	**Operating Systems Overview, System Structures**	8 Hrs
Operating Systems Overview: Introduction, Operating system functions, Operating systems operations, Computing environments, Open-Source Operating Systems System Structures: Operating System Services, User and Operating-System Interface, systems calls, Types of System Calls, system programs, Operating system Design and Implementation, Operating system structure, Operating system debugging, System Boot.		
UNIT – II	**Process Concept, Multithreaded Programming, Process Scheduling, Inter-process Communication**	10 Hrs
Process Concept: Process scheduling, Operations on processes, Inter-process communication, Communication in client server systems. Multithreaded Programming: Multithreading models, Thread libraries, Threading issues, Examples. Process Scheduling: Basic concepts, Scheduling criteria, Scheduling algorithms, Multiple processor scheduling, Thread scheduling, Examples. Inter-process Communication: Race conditions, Critical Regions, Mutual exclusion with busy waiting, Sleep and wakeup, Semaphores, Mutexes, Monitors, Message passing, Barriers, Classical IPC Problems - Dining philosophers problem, Readers and writers problem.		
UNIT – III	**Memory-Management Strategies, Virtual Memory Management**	8 Hrs
Memory-Management Strategies: Introduction, Swapping, Contiguous memory allocation, Paging, Segmentation, Examples. Virtual Memory Management: Introduction, Demand paging, Copy on-write, Page replacement, Frame allocation, Thrashing, Memory-mapped files, Kernel memory allocation, Examples.		
UNIT – IV	**Deadlocks, File Systems**	9 Hrs
Deadlocks: Resources, Conditions for resource deadlocks, Ostrich algorithm, Deadlock detection And recovery, Deadlock avoidance, Deadlock prevention. File Systems: Files, Directories, File system implementation, management and optimization. Secondary-Storage Structure: Overview of disk structure, and attachment, Disk scheduling, RAID structure, Stable storage implementation.		
UNIT – V	**System Protection, System Security**	8 Hrs
System Protection: Goals of protection, Principles and domain of protection, Access matrix, Access control, Revocation of access rights. System Security: Introduction, Program threats, System and network threats, Cryptography as a security, User authentication, implementing security defenses, firewalling to protect systems and networks, Computer security classification. Case Studies: Linux, Microsoft Windows		

Textbooks:

1. Silberschatz A, Galvin P B, and Gagne G, Operating System Concepts, 9th edition, Wiley, 2016.
2. Tanenbaum A S, Modern Operating Systems, 3rd edition, Pearson Education, 2008. (Topics: Interprocess Communication and File systems.)

Reference Books:

1. Tanenbaum A S, Woodhull A S, Operating Systems Design and Implementation, 3rd edition, PHI, 2006.
2. Dhamdhere D M, Operating Systems A Concept Based Approach, 3rd edition, Tata McGraw Hill, 2012.
3. Stallings W, Operating Systems -Internals and Design Principles, 6th edition, Pearson Education, 2009
4. Nutt G, Operating Systems, 3rd edition, Pearson Education, 2004

Online Learning Resources:
1.https://nptel.ac.in/courses/106/106/106106144/
2.http://peterindia.net/OperatingSystems.html

Mapping of Course Outcomes with Program Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3									2			
CO2	3	3				2					3			
CO3	3	3		3	3	3								
CO4	3	3	3	2	3	2	2				2			
CO5	2	3					3				2			

Correlation matrix

Unit No.	CO					Program Outcome (PO)	PO(s) : Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Correlation	Co"s Action verb	BTL			
1	8	19%	2	CO1 :Understand	L2	PO1 PO2 PO11	PO1: Apply(L3) PO2: Review(L2) PO11: Thumb rule	2 3 2
2	10	23%	3	CO2 :Apply	L3	PO1 PO2 PO6 PO11	PO1: Apply(L3) PO2: Review(L2) PO6: Thumb rule PO11: Thumb rule	3 3 2 3
3	8	19%	2	CO3 : Analyze	L4	PO1 PO2 PO4 PO5 PO6	PO1: Apply(L3) PO2: Review(L2) PO4: Analyze (L4) PO5: Apply(L3) PO6: Thumb rule	3 3 3 3 3
4	9	21%	3	CO4 :Apply	L3	PO1 PO2 PO3 PO4 PO5 PO6 PO7 PO11	PO1: Apply(L3) PO2: Review(L2) PO3: Develop (L3) PO4: Analyze (L4) PO5: Apply(L3) PO6: Thumb rule PO7: Thumb rule PO11: Thumb rule	3 3 3 2 3 2 2 2
5	8	19%	2	CO5 :Understand	L2	PO1 PO2 PO7 PO11	PO1: Apply(L3) PO2: Review(L2) PO7: Thumb rule PO11: Thumb rule	2 3 3 2
	43	**100%**						

Justification Statements :

CO1: Understand the basic concepts of Operating Systems and its services. Action Verb : Understand(L2)
PO1 Verb : Apply(L3) CO1 Action verb is less than PO1 verb by one level. Therefore the correlation is medium (2)
PO2 Verb : Review(L2) CO1 Action verb is same as PO2 verb. Therefore the correlation is high(3)
PO11: Thumb rule In today‘s world operating system services are updating, those services needs to understand. Therefore the correlation is medium (2)

CO2: Apply the concepts of process synchronization and CPU scheduling by drawing Gantt chart
PO1: Apply(L3) CO2 Action verb is same level as PO1 verb. Therefore the correlation is high (3)
PO2 Verb : Review(L2) CO1 Action verb is greater than PO2 verb by one level. Therefore the correlation is high (3)
PO6: Thumb rule Most of the scheduling algorithm were used to solve some of the societal problems like forming Queue line. Therefore the correlation is Moderate (2)
PO11: Thumb rule Scheduling is the one of the daily activity done in many sectors. Therefore the correlation is High(3**)**

CO3: Analyze the memory management and its allocation policies.: Analyze (L4)
PO1: Apply(L3) CO3 Action verb is greater level as PO1 verb. Therefore the correlation is high (3)
PO2: Review (L2) CO3 Action verb is greater than PO2 verb. Therefore the correlation is high (3)
PO3: Develop (L3) CO3 Action verb is greater than PO3 verb by one level. Therefore the correlation is high(3)
PO4: Analyze (L4) CO3 Action verb is same as PO4 verb. Therefore the correlation is high(3)
PO5: Apply(L3) CO3 Action verb is greater than PO5 verb by one level. Therefore the correlation is high(3)
PO6: Thumb rule Most of the memory management policies were used to solve some of the societal problems. Therefore the correlation is Moderate (2)

CO4: Apply the different conditions for deadlock handling and solve various disk scheduling algorithms:Apply(L3)
PO1: Apply(L3) CO4 Action verb is same as PO1 verb. Therefore the correlation is high(3)

PO2: Review (L2) CO4 Action verb is greater level as PO2 verb. Therefore the correlation is high (3)
PO3: Develop (L3) CO4 Action verb is same as PO1 verb. Therefore the correlation is high(3)
PO4: Analyze (L4) CO4 Action verb is less than PO4 verb by one level. Therefore the correlation is medium (2)
PO5: Apply(L3) CO4 Action verb is greater than PO5 verb. Therefore the correlation is high(3)
PO6: Thumb rule Disk scheduling and file system interfaces are applied to provide solutions for E-Commerce database access . Therefore the correlation is medium (2)
PO7: Thumb rule Since ethical principles shall be followed in file manipulations and data storage. Therefore the correlation is high(3)
PO11: Thumb rule File manipulation of data and storage of data is playing major role in current scenario. Therefore, the correlation is medium (2)
CO5: Understand the various System Security and Protection mechanisms:Understand(L2)
PO1: Apply(L3) CO5 Action verb is less than PO1 verb by one level. Therefore, the correlation is medium (2)
PO2: Review (L2) CO5 Action verb is same asPO2 verb. Therefore, the correlation is high(3)
PO7: Thumb rule Ethical principles should be followed for various security issues. Therefore the correlation is high(3)
PO11: Thumb rule Security services and principles are keep on updating in the today‘s world. Therefore, the correlation is medium (2)

III YEAR II SEMESTER

Subject Code	Subject Name	L	T/CLC	P	CREDITS
23AOE0505	MACHINE LEARNING (OE – I)	2	1	0	3

Course Outcomes: After studying the course, students will be able to

CO1	**Understand** the types of Machine Learning and preparing to model
CO2	**Evaluate** the hypotheses by comparing its learning algorithms
CO3	**Evaluate** the decision making problems by using SVM and graphical models
CO4	**Apply** the supervised learning techniques for few machine learning problems
CO5	**Analyze** the Unsupervised learning methods using clustering methods.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms Level
CO1	Understand	the types of Machine Learning and preparing to model.			L2
CO2	Evaluate	the hypotheses	by comparing its learning algorithms		L5
CO3	Evaluate	The decision making problems	by using SVM and graphical models		L5
CO4	Apply	The supervised learning techniques		for few machine learning problems	L3
CO5	Analyze	The Unsupervised learning methods	using clustering methods.		L4

UNIT – I	**Introduction to Machine Learning &Preparing to Model**	**8 Hrs**
Introduction: What is Human Learning? Types of Human Learning, what is Machine Learning? Types of Machine Learning, Problems Not to Be Solved Using Machine Learning, Applications of Machine Learning, State-of-The-Art Languages/Tools in Machine Learning, Issues in Machine Learning Preparing to Model: Introduction, Machine Learning Activities, Basic Types of Data in Machine Learning, Exploring Structure of Data, Data Quality and Remediation, Data Pre-Processing		
UNIT – II	**Modelling and Evaluation &Basics of Feature Engineering**	**8 Hrs**
Introduction, selecting a Model, training a Model (for Supervised Learning), Model Representation and Interpretability, Evaluating Performance of a Model, Improving Performance of a Model Basics of Feature Engineering: Introduction, Feature Transformation, Feature Subset Selection		
UNIT – III	**Bayesian Concept Learning & Supervised Learning: Classification**	**9 Hrs**
Introduction, Why Bayesian Methods are Important? Bayes' Theorem, Bayes' Theorem and Concept Learning, Bayesian Belief Network Supervised Learning: Classification: Introduction**,** Example of Supervised Learning**,** Classification Model**,** Classification Learning Steps**,** Common Classification Algorithms-*k*-Nearest Neighbour(*k*NN), Decision tree, Random forest model, Support vector machines		
UNIT – IV	**Supervised Learning: Regression**	**9 Hrs**
Introduction, Example of Regression, Common Regression Algorithms-Simple linear regression, Multiple linear regression, Assumptions in Regression Analysis, Main Problems in Regression Analysis, Improving Accuracy of the Linear Regression Model, Polynomial Regression Model, Logistic Regression, Maximum Likelihood Estimation.		
UNIT – V	**Unsupervised Learning**	**9 Hrs**
Introduction, Unsupervised vs Supervised Learning, Application of Unsupervised Learning, Clustering – Clustering as a machine learning task, Different types of clustering techniques, Partitioning methods, *K*-Medoids: a representative object-based technique, Hierarchical clustering, Density-based methods-DBSCAN Finding Pattern using Association Rule- Definition of common terms, Association rule, The apriori algorithm for association rule learning, Build the apriori principle rules		

Textbooks:

1. Machine Learning, SaikatDutt, Subramanian Chandramouli, Amit Kumar Das, Pearson, 2019.

Reference Books:

1. EthernAlpaydin, ―Introduction to Machine Learning‖, MIT Press, 2004.
2. Stephen Marsland, ―Machine Learning -An Algorithmic Perspective‖, Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series,2014.
3. Andreas C. Müller and Sarah Guido ―Introduction to Machine Learning with Python: A Guide for Data Scientists‖, Oreilly.

Online Resources:

1. Andrew Ng, ―Machine Learning B.Techning‖ https://www.deeplearning.ai/machine-learning- B.Techning/
2. Shai Shalev-Shwartz , Shai Ben-David, ―Understanding Machine Learning: From Theory to Algorithms‖ , Cambridge University Press https://www.cse.huji.ac.il/~shais/UnderstandingMachineLearning/index.html

Mapping of course outcomes with program outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	3	2		2							3	3
CO2	3	3	3	3	3			3			3	2	2
CO3	3	3	2	2	2		3				3	2	2
CO4	3	3	3	2	3	2						2	
CO5	3	3	3	3	3			3			3		3

Correlation matrix

Unit No.	CO					Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO12)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Correlation	Co's Action verb	BTL			
1	8	19%	2	Understand	L2	PO1 PO2 PO3 PO5	PO1: Apply(L3) PO2: Review(L2) PO3: Develop(L3) PO5: Apply(L3)	2 3 2 2
2	8	19%	2	Evaluate	L5	PO1 PO2 PO3 PO4 PO5 PO8 PO11	PO1: Apply(L3) PO2: Review(L2) PO3: Develop (L3) PO4: Analyze (L4) PO5: Apply(L3) PO8: Thumb rule PO11: Thumb rule	3 3 3 3 3 3 3
3	9	21%	3	Evaluate	L5	PO1 PO2 PO3 PO4 PO5 PO7 PO11	PO1: Apply(L3) PO2: Analyze(L4) PO3: Design (L6) PO4: Design (L6) PO5: Create(L6) PO7: Thumb rule PO11: Thumb rule	3 3 2 2 2 3 3
4	9	21%	3	Apply	L3	PO1 PO2 PO3 PO4 PO5 PO6	PO1: Apply(L3) PO2: Review(L2) PO3: Develop (L3) PO4: Analyze (L4) PO5: Apply(L3) PO6: Thumb rule	3 3 3 2 3 2
5	9	21%	3	Analyze	L4	PO1 PO2 PO3 PO4 PO5 PO8 PO11	PO1: Apply(L3) PO2: Review(L2) PO3: Develop(L3) PO4: Analyze(L4) PO5: Apply(L3) PO8: Thumb rule PO11: Thumb rule	3 3 3 3 3 3 3
	43							

Justification Statements:

CO1: Understand the types of Machine Learning and preparing to model.

Action Verb: Understand(L2)

PO1 Verb: Apply(L3)

CO1 Action verb is less than PO1 verb by one level. Therefore, the correlation is moderate (2)

PO2 Verb: Review(L2)

CO1 Action verb is same level as PO2 verb. Therefore, the correlation is high (3)

PO3: Develop(L3)

CO2 Action verb is less than PO3 verb by one level. Therefore, the correlation is moderate (2)

PO5: Apply(L3)

CO2 Action verb is less than PO5 verb by one level. Therefore, the correlation is moderate (2)

CO2: Evaluate the hypotheses by comparing its learning algorithms

Action Verb : Evaluate (L5)

PO1: Apply(L3)

CO2 Action verb is greater level of PO1 verb. Therefore, the correlation is High (3)
PO2 Verb : Review(L2)
CO2 Action verb is greater than PO2 verb. Therefore the correlation is High(3)
PO3: Develop (L3)
CO2 Action verb is greater than PO3 verb. Therefore, the correlation is High (3)
PO4: Analyze (L4)
CO2 Action verb is greater than PO4 verb. Therefore the correlation is High(3)
PO5 Verb : Apply(L3)
CO2 Action verb is greater than PO5 verb. Therefore, the correlation is High (3)
PO8 : Thumb rule
While creating hypothesis one need to follow the ethical principles. Therefore, the correlation is High (3)
PO11: Thumb rule
In current scenario all machine learning models are updating so one needs to follow the change. Therefore, the correlation is high (3)

CO3: Evaluate the decision making problems by using SVM and graphical models
Action Verb : Evaluate (L5)
PO1: Apply(L3)
CO3 Action verb is greater level of PO1 verb. Therefore, the correlation is High (3)
PO2: Analyze (L4)
CO3 Action verb is greater level as PO2 verb. Therefore, the correlation is high (3)
PO3: Design (L6)
CO3 Action verb is less than PO3 verb by one level. Therefore the correlation is medium(2)
PO4: Design (L6)
CO3 Action verb is less than PO4 verb by one level. Therefore the correlation is medium(2)
PO5: Create(L6)
CO3 Action verb is less than PO5 verb by one level. Therefore the correlation is medium(2)
PO7: Thumb rule
While making decisions for solving real world problems one must follow the ethical principles. Therefore, the correlation is High (3)
PO11: Thumb rule
For developing solutions for future problems a continuous study is need. Therefore, the correlation is high (3)

CO4: Apply the supervised learning techniques for few machine learning problems
Action Verb : Apply (L3)
PO1 Verb : Apply(L3)
CO4 Action verb is same level of PO1 verb. Therefore, the correlation is High (3)
PO2 Verb : Review(L2)
CO4 Action verb is greater than PO2 verb. Therefore the correlation is High(3)
PO3: Develop (L3)
CO4 Action verb is same level of PO3 verb. Therefore, the correlation is High (3)
PO4: Analyze (L4)
CO4 Action verb is less than PO4 verb by one level. Therefore the correlation is medium(2)
PO5 Verb : Apply(L3)
CO4 Action verb is same level of PO5 verb. Therefore, the correlation is High (3)
PO6: Thumb rule
Some of the machine learning models will provide solutions to current societal problems. Therefore the correlation is medium (2)

CO5: Analyze the Unsupervised learning methods using clustering methods.
Action Verb : Analyze (L4)
PO1: Apply(L3)
CO5 Action verb is greater level of PO1 verb. Therefore, the correlation is High (3)
PO2 Verb : Review(L2)
CO5 Action verb is greater than PO2 verb. Therefore the correlation is High(3)
PO3: Develop (L3)
CO5 Action verb is greater than PO3 verb. Therefore, the correlation is High (3)
PO4: Analyze (L4)
CO5 Action verb is greater than PO4 verb. Therefore the correlation is High(3)
PO5 Verb : Apply(L3)
CO5 Action verb is greater than PO5 verb. Therefore, the correlation is High (3)
PO8 : Thumb rule
some ethical principles will apply while training a model using discrimination methods. Therefore, the correlation is High (3)
PO11: Thumb rule
In today's world training a machine is big challenge to the developers, it is a continuous learning process.
Therefore, the correlation is high (3)

III YEAR II SEMESTER

Subject Code	Subject Name	L	T/CLC	P	CREDITS
23AOE9902	ADVANCED OPERATION RESEARCH (OE – II)	2	1	0	3

Course Outcomes: After studying the course, students will be able to

CO1	Understand the concepts of linear programming in solving practical problems in industry.
CO2	Analyze the transportation models to trace the solutions to the real-world problems.
CO3	Apply mathematical skills to solve nonlinear programming models arising from a wide range of applications.
CO4	Apply the concept of non-linear programming for solving non-linear constraints.
CO5	Apply the concept of unconstrained geometric programming for solving the non-linear constraints.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Understand	the concepts of linear programming	in solving practical problems in industry.		L2
2	Analyze	the transportation models	to trace the solutions	to the real-world problems.	L4
3	Apply	mathematical skills	to solve nonlinear programming models	arising from a wide range of applications.	L3
4	Apply	the concept of non-linear programming	for solving non-linear constraints.		L3
5	Apply	the concept of unconstrained geometric programming	for solving the non-linear constraints.		L3

UNIT-I

UNIT – I: Linear programming I
Introduction, Applications of Linear Programming, Standard form of a Linear Programming Problem, Geometry of Linear Programming Problems, Basic Definitions in Linear Programming.

UNIT-II

UNIT–II : Linear programming II: Duality in Linear Programming
Simplex Method, Simplex Algorithm and, Big-M method. Symmetric Primal-Dual Relations, General Primal-Dual Relations, Duality Theorem, Dual Simplex Method.

UNIT-III

UNIT – III : Linear programming III
Transportation Problem and assignment problem, Complementary slackness Theorem.

UNIT-IV

UNIT – IV : Non-linear programming: Unconstrained optimization techniques
Introduction: Classification of Unconstrained minimization methods,
Direct Search Methods: Random Search Methods: Descent Method and Fletcher Powell Method, Grid Search Method.

UNIT-V

UNIT – V : Non-linear programming: Constrained optimization techniques
Introduction, Characteristics of a constrained problem, Random Search Methods, complex method, Sequential linear programming, Basic approach in methods of Feasible directions, Zoutendijk's method of feasible directions: direction finding problem, determination of step length, Termination criteria.

TEXT BOOK:

1. Singiresu S Rao., Engineering Optimization: Theory and Practices, New Age Int. (P) Ltd Publishers, New Delhi.
2. J. C. Panth, Introduction to Optimization Techniques, (7-e) Jain Brothers, New Delhi.

REFERENCES:

1. Harvey M. Wagner, Principles of Operation Research, Printice-Hall of India Pvt. Ltd. New Delhi.
2. Peressimi A.L., Sullivan F.E., Vhl, J. J. Mathematics of Non-linear Programming, Springer – Verlag.

Web Reference:

https://onlinecourses.nptel.ac.in/noc24_ee122/preview
https://archive.nptel.ac.in/courses/111/105/111105039/
https://onlinecourses.nptel.ac.in/noc21_ce60/preview

Mapping of COs to POs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PS01	PSO2
1		1											
2		3											
3	3												
4	3												
5	3												

CO-PO MAPPING JUSTIFICATION:

Unit No	Course Outcomes					Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
	Lesson Plan Hrs	%	Correlation	CO's Action Verb	BTL			
1				**Understand**	**L2**	PO2	**Analyze**	1
2				**Analyze**	**L4**	PO2	**Analyze**	3
3				**Apply**	**L3**	PO1	**Apply**	3
4				**Apply**	**L3**	PO1	**Apply**	3
5				**Apply**	**L3**	PO1	**Apply**	3

JUSTIFICATION STATEMENTS:

CO1: Understand the concepts of linear programming in solving practical problems in industry.
Action Verb: Understand (L2)
PO2 Verbs: Analyze (L4)
CO1 Action Verb is two levels low to PO2 verb ; Therefore correlation is low (1).
CO2: Analyze the transportation models to trace the solutions to the real-world problems.
Action Verb: Analyze (L4)
PO2 Verbs: Analyze (L4)
CO2 Action Verb is equal to PO2 verb; Therefore correlation is high (3).
CO3: Apply mathematical skills to solve nonlinear programming models arising from a wide range of applications.
Action Verb: Apply **(L3)**
PO1 Verb: Apply (L3)
CO3 Action Verb level is equal to PO1 verb; Therefore correlation is high (3).
CO4: Apply the concept of non-linear programming for solving non-linear constraints.
Action Verb: Apply (L3)
PO1 Verb: Apply (L3)
CO4 Action Verb level is equal to PO1 verb; Therefore correlation is high (3).
CO5: Apply the concept of unconstrained geometric programming for solving the non-linear constraints.
Action Verb: Apply (L3)
PO1 Verb: Apply (L3)
CO5 Action verb is equal to PO1 verb; therefore the correlation is high (3).

III YEAR II SEMESTER

Subject Code	Subject Name	L	T/CLC	P	CREDITS
23AOE9903	MATHEMATICAL FOUNDATION OF QUANTUM TECHNOLOGIES (OE – II)	2	1	0	3

Course Outcomes: After studying the course, students will be able to

CO1	Apply the applications to quantum systems through the study of vector spaces, inner products, and linear operators.
CO2	Analyze the transition from finite to infinite dimensional systems with linear algebra concepts to function spaces.
CO3	Analyze the quantum mechanical formalism including measurement theory, uncertainty relations, and time evolution.
CO4	Evaluate the statistical interpretations through quantum mechanical principles to solve problems in simple quantum systems.
CO5	Create the understanding of measurement processes and modern quantum theory from the advanced concepts in composite systems.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Apply	the applications to quantum systems	through the study of vector spaces, inner products, and linear operators.		L3
2	Analyze	the transition from finite to infinite dimensional systems	with linear algebra concepts to function spaces.		L4
3	Analyze	the quantum mechanical formalism including measurement theory, uncertainty relations, and time evolution.	.		L4
4	Evaluate	statistical interpretations through quantum mechanical principles	to solve problems in simple quantum systems.		L5
5	Create	the understanding of measurement processes and modern quantum theory	from the advanced concepts in composite systems.		L6

UNIT-I

UNIT I: Linear Algebra Foundation for Quantum Mechanics **10 hours**

Vector spaces definition and examples (R^2, R^3, function spaces), Inner products (dot product, orthogonality, normalization), Linear operators (matrices, eigen values, eigen vectors), Finite-dimensional examples (2×2 matrices, spin-1/2 systems), Dirac notation introduction ($|\psi\rangle$, $\langle\varphi|$, $\langle\varphi|\psi\rangle$), Change of basis (transformations, unitary matrices).

UNIT-II

UNIT II: From Finite to Infinite Dimensions **8 hours**

Function spaces (L^2 space, square-integrable functions), Inner products for functions ($\int\psi^*\varphi\, dx$), Orthogonal function sets (Fourier series, basis functions), Introduction to Hilbert space concept (complete inner product spaces), Position and momentum representations (wave functions), Operators on functions (d/dx, multiplication by x).

UNIT-III

UNIT III: Quantum Mechanical Formalism **8 hours**

Mathematical formulation (states as vectors, observables as operators), Measurement theory (Born rule, expectation values, probabilities), Uncertainty relations (mathematical derivation from commutators), Time evolution (Schrödinger equation, unitary evolution).

UNIT-IV

UNIT IV: Applications and Statistical Interpretation **6 hours**
Simple applications (infinite square well, harmonic oscillator), Statistical interpretation (ensembles, pure vs mixed states), Measurement process (von Neumann measurement scheme).
UNIT-V
UNIT V: Advanced Topics **8 hours**
Composite systems (tensor products basic introduction), Reversibility and irreversibility (unitary evolution vs measurement), Thermodynamic connections (equilibrium states, entropy), Modern perspectives (decoherence, measurement problem conceptual).

Textbooks:

- David J. Griffiths, Darrell F. Schroeter, "Introduction to Quantum Mechanics", 3rd Edition, Cambridge University Press (2018).
- R. Shankar, Principles of Quantum Mechanics, 2nd Edition, Kluwer Academy/Plenum Publishers (1994).

Reference Books:

- George. F. Simmons, "Introduction to Topology and Modern Analysis",MedTech Science Press.
- Gilbert Strang, Linear Algebra and Its Applications, 4th Edition, Cengage Learning (2006).
- John von Neumann and Robert T Beyer, Mathematical Foundations of Quantum Mechanics, Princeton Univ. Press (1996).

Web Resources

1. https://eclass.uoa.gr/modules/document/file.php/CHEM248/Griffiths%20%20Introduction%20to%20Quantum%20Mechanics%203rd%20ed%202018.pdf
2. https://fisica.net/mecanica-quantica/Shankar%20-%20Principles%20of%20quantum%20mechanics.pdf

CORRELATION OF COS WITH THE POS & PSOS:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3												
CO2		3											
CO3		3											
CO4			3										
CO5			3										

CO-PO MAPPING JUSTIFICATION:

Unit No	Course Outcomes					Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
	Lesson Plan Hrs	%	Correlation	CO's Action Verb	BTL			
1				Apply	L3	PO1	Apply	3
2				Analyze	L4	PO2	Analyze	3
3				Analyze	L4	PO2	Analyze	3
4				Evaluate	L5	PO3	Evaluate	3
5				Create	L6	PO3	Create	3

JUSTIFICATION STATEMENTS:

CO1: Apply the applications to quantum systems through the study of vector spaces, inner products, linear operators.
Action Verb: Apply(L3)
PO1 Verbs: Apply (L3) CO1 Action Verb is equal to PO1 verb ; Therefore correlation is high(3).
CO2: Analyze the transition from finite to infinite dimensional systems with linear algebra concepts to function spaces.
Action Verb: Analyze (L4)
PO2 Verbs: Analyze (L4) CO2 Action Verb is equal to PO2 verb; Therefore correlation is high (3).
CO3: Analyze the quantum mechanical formalism including measurement theory, uncertainty relations, time evolution.
Action Verb: Analyze (L4)
PO1 Verb: Apply (L3) CO3 Action Verb level is equal to PO1 verb; Therefore correlation is high (3).
CO4: Evaluate the statistical interpretations through quantum mechanical principles to solve problems in simple quantum systems.
Action Verb: Evaluate (L5)
PO3 Verb: Evaluate (L5) CO4 Action Verb level is equal to PO3 verb; Therefore correlation is high (3).
CO5: Create the understanding of measurement processes and modern quantum theory from the advanced concepts in composite systems.
Action Verb: Create (L6)
PO3 Verb: Create (L6) CO5 Action verb is equal to PO3 verb; therefore the correlation is high (3).

III YEAR II SEMESTER

Subject Code	Subject Name	L	T/CLC	P	CREDITS
23AOE9907	PHYSICS OF ELECTRONIC MATERIALS AND DEVICES (OE – II)	2	1	0	3

Course Outcomes: After studying the course, students will be able to

CO1	Understand the fundamentals of crystal growth and thin films.
CO2	Analyze the charge carrier dynamics in semiconductors by implementing the equations of state.
CO3	Understand the basics of Semiconductors for Engineering Applications.
CO4	Analyze the concepts of excitons and luminescence in Semiconductors.
CO5	Apply the fundamentals of semiconductors for various display devices.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Understand	The fundamentals of crystal growth and thin films.			L2
2	Analyze	The charge carrier dynamics in semiconductors by implementing the equations of state.			L4
3	Understand	The basics of Semiconductors for Engineering Applications.			L2
4	Analyze	The concepts of excitons and luminescence in Semiconductors.			L4
5	Apply	The fundamentals of semiconductors for various display devices.			L3

UNIT-I

UNIT I Fundamentals of Materials Science

Introduction, Phase rule, Phase Diagram, Elementary idea of Nucleation and Growth, Methods of crystal growth. The basic idea of point, line, and planar defects. Concept of thin films, preparation of thin films, Deposition of thin film using thermal evaporation and sputtering methods (RF and glow discharge).

UNIT-II

UNIT II Semiconductors

Introduction, charge carriers in semiconductors, effective mass, Diffusion and drift, Diffusion and recombination, Diffusion length. The Fermi level & Fermi-Dirac distribution, Electron and Hole in quantum well, Change of electron-hole concentration- Qualitative analysis, Temperature dependency of carrier concentration, Conductivity and mobility, Effects of temperature and doping on mobility, High field effects.

UNIT-III

UNIT III Physics of Semiconductor Devices:

Introduction, Band structure, PN junctions and their typical characteristics under equilibrium and under bias, Heterojunctions, Examples of Semiconductors for electronic applications: Solar Cell Transistors, MOSFETs.

UNIT-IV

UNIT IV Excitons and Luminescence:

Luminescence: Different types of luminescence, basic definitions, Light emission in solids, Inter-band luminescence, Direct and indirect gap materials. Photoluminescence : General Principles of photoluminescence, Excitation and relaxation, OLED, Quantum-dot. Electro-luminescence : General Principles of electroluminescence, light emitting diode, diode laser.

UNIT-V

UNIT V Display devices :

LCD, three-dimensional display: Holographic display, light-field displays: Head-mounted display, MOEMS (Micro-Opto-Electro-Mechanical Systems) and MEMS displays.

Textbooks:

1. Principles of Electronic Materials and Devices-S.O. Kasap, McGraw-Hill Education (India) Pvt. Ltd.,4thedition, 2021.
2. Semiconductor physics & devices: basic principles, 4th Edition, McGraw-Hill, 2012.

Reference Books:

1. Solid State Electronic Devices -B.G. Streetman and S. Banerjee, PHI Learning,6th edition
2. Electronic Materials Science- Eugene A. Irene, Wiley, 2005
3. Electronic Components and Materials, Grover and Jamwal, DhanpatRai and Co., New Delhi., 2012. 4. An Introduction to Electronic Materials for Engineers-Wei Gao, Zhengwei Li, Nigel Sammes, World Scientific Publishing Co. Pvt. Ltd. 2nd Edition,2011

NPTEL course links:

1. https://nptel.ac.in/courses/113/106/113106062/
2. https://onlinecourses.nptel.ac.in/noc20_ph24/preview

CORRELATION OF COS WITH THE POS & PSOS:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2				2								
CO2	3	3											
CO3	2				2								
CO4	3				3								
CO5	3												

CO-PO MAPPING JUSTIFICATION:

Unit No	Course Outcomes					Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
	Lesson Plan Hrs	%	Correlation	CO's Action Verb	BTL			
1				Understand	L2	PO1, PO5	PO1: Apply (L3)	2
2				Analyze	L4	PO1, PO2	PO1: Apply (L3)	3
3				Understand	L2	PO1, PO5	PO1, PO5: Apply (L3)	2
4				Analyze	L4	PO1, PO5	PO1, PO5: Apply (L3)	3
5				Apply	L3	PO1	PO1: Apply (L3)	3

JUSTIFICATION STATEMENTS:

CO1: Understand the fundamentals of crystal growth and thin films.
Action Verb: Understand (L2)
PO1 & PO5 Verbs: Apply (L3)
CO1 Action Verb is lesser than PO1 and PO5 verbs by one level; Therefore, correlation is moderate (2).
CO2: Analyze the charge carrier dynamics in semiconductors by implementing the equations of state.
Action Verb: Analyze (L4)
PO1 & PO2 Verbs: Apply (L3)
CO2 Action Verb is greater than PO1 and PO2 verbs; Therefore correlation is high (3).
CO3: Understand the basics of Semiconductors for Engineering Applications.
Action Verb: Understand (L2)
PO1 and PO5 Verbs: Apply (L3)
CO3 Action Verb is less than PO1 and PO5 verb by one level; Therefore correlation is moderate (2).
CO4: Analyze the concepts of excitons and luminescence in Semiconductors.
Action Verb: Analyze (L4)
PO1 Verb and PO5 verbs: Apply (L3)
CO4 Action Verb is greater than PO1 and PO5 verbs by one level; Therefore, correlation is high (3).
CO5: Apply the fundamentals of semiconductors for various display devices.
Action Verb: Analyze (L4)
PO1 : Apply (L3)
CO5 Action verb is equal to PO1 verb; therefore, the correlation is high (3).

III YEAR II SEMESTER

Subject Code	Subject Name	L	T/CLC	P	CREDITS
23AOE9912	CHEMISTRY OF POLYMERS AND APPLICATIONS (OE – II)	2	1	0	3

Course Outcomes: After studying the course, students will be able to

CO1	Understand polymer fundamentals and classification systems.
CO2	Analyze the chemical and physical properties of natural polymers and their applications.
CO3	Apply the knowledge of thermoplastic and thermoset polymers in practical situations
CO4	Understand the fundamental principles of hydrogel in polymer networks.
CO5	Analyze the preparation and mechanism of conducting and degradable polymers

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Understand	Polymer fundamentals and classification systems.			L2
2	Analyze	the chemical and physical properties of natural polymers and their applications.			L4
3	Apply	the knowledge of thermoplastic and thermoset polymers in practical situations			L3
4	Understand	the fundamental principles of hydrogel in polymer networks.			L2
5	Analyze	the fundamental principles of hydrogel in polymer networks			L4

UNIT-I

Unit – I: Polymers-Basics and Characterization:
Basic concepts: monomers, repeating units, degree of polymerization, linear, branched and network polymers, classification of polymers, Polymerization: addition, condensation, and copolymerization and coordination polymerization. Average molecular weight concepts: number, weight and viscosity average molecular weights, polydispersity and molecular weight distribution. Measurement of molecular weight: End group, viscosity, light scattering, osmotic and ultracentrifugation methods, analysis and testing of polymers.

UNIT-II

Unit – II: Natural Polymers & Modified cellulosic
Natural Polymers: Chemical & Physical structure, properties, source, important chemical modifications, applications of polymers such as cellulose, lignin, starch, rosin, shellac, latexes, vegetable oils and gums, proteins.
Modified cellulosic: Cellulose esters and ethers such as Ethyl cellulose, CMC, HPMC, cellulose acetals, Liquid crystalline polymers; specialty plastics- PES, PAES, PEEK and PEA.

UNIT-III

Unit – III: Synthetic Polymers
Addition and condensation polymerization processes– Bulk, Solution, and Suspension and Emulsion polymerization. Preparation and significance, classification of polymers based on physical properties. Thermoplastics, Thermosetting plastics, Fibers and elastomers, General Applications. Preparation of Polymers based on different types of monomers, Olefin polymers (PE, PVC), Butadiene polymers (BUNA-S, BUNA-N), nylons, Urea-formaldehyde, phenol – formaldehyde, Melamine Epoxy and Ion exchange resins.

UNIT-IV

Unit-IV: Hydrogels of Polymer networks
Definitions of Hydrogel, polymer networks, Types of polymer networks, Methods involved in hydrogel preparation, Classification, Properties of hydrogels, Applications of hydrogels in drug delivery.

UNIT-V

Unit – V: Conducting and Degradable Polymers:

Conducting polymers: Introduction, Classification, Mechanism of conduction in Poly Acetylene, Poly Aniline, Poly Thiophene, Doping,Applications.
Degradable polymers: Introduction, Classifications, Examples, Mechanism of degradation, poly lactic acid, Nylon-6, Polyesters, applications.

Text Books:

1. A Text book of Polymer science, Billmayer
2. Polymer Chemistry – G.S.Mishra
3. Polymer Chemistry – Gowarikar

References Books:

1. Organic polymer Chemistry, K.J.Saunders, Chapman and Hall
2. Advanced Organic Chemistry, B.Miller, Prentice Hall
3. Polymer Science and Technology by Premamoy Ghosh, 3rd edition, McGraw-Hill, 2010.

Mapping of COs to POs and PSOs

CORRELATION OF COS WITH THE POS & PSOS:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3												
CO2	3												
CO3	3												
CO4	3												
CO5	3												

CO-PO MAPPING JUSTIFICATION:

Unit No	Course Outcomes					Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
	Lesson Plan Hrs	%	Correlation	CO's Action Verb	BTL			
1				Understand	L2	PO1	PO1: Apply (L3)	2
2				Analyze	L4	PO1	PO1: Apply (L3)	3
3				Apply	L3	PO1	PO1: Apply (L3)	3
4				Understand	L2	PO1	PO1: Apply (L3)	3
5				Analyze	L4	PO1	PO1: Apply (L3)	3

JUSTIFICATION STATEMENTS:

CO1: Understand polymer fundamentals and classification systems.
Action Verb: Understand (L2)
PO1 Verbs: Apply (L3) CO1 Action Verb is less than PO1 verb by one level; Therefore correlation is moderate (2).
CO2: Analyze the chemical and physical properties of natural polymers and their applications
Action Verb: Analyze (L4)
PO1 Verbs: Apply (L3) CO2 Action Verb is less than PO1 verb; Therefore correlation is moderate (3).
CO3: Apply the knowledge of thermoplastic and thermoset polymers in practical situations.
Action Verb: Apply (L3)
PO1 Verb: Apply (L3) CO3 Action Verb level is equal to PO1 verb; Therefore correlation is high (3).
CO4: Understand the fundamental principles of hydrogel in polymer networks.
Action Verb: Understand (L2)
PO1 Verb: Apply (L3) CO3 Action Verb is less than PO1 verb by one level; Therefore correlation is moderate (3).
CO5 Analyze the preparation and mechanism of conducting and degradable polymers
Action Verb: Analyze (L4)
PO1 Verb: Apply (L3) CO5 Action Verb is less than PO1 verb by one level; Therefore correlation is moderate (3).

III YEAR II SEMESTER

Subject Code	Subject Name	L	T/CLC	P	CREDITS
23AOE9916	ACADEMIC WRITING AND PUBLIC SPEAKING (OE – II)	2	1	0	3

Course Outcomes: After studying the course, students will be able to

CO1	Apply the essential features of Academic Writing in scholarly works.
CO2	Apply the strategies of writing skills in research paper writing without plagiarism.
CO3	Create a coherent and well-organized paragraphs in essays, reports, reviews and SOP
CO4	Analyze the characteristics and strategies of public speaking skills for impactful speeches.
CO5	Apply non-verbal communication skills for effective public speaking.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Apply	the essential features of Academic Writing in scholarly works			L3
2	Apply	the strategies of writing skills in research paper writing without plagiarism.	without plagiarism.		L3
3	Create	a coherent and well-organized paragraphs in essays, reports, reviews and SOP			L6
4	Analyze	the characteristics and strategies of public speaking skills for impactful speeches.		for impactful speeches.	L4
5	Apply	non-verbal communication skills for effective public speaking..		for effective public speaking..	L3

UNIT - I	Introduction to Academic Writing	Lecture Hrs
Introduction to Academic Writing – Essential Features of Academic Writing – Courtesy – Clarity – Conciseness – Correctness – Coherence – Completeness – Types – Descriptive, Analytical, Persuasive, Critical writing		
UNIT - II	**Academic Journal Article**	Lecture Hrs
Art of condensation- summarizing and paraphrasing - Abstract Writing, writing Project Proposal, writing application for internship, Technical/Research/Journal Paper Writing – Conference Paper writing - Editing, Proof Reading - Plagiarism		
UNIT - III	**Essay & Writing Reviews**	Lecture Hrs
Compare and Contrast – Argumentative Essay – Exploratory Essay – Features and Analysis of Sample Essays – Writing Book Report, Summarizing, Book/film Review- SoP		
UNIT - IV	**Public Speaking**	Lecture Hrs
Introduction, Nature, characteristics, significance of Public Speaking – Presentation – 4 Ps of Presentation – Stage Dynamics – Answering Strategies –Analysis of Impactful Speeches- Speeches for Academic events		
UNIT - V	**Public Speaking and Non-Verbal Delivery**	Lecture Hrs
Body Language – Facial Expressions-Kinesics – Oculesics – Proxemics – Haptics – Chronomics - Paralanguage - Signs		

Textbooks:

3. *Critical Thinking, Academic Writing and Presentation Skills*: MG University Edition Paperback – 1 January 2010 Pearson Education; First edition (1 January 2010)
4. Pease, Allan & Barbara. *The Definitive Book of Body Language*RHUS Publishers, 2016

ference Books:

1. Alice Savage, Masoud Shafiei *Effective Academic Writing,**2Ed.,***2014 .sserP ytisrevinU drofxO
2. Shalini Verma, *Body Language*, S Chand Publications 2011.
3. Sanjay Kumar and Pushpalata,*Communication Skills* 2E 2015, Oxford.
4. Sharon Gerson, Steven Gerson,*Technical Communication Process and Product,* Pearson, New Delhi, 2014
5. *Elbow, Peter. Writing with Power. OUP USA, 1998*

Online Learning Resources:

1. https://youtu.be/NNhTIT81nH8
2. phttps://www.youtube.com/watch?v=478ccrWKY-A
3. https://www.youtube.com/watch?v=nzGo5ZC1gMw
4. https://www.youtube.com/watch?v=Qve0ZBmJMh4
5. https://courses.lumenlearning.com/publicspeakingprinciples/chapter/chapter-12-nonverbal- aspects-of-delivery/
6. https://onlinecourses.nptel.ac.in/noc21_hs76/preview
7. https://archive.nptel.ac.in/courses/109/107/109107172/#
8. https://archive.nptel.ac.in/courses/109/104/109104107/

CORRELATION OF COS WITH THE POS & PSOS:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1									2				
CO2									2				
CO3									3				
CO4									3		3		
CO5									2		2		

CO-PO MAPPING JUSTIFICATION:

Unit No	Course Outcomes					Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
	Lesson Plan Hrs	%	Correlation	CO's Action Verb	BTL			
1							Thumb Rule	2
2							Thumb Rule	2
3							Thumb Rule	3
4							Thumb Rule	2
5							Thumb Rule	2

JUSTIFICATION STATEMENTS:

CO1: Apply the essential features of Academic Writing in scholarly works.

Action Verb: Apply (L3)

CO1 Action Verb Apply is of BTL 3. Using Thumb rule, L3 correlates PO6 to PO11 as moderate (2).

CO2: Apply the strategies of writing skills in research paper writing without plagiarism.

CO2 Action Verb Apply is of BTL 3. Using Thumb rule, L3 correlates PO6 to PO11 as moderate (2)

CO3: Create a coherent and well-organized paragraphs in essays, reports, reviews and SOP.

CO3 Action Verb Create is of BTL 6. Using Thumb rule, L6 correlates PO6 to PO11 as high (3).

CO4: Analyze the characteristics and strategies of public speaking skills for impactful speeches.

Action Verb: Analyze (L4)

CO4 Action Verb Analyze is of BTL 4. Using Thumb rule, L4 correlates PO6 to PO11 as high (3).

CO5: Apply non-verbal communication skills for effective public speaking.

Action Verb: Apply (L3)

CO5 Action Verb Apply is of BTL 3. Using Thumb rule, L3 correlates PO6 to PO11 as moderate (2).

III YEAR II SEMESTER

Subject Code	Subject Name	L	T/CLC	P	CREDITS
23APC0122	HIGHWAY ENGINEERING LAB	0	0	3	1.5

Course Outcomes: After studying the course, students will be able to

CO1	Evaluate the quality and suitability of aggregates for highway applications
CO2	Evaluate the suitability of aggregates for road construction.
CO3	Evaluate the quality and suitability of bitumen for highway applications
CO4	Analyze test results to assess the consistency, durability, and temperature susceptibility of bituminous binders for pavement applications.
CO5	Analyze bitumen extraction to determine binder content in bituminous mixes and assess compliance with mix design standards.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Evaluate	The quality and suitability		For Highway applications	L5
2	Evaluate	the suitability of aggregates		for road construction.	L5
3	Evaluate	The quality and suitability of bitumen		For Highway applications	L5
4	Analyze	test results to assess the consistency, durability, and temperature susceptibility		of bituminous binders for pavement applications.	L4
5	Analyze	bitumen extraction to determine binder content in bituminous mixes and assess compliance	with mix design standards		L4

LIST OF EXPERIMENTS

I. TEST ON AGGREGATES

1. Specific Gravity Determination of the Coarse Aggregate Sample
2. Determination of Abrasion Value of the Coarse Aggregate Sample.
3. Determination of Impact Value of Coarse Aggregate
4. Determination of Elongation Index of Coarse Aggregate
5. Determination of Flakiness Index of Coarse Aggregate
6. Determination of Aggregate Crushing Value of Coarse Aggregate
7. Determination of Water Absorption Capacity of the Coarse Aggregate Sample.

II. TEST ON BITUMEN

1. Specific Gravity Determination of The Bitumen/Asphalt Sample.
2. Penetration Test on Bitumen.
3. Viscosity Determination of Bituminous Binder.
4. Determination of Softening Point of The Asphalt/Bitumen Sample
5. Determination of Ductility Value of The Bitumen Sample
6. Estimation of Loss of Bitumen on Heating
7. Bitumen Extraction Test

TEXTBOOKS:

1. Highway Material Testing Manual, Khanna, Justo and Veera Raghavan, Nemchand Brothers

REFERENCES:

1. IS 383 :1993 ―Specification for Coarse and Fine Aggregates From Natural Sources for Concrete‖
2. 1S 1201 -1220 (1978) ―Methods for testing tars and bituminous materials‖
3. IRC SP 53 -2010 ―Guidelines on use of modified bitumen‖
4. MS-2 Manual for Marshalls Mix design 2002

WEB RESOURCES:

https://ts-nitk.vlabs.ac.in/

CORRELATION OF COS WITH THE POS & PSOS:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	2	2		3						2	
CO2	2	2	2	2		3						2	
CO3	2	2	2	2		3						2	
CO4	2	3		3		3						2	
CO5	2	3		3		3						2	

CO-PO MAPPING JUSTIFICATION:

CO	CO		Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
	Verb	BTL			
1	Evaluate	L5	PO1 PO2 PO3 PO4 PO6	Apply (L3) Analyze (L4) Design (L6) Analysis (L4) Thumb Rule	2 2 2 2 3
2	Evaluate	L5	PO1 PO2 PO3 PO4 PO6	Apply (L3) Analyze (L4) Design (L6) Analysis (L4) Thumb Rule	2 2 2 2 3
3	Evaluate	L5	PO1 PO2 PO3 PO4 PO6	Apply (L3) Analyze (L4) Design (L6) Analysis (L4) Thumb Rule	2 2 2 2 3
4	Analyze	L4	PO1 PO2 PO4 PO6	Apply (L3) Analyze (L4) Analyze (L4) Thumb Rule	2 3 3 3
5	Analyze	L4	PO1 PO2 PO4 PO6	Apply (L3) Analyze (L4) Analyze (L4) Thumb Rule	2 3 3 3

JUSTIFICATION STATEMENTS:

CO1: Evaluate the quality and suitability of aggregates for highway applications

Action Verb: Evaluate (L5)

PO1: Apply (L3)

CO 1 Action verb is greater than PO1 verb; Therefore, correlation is moderate (2).

PO2: Analyze (L4)

CO 1 Action verb is greater than PO2 verb by one level; Therefore, correlation is moderate (2).

PO3: Design

CO 1 Action verb is less than PO3 verb by one level; Therefore, correlation is moderate (2).

PO4: Design

CO 1 Action verb is less than PO3 verb by one level; Therefore, correlation is moderate (2).

PO6: Action verb Evaluate is of BTL 5. Using Thumb rule, L5 correlates PO6 as High (3)

CO 2: Evaluate the suitability of aggregates for road construction.

Action Verb: Evaluate (L5)

PO1: Apply (L3)

CO 2 Action verb is greater than PO1 verb; Therefore, correlation is moderate (2).

PO2: Analyze (L4)

CO 2 Action verb is greater than PO2 verb by one level; Therefore, correlation is moderate (2).

PO3: Design
CO 2 Action verb is less than PO3 verb by one level; Therefore, correlation is moderate (2).
PO4: Design
CO 2 Action verb is less than PO3 verb by one level; Therefore, correlation is moderate (2).
PO6: Action verb Evaluate is of BTL 5. Using Thumb rule, L5 correlates PO6 as High (3)

CO 3: Evaluate the quality and suitability of bitumen for highway applications

Action Verb: Evaluate (L5)
PO1: Apply (L3)
CO 3Action verb is greater than PO1 verb; Therefore, correlation is moderate (2).
PO2: Analyze (L4)
CO 3 Action verb is greater than PO2 verb by one level; Therefore, correlation is moderate (2).
PO3: Design
CO 3 Action verb is less than PO3 verb by one level; Therefore, correlation is moderate (2).
PO4: Design
CO 3 Action verb is less than PO3 verb by one level; Therefore, correlation is moderate (2).
PO6: Action verb Evaluate is of BTL 5. Using Thumb rule, L5 correlates PO6 as High (3)

CO 4: Analyze test results to assess the consistency, durability, and temperature susceptibility of bituminous binders for pavement applications.

Action Verb: Analyze (L4)
PO1: Apply(L3)
CO 4 Action verb is greater than PO1 verb. Therefore, the correlation is moderate (3)
PO2: Analyze (L4)
CO 4 Action verb is equal to PO2 verb. Therefore, the correlation is high (3)
PO 4: Analysis (L4)
CO 4 Action Verb is equal to PO4; Therefore, correlation is high (3)
CO 4 Action Verb Analyze is of BTL 4. Using Thumb rule, L4 correlates PO6 as high (3).

CO 5: Analyze bitumen extraction to determine binder content in bituminous mixes and assess compliance with mix design standards.

Action Verb: Analyze (L4)
PO1: Apply(L3)
CO 5 Action verb is greater than PO1 verb. Therefore, the correlation is moderate (3)
PO2: Analyze (L4)
CO 5 Action verb is equal to PO2 verb. Therefore, the correlation is high (3)
PO 4: Analysis (L4)
CO 5 Action Verb is equal to PO4; Therefore, correlation is high (3)
CO 5 Action Verb Analyze is of BTL 4. Using Thumb rule, L4 correlates PO6 as high (3).

III YEAR II SEMESTER

Subject Code	Subject Name	L	T/CLC	P	CREDITS
23APC0123	ENVIRONMENTAL ENGINEERING LAB	0	0	3	1.5

Course Outcomes: After studying the course, students will be able to

CO1	Understand the sampling, preservation, and characterization methods of water and wastewater.
CO2	Analyze physical and chemical water quality parameters such as turbidity, conductivity, sulphates, iron, fluoride, and chlorine content.
CO3	Evaluate biological characteristics of water and wastewater including BOD, COD, DO, and coliforms.
CO4	Evaluate treatment efficiency using parameters like optimum coagulant dosage, sludge volume index, and solids estimation.
CO5	Evaluate standard laboratory procedures and instruments in the analysis of water and wastewater for environmental assessment.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Understand	Sampling, preservation, and characterization methods of water and wastewater	Given raw water/wastewater samples		L2
2	Analyze	Physical and chemical parameters (e.g., turbidity, conductivity, sulphates, iron, fluoride, chlorine)	Provided water samples and standard reagents		L4
3	Evaluate	Biological characteristics (BOD, COD, DO, coliforms) of water and wastewater	Using standard laboratory procedures		L5
4	Evaluate	Treatment efficiency parameters (e.g., coagulant dosage, sludge volume index, solids)	Through experimental observation and testing		L5
5	Evaluate	Standard lab procedures and instruments for water and wastewater analysis	With access to lab setup and equipment	Conduct tests accurately and report results	L3

LIST OF EXPERIMENTS

I. ANALYSIS of WATER SAMPLE

1. Sampling and preservation methods for water and wastewater (Demonstration only)
2. Measurement of Electrical conductivity and turbidity
3. Determination of fluoride in water by spectrophotometric method /ISE
4. Determination of iron in water (Demo)
5. Determination ofSulphate in water
6. Determination of Optimum Coagulant Dosage by Jar test apparatus
7. Determination of available Chlorine in Bleaching powder and residual chlorine in water

II. ANALYSIS of WASTEWATER SAMPLE

1. Estimation of suspended, volatile and fixed solids
2. Determination of Sludge Volume Index in waste water
3. Determination of Dissolved Oxygen
4. Estimation of B.O.D.
5. Estimation of C.O.D.
6. Determination of TKN and Ammonia Nitrogen in wastewater
7. Determination of total and faecal coliform (Demonstration only)

Note: Minimum 10 out of the above experiments are to be carried out.

TEXTBOOKS:

1. Manual on Water Supply and Treatment. Ministry of Urban Development, New Delhi.
2. Manual on Sewerage and Sewage Treatment Systems, Part A, B and C. Central Public Health and Environmental Engineering Organization, Ministry of Urban Development.

REFERENCES:

1. Environmental Engineering Laboratory Manual by Dr. S.K. Panigrahi, L. Mohanty, S.K. Kataria& Sons

WEB RESOURCES:

https://ee1-nitk.vlabs.ac.in/
https://ee2-nitk.vlabs.ac.in/

CORRELATION OF COS WITH THE POS & PSOS:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2		2								3	2
CO2	2	3	1	3								3	3
CO3	1	2	2	2	2							3	3
CO4	1	2	2	2	2							3	3
CO5	1	2	2	2	2							3	3

CO-PO MAPPING JUSTIFICATION:

CO	CO		Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
	Verb	BTL			
1	Understand	L2	PO1 PO2 PO4	Apply – L3 Analyze – L4 Analyze – L4	2 2 2
1	Analyze	L4	PO1 PO2 PO3 PO4	Apply – L3 Analyze – L4 Design – L6 Analyze – L4	2 3 1 3
3	Evaluate	L5	PO1 PO2 PO3 PO4 PO5	Apply – L3 Analyze – L4 Design – L6 Analyze – L4 Create – L6	1 2 2 2 2
4	Evaluate	L5	PO1 PO2 PO3 PO4 PO5	Apply – L3 Analyze – L4 Design – L6 Analyze – L4 Create – L6	1 2 2 2 2
5	Evaluate	L3	PO1 PO2 PO3 PO4 PO5	Apply – L3 Analyze – L4 Design – L6 Analyze – L4 Create – L6	1 2 2 2 2

JUSTIFICATION STATEMENTS:

CO 1: Understand the sampling, preservation, and characterization methods of water and wastewater.

Action Verb: Understand (L2)

PO1: Apply(L3)

CO 1 Action Verb is less than PO1 verb by one level; Therefore, correlation is moderate (2).

PO2: Analyze (L4)

CO 1 Action Verb is less than PO2 verb by one level; Therefore, correlation is moderate (2).

PO4: Analyze (L4)

CO 1 Action Verb is less than PO2 verb by one level; Therefore, correlation is moderate (2).

CO 2: Analyze physical and chemical water quality parameters such as turbidity, conductivity, sulphates, iron, fluoride, and chlorine content.
Action Verb: Analyze (L4)
PO1: Apply(L3)
CO 2 Action verb is greater than PO1 verb. Therefore, the correlation is moderate (2)
PO2: Analyze (L4)
CO 2 Action verb is equal to PO2 verb. Therefore, the correlation is high (3)
PO 3: Design (L6)
CO 2 Action Verb is two level low to PO4; Therefore, correlation is low (1)
PO 4: Analysis (L4)
CO 2 Action Verb is equal to PO4; Therefore, correlation is high (3)

CO 3: Evaluate biological characteristics of water and wastewater including BOD, COD, DO, and coliforms.
Action Verb: Evaluate (L5)
PO1: Apply (L3)
CO 3: Action verb is greater than PO1 verb; Therefore, correlation is low (1).
PO2: Analyze (L4)
CO 3 Action verb is greater than PO2 verb by one level; Therefore, correlation is moderate (2).
PO3: Design
CO 3 Action verb is less than PO3 verb by one level; Therefore, correlation is moderate (2).
PO4: Analyze (L4)
CO 3 Action verb is less than PO3 verb by one level; Therefore, correlation is moderate (2).
PO 5: Create (L6)
CO 3 Action verb is less than PO3 verb by one level; Therefore, correlation is moderate (2).

CO 4: Evaluate treatment efficiency using parameters like optimum coagulant dosage, sludge volume index, and solids estimation.
Action Verb: Evaluate (L5)
PO1: Apply (L3)
CO 4: Action verb is greater than PO1 verb; Therefore, correlation is low (1).
PO2: Analyze (L4)
CO 4 Action verb is greater than PO2 verb by one level; Therefore, correlation is moderate (2).
PO3: Design
CO 4 Action verb is less than PO3 verb by one level; Therefore, correlation is moderate (2).
PO4: Analyze (L4)
CO 4 Action verb is less than PO3 verb by one level; Therefore, correlation is moderate (2).
PO 5: Create (L6)
CO 4 Action verb is less than PO3 verb by one level; Therefore, correlation is moderate (2).

CO 5: Evaluate standard laboratory procedures and instruments in the analysis of water and wastewater for environmental assessment.
Action Verb: Evaluate (L5)
PO1: Apply (L3)
CO 5: Action verb is greater than PO1 verb; Therefore, correlation is low (1).
PO2: Analyze (L4)
CO 5 Action verb is greater than PO2 verb by one level; Therefore, correlation is moderate (2).
PO3: Design
CO 5 Action verb is less than PO3 verb by one level; Therefore, correlation is moderate (2).
PO4: Analyze (L4)
CO 5 Action verb is less than PO3 verb by one level; Therefore, correlation is moderate (2).
PO 5: Create (L6)
CO 5 Action verb is less than PO3 verb by one level; Therefore, correlation is moderate (2).

III YEAR II SEMESTER

Subject Code	Subject Name	L	T	P	CREDITS
23ASC0103	BUILDING INFORMATION MODELING	0	1	2	2

Course Outcomes: After studying the course, students will be able to

CO1	Understand the fundamentals of BIM and Autodesk Revit‘s interface and workflow
CO2	Apply basic drawing, editing and modification tools in Revit for creating and modifying models.
CO3	Create various architectural elements such as walls, doors, windows, floors
CO4	Create various architectural elements such as ceilings and roofs
CO5	Design and elevations for visualization and detailing purposes.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Understand	the fundamentals of BIM and Autodesk Revit‘s interface and workflow			L2
2	Apply	basic drawing, editing and modification tools in Revit			L3
3	Create	various architectural elements such as walls, doors, windows, floors			L6
4	Create	various architectural elements such as ceilings and roofs			L6
5	Design	elevations for visualization and detailing purposes.			L6

LIST OF EXPERIMENTS

1. INTRODUCTION to BIM & AUTODESK REVIT - About Autodesk and Auto cad, Workflow and BIM, Revit Terms, Overview of The Interface, Starting Projects, Viewing Commands.
2. BASIC DRAWING and EDITING tools - Using General Drawing tools, Editing Elements, Working with Modification tools.
3. SETTING UP LEVELS and GRIDS - Setting up Levels and Grids, Creating Structural Grids, Adding Columns, Linking and Importing CAD files.
4. MODELING WALLS Modelling Walls, Modifying Walls, Model Exterior Shell, Add Interior Walls.
5. WORKING WITH DOORS and WINDOWS Inserting Doors and Windows, Loading Door and Window Types from Library, Creating Additional Door and Window Sizes.
6. WORKING WITH CURTAIN WALLS Creating Curtain Walls, Adding Curtain Grids, Working with Curtain Wall Panels, Attaching Mullions to Curtain Grids.
7. WORKING WITH VIEWS Setting the View Display, Duplicating Views, Adding Callout Views, Elevations and Sections.
8. ADDING COMPONENTS Adding Component, Modifying Component, Working with Elements.
9. MODELING FLOORS Modelling& Modifying Floors, Joining Geometry, Creating Shaft Openings, Creating Sloped Floors
10. MODELING CEILINGS & ROOFS Modelling Ceilings, Adding Ceiling Fixtures, Creating Ceiling Soffits, Modelling Roofs
11. MODELING STAIRS and RAILING Creating Component Stairs, Modifying Component Stairs, Working with Railings, Sketching Custom Stairs, Creating Ramps.

TEXTBOOKS:

1. Chuck Eastman, Paul Teicholz, Rafael Sacks, Kathleen Liston ―BIM HANDBOOK, Wiley, 2ndEdition, 2011
2. Wing, Eric. Autodesk Revit Architecture 2017: No Experience Required. Indianapolis: John Wiley & Sons, 2016

REFERENCES:

1. Kim, Marcus, Lance Kirby, and Eddy Krygiel. Mastering Autodesk Revit 2017 for architecture. 1st ed. INpolis, IN: John Wiley & Sons, 2016.
2. Garber, Richard. BIM Design: Realizing the Creative Potential of Building Information Modeling. AD Smart 02. Chichester, U.K.: Wiley, 2004

3. Peter B. and Nigel D., ―BIMin Principle and in Practice‖, 1 st Edition, ICE Publishing, 2014.
4. BIM Handbook: A Guide to Building Information Modeling for Owners, Managers, Designers, Engineers and Contractors,
5. Chuck Eastman, Paul Teicholz, Rafael Sacks and Kathleen Liston, John Wiley & Sons, 2008.
6. BIM and Construction Management: Proven tools, Methods, and Workflows, Brad Hardin, Sybex, 2009.
7. Building Information Modeling: BIMin Current and Future Practice, Karen Kensek and Douglas Noble, Wiley, 2014, First Edition.

WEB RESOURCES:

https://minnodillc.com/building-information-modeling-bim/
https://www.skyfilabs.com/online-courses/building-information-modelling-course

CORRELATION OF COS WITH THE POS & PSOS:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2				2						2	3
CO2	3	2				2						2	3
CO3	2	2	3	2		3						2	3
CO4	2	2	3	2		3						2	3
CO5	3	2	3	2		3						2	3

CO-PO MAPPING JUSTIFICATION:

CO	CO		Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
	Verb	BTL			
1	Understand	L2	PO1 PO2 PO6	Apply (L3) Analyze (L4) Thumb Rule	2 2 2
2	Apply	L3	PO1 PO2 PO6	Apply (L3) Analyze (L4) Thumb Rule	3 2 2
3	Create	L6	PO1 PO2 PO3 PO4 PO6	Apply (L3) Analyze (L4) Design (L6) Analysis (L4) Thumb Rule	2 2 3 2 3
4	Create	L6	PO1 PO2 PO3 PO4 PO6	Apply (L3) Analyze (L4) Design (L6) Analysis (L4) Thumb Rule	2 2 3 2 3
5	Design	L6	PO1 PO2 PO3 PO4 PO6	Apply (L3) Analyze (L4) Design (L6) Analysis (L4) Thumb Rule	2 2 3 2 3

JUSTIFICATION STATEMENTS:

CO 1: Understand the fundamentals of BIM and Autodesk Revit‘s interface and workflow

Action Verb: Understand (L2)
PO1: Apply(L3)
CO 1 Action Verb is less than PO1 verb by one level; Therefore, correlation is moderate (2).
PO2: Analyze (L4)
CO 1 Action Verb is less than PO2 verb by one level; Therefore, correlation is moderate (2).
CO 1 Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO6 as moderate (2).

CO 2: Apply basic drawing, editing and modification tools in Revit for creating and modifying models.

Action Verb: Analyze (L4)
PO1: Apply(L3)

CO 2 Action verb is greater than PO1 verb. Therefore, the correlation is moderate (3)
PO2: Analyze (L4)
CO 2 Action verb is equal to PO2 verb. Therefore, the correlation is high (3)
PO 4: Analysis (L4)
CO 2 Action Verb is equal to PO4; Therefore, correlation is high (3)
CO 2 Action Verb Analyze is of BTL 4. Using Thumb rule, L4 correlates PO6 as high (3).

CO 3: Create various architectural elements such as walls, doors, windows, floors, ceilings, and roofs
Action Verb: Create or Design (L6)
PO1: Apply (L3)
CO 3Action verb is greater than PO1 verb; Therefore, correlation is moderate (2).
PO2: Analyze (L4)
CO 3 Action verb is greater than PO2 verb; Therefore, correlation is moderate (2).
PO3: Design
CO 3 Action verb is equal to PO3 Therefore, correlation is high (3).
PO4: Analysis
CO 3 Action verb is less than PO3 verb; Therefore, correlation is moderate (2).
PO6: Action verb Design is of BTL 6. Using Thumb rule, L6 correlates PO6 as High (3)

CO 4: Create various architectural elements such as walls, doors, windows, floors, ceilings, and roofs
Action Verb: Create or Design (L6)
PO1: Apply (L3)
CO 4 Action verb is greater than PO1 verb; Therefore, correlation is moderate (2).
PO2: Analyze (L4)
CO 4 Action verb is greater than PO2 verb; Therefore, correlation is moderate (2).
PO3: Design
CO 4 Action verb is equal to PO3 Therefore, correlation is high (3).
PO4: Analysis
CO 4 Action verb is less than PO3 verb; Therefore, correlation is moderate (2).
PO6: Action verb Design is of BTL 6. Using Thumb rule, L6 correlates PO6 as High (3)

CO 5: Design and elevations for visualization and detailing purposes.
Action Verb: Create or Design (L6)
PO1: Apply (L3)
CO 5Action verb is greater than PO1 verb; Therefore, correlation is moderate (2).
PO2: Analyze (L4)
CO 5 Action verb is greater than PO2 verb; Therefore, correlation is moderate (2).
PO3: Design
CO 5 Action verb is equal to PO3 Therefore, correlation is high (3).
PO4: Analysis
CO 5 Action verb is less than PO3 verb; Therefore, correlation is moderate (2).
PO6: Action verb Design is of BTL 6. Using Thumb rule, L6 correlates PO6 as High (3)

III YEAR II SEMESTER

Subject Code	Subject Name	L	T/CLC	P	CREDITS
23AMC9902	TECHNICAL PAPER WRITING AND INTELLECTUAL PROPER RIGHTS	2	0	0	0

Course Outcomes: After studying the course, students will be able to

CO1	Understand various principles and styles of technical writing by avoiding confusion, repetition, unclear language and plagiarism.
CO2	Apply the fundamentals of technical research paper writing by organizing abstract, objectives, limitations, literature review to frame effective research questions.
CO3	Apply the research process and publication mechanisms and follow citation rules and proofreading techniques for paper writing.
CO4	Evaluate the rights and responsibilities of the holder of Intellectual Property.
CO5	Apply various forms of copy rights and patents at national and international levels.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Understand	various principles and styles of technical writing by avoiding confusion, repetition, unclear language and plagiarism.	by avoiding confusion, repetition,unclear language and plagiarism.		L2
2	Apply	the fundamentals of technical research paper writing by organizing abstract, objectives, limitations, literature review to frame effective research questions.	by organizing abstract, objectives, limitations, literature review to frame effective research questions.		L3
3	Apply	the research process and publication mechanisms and follow citation rules and proofreading techniques for paper writing.		for paper writing.	L3
4	Evaluate	rights and responsibilities of holder of Patent, Copyright, trademark, International Trademark etc.			L5
5	Apply	various forms of copy rights and patents at national and international levels		At national and international levels	L3

UNIT-I

PRINCIPLES OF TECHNICAL WRITING: Styles in technical writing; clarity, precision, coherence and logical sequence in writing-avoiding ambiguity- repetition, and vague language -highlighting your findings-discussing your limitations -hedging and criticizing -plagiarism and paraphrasing.

UNIT-II

TECHNICAL RESEARCH PAPER WRITING: Abstract- Objectives-Limitations-Review of Literature-Problems and Framing Research Questions- Synopsis

UNIT-III

PROCESS OF RESEARCH: publication mechanism: types of journals- indexing-seminars- conferences- proof reading –plagiarism style; seminar & conference paper writing; Methodology-discussion-results- citation rules

UNIT-IV

INTRODUCTION TO INTELLECTUAL PROPERTY: Introduction, types of intellectual property, international organizations, agencies and treaties, importance of intellectual property rights

TRADE MARKS: Purpose and function of trademarks, acquisition of trade mark rights, protectable matter, selecting and evaluating trade mark, trade mark registration processes.

UNIT-V

LAW OF COPY RIGHTS: Fundamentals of copy right law, originality of material, rights of reproduction, rights to perform the work publicly, copy right ownership issues, copy right registration, notice of copy right, international copy right law

LAW OF PATENTS: Foundation of patent law, patent searching process, ownership rights and transfer. Patent law, intellectual property audits.

TEXTBOOKS:

1. Deborah. E. Bouchoux, *Intellectual Property Rights*, Cengage Learning India, 2013
2. Meenakshi Raman, Sangeeta Sharma. *Technical Communication:Principles and practices.*Oxford.

REFERENCES:

1. R.Myneni, *Law of Intellectual Property*, 9th Ed, Asia law House, 2019.
2. Prabuddha Ganguli, *Intellectual Property Rights* Tata Mc graw Hill, 2001
3. P.Naryan, *Intellectual Property Law*, 3rd Ed ,Eastern Law House, 2007.
4. Adrian Wallwork. *English for Writing Research Papers* Second Edition. Springer Cham Heidelberg New York ,2016
5. Dan Jones, Sam Dragga, *Technical Writing Style*

WEB RESOURCES:

1. https://theconceptwriters.com.pk/principles-of-technical-writing/
2. https://www.ewh.ieee.org/soc/emcs/acstrial/newsletters/summer10/TechPaperWriting.html
3. https://www.ewh.ieee.org/soc/emcs/acstrial/newsletters/summer10/TechPaperWriting.html
4. https://www.manuscriptedit.com/scholar-hangout/process-publishing-research-paper-journal/
5. https://www.icsi.edu/media/website/IntellectualPropertyRightLaws&Practice.pdf
6. https://lawbhoomi.com/intellectual-property-rights-notes/
7. https://www.extension.purdue.edu/extmedia/ec/ec-723.pdf

CORRELATION OF COS WITH THE POS & PSOS:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1									2				
CO2		3											
CO3									2		2		
CO4											3		
CO5											2		

CO-PO MAPPING JUSTIFICATION:

Unit No	Course Outcomes					Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
	Lesson Plan Hrs	%	Correlation	CO's Action Verb	BTL			
1							Thumb Rule	2
2							Analyze	3
3							Thumb Rule	2
4							Thumb Rule	3
5							Thumb Rule	2

JUSTIFICATION STATEMENTS:

CO1: Understand various principles and styles of technical writing by avoiding confusion, repetition, unclear language and plagiarism.

Action Verb: Understand (L2)

CO1 Action Verb Understand is of BTL 2. Using Thumb rule, L2 correlates PO6 to PO11 as moderate (2).

CO2: Apply the fundamentals of technical research paper writing by organizing abstract, objectives, limitations, literature review to frame effective research questions.

Action Verb: Apply (L3)

PO2 : Verb: Analyze

CO2 Action Verb Apply is of BTL 3. L3 is equal to PO2, then correlation is high (3)

CO3: Apply the research process and publication mechanisms and follow citation rules and proofreading techniques for paper writing.

Action Verb: Apply (L3)

CO3 Action Verb Apply is of BTL 3. Using Thumb rule, L3 correlates PO6 to PO11 as moderate (2)

CO4: Evaluate the rights and responsibilities of the holder of Intellectual Property.

Action Verb: Evaluate (L5)

CO4 Action Verb Analyze is of BTL 4. Using Thumb rule, L5 correlates PO6 to PO11 as high (3).

CO5: Apply various forms of copy rights and patents at national and international levels.

Action Verb: Apply (L3)

CO5 Action Verb Analyse is of BTL 4. Using Thumb rule, L3 correlates PO6 to PO11 as moderate (2).