Dr. Babasaheb Ambedkar Technological University, Lonere

Dr. Babasaheb Ambedkar Technological University
(Established as a University of Technology in the State of Maharashtra)
(Under Maharashtra Act No. XXIX of 2014)
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Course Structure and Detailed Syllabus

of

B. Tech Programme

for

Electronics & Computer Engineering / Electronics and Computer Science

from

Second Year Engineering

In line with National Education Policy 2020

(Effective from Academic year 2025-26

for Affiliated Colleges only)

Department of Electronics and Computer Engineering / Department of Electronics and Computer Science

Credit Framework under Four-Years UG Engineering Programme with Multiple Entry and Multiple Exit options:

- The Four-year Bachelor's Multidisciplinary Engineering Degree Programme allows the students to experience the full range of holistic and multidisciplinary education in addition to a focus on the chosen major and minors as per their choices and the feasibility of exploring learning from different institutions.
- The minimum and maximum credit structure for different levels under the Four-year Bachelor's Multidisciplinary Engineering UG Programme with multiple entry and multiple exit options are as given below:

Credit Framework

Levels	Qualification Title	Credit Requirements		Semester	Year
		Minimum	Maximum		
4.5	One Year UG Certificate in Engg./ Tech.	40	44	2	1
5.0	Two Years UG Diploma in Engg./ Tech.	80	88	4	2
5.5	Three Years Bachelor's Degree in Vocation (B. Voc.) or B. Sc. (Engg./ Tech.)	120	132	6	3
	4-Years Bachelor's degree				

Levels	Qualification Title	Credit Requirements		Semester	Year
		Minimum	Maximum		
6.0	(B.E./ B.Tech. or Equivalent) in Engg./ Tech. with Multidisciplinary Minor	160	176	8	4
6.0	4-Years Bachelor's degree (B.E./ B.Tech. or Equivalent) in Engg./ Tech.- Honors and Multidisciplinary Minor	180	194	8	4
6.0	4-Years Bachelor's degree (B.E./ B.Tech. or Equivalent) in Engg./ Tech.- Honors with Research and Multidisciplinary Minor	180	194	8	4
6.0	4-Years Bachelor's degree (B.E./ B.Tech. or Equivalent) in Engg./ Tech.- Major Engg. Discipline with Double Minors (Multidisciplinary and Specialization Minors)	180	194	8	4

- There are multiple exit options at each level. Student will be given a specific Qualification mentioned in the table depending on the level at which he/she decide to have an exit. Ex. If a student decides to exit after completion of two years (level 5.0) of the program, he will be given a Diploma in Engineering with specific exit condition mentioned in the syllabus of the specific branch. He/she can re-join the program with the multiple entry option at the level next where he/she chose to exit previously. (Student can join at level 5.5 if successfully completed level 5.0 previously at the time of exit).
- Minimum credit requirements of each level are mentioned in the credit framework table.
- There are 4 distinct options available at level 6.0.
- First one is basic level 6.0 option where minimum 160-maximum 176 credits are mandatory which can be completed as per the Semester-wise Credit distribution structure mentioned in the table given below.

Here, the Bachelor's Engineering Degree in chosen Engg./ Tech. Discipline with multidisciplinary minor (min.160-max.176 Credits) i.e. "**B. Tech in Electronics and Computer Engineering with Data Science**" (160-176 credits) enables students to take up five-six or required additional courses of 14 credits in the discipline other than Electronics and Computer Engineering distributed over semesters III to VIII. Here in the case of "**B. Tech in Electronics and Computer Engineering with Data Science**" (160-176 credits) student is supposed to complete the assigned 14 credits from other discipline's minor buckets.

- Remaining three level 6.0 options are the advanced options where the student is given an opportunity to get extra qualification by earning some extra credits (18-20 extra credits). These three options are given below:
- Level 6.0: The **Bachelor's Engineering Degree with Honours** in chosen Major Engg./ Tech. Discipline i.e. in Electronics and Computer Engineering with Honours with Multidisciplinary Minor (180-194 credits) enables students of Electronics and Computer Engineering to take up five-six additional courses of 18 to 20 credits in the Electronics and Computer Engineering discipline distributed over semesters III to VIII. The decision regarding the mechanism of distribution of these 18-20 credits over semesters III to VIII, which are over and above the min.160-max.176 Credits prescribed for the duration of four years will be taken by Academic Authorities of University. **Student must have CGPA equal to or greater than 7.5 at the end of second semester to go for this option**.
- Level 6.0: The **Bachelor's Engineering Degree with Research** in i.e. in Electronics and Computer Engineering with Research with Multidisciplinary Minor (180-194 credits) enables students of Electronics and Computer Engineering to take up a research project of 18 to 20 credits in the Electronics and Computer Engineering discipline distributed over semesters VII to VIII. **Student must have CGPA equal to or greater than 7.5 at the end of sixth semester to go for this option**.
- Level 6.0: The **Bachelor's Engineering Degree in chosen Engg./ Tech. Discipline with Double Minor** (Multidisciplinary and Specialization Minor, 180-194 credits), i.e. "**B. Tech in Electronics and Computer Engineering with *other selected discipline in* Engineering (as MDM) with Specialization Minor in Data Science**" (180-194 credits) enables students to take up five-six additional courses of 14 credits in the discipline other than Electronics and Computer Engineering(for completion of multidisciplinary minor) and 18 to 20 extra credits in the **Data Science discipline** distributed over semesters III to VIII. Here, the ***other selected discipline* in Engineering should be different from Specialization Minor i.e. Data Science**. This enables students to take up five-six or required additional courses of 18 to 20 credits in the **Data Science** discipline distributed over semesters III to VIII, which are over and above the min.160-max.176 Credits. The decision regarding the mechanism of distribution of these 18-20 credits over semesters III to VIII, prescribed for the duration of four years will be taken by Academic Authorities of University. **Student must have CGPA equal to or greater than 7.5 at the end of second semester to go for this option**.

Semester-wise Credit distribution structure for Four Year UG Engineering Program - One Major, One Minor

Semester		I	II	III	IV	V	VI	VII	VIII	Total Credits
Basic Science Course	BSC/ESC	06-08	08-10		--	--	--	--	--	14-18
Engineering Science Course		10-08	06-04		--	--	--	--	--	16-12
Programme Core Course (PCC)	Program Courses	--	02	08-10	08-10	10-12	08-10	04-06	04-06	44-56
Programme Elective Course (PEC)		--	--	--	--	04	08	02	06	20
Multidisciplinary Minor (MD M)	Multidisciplinary Courses		-	02	02	04	02	02	02	14
Open Elective (OE) Other than a particular program		--	--	04	02	02	--	--	--	08
Vocational and Skill Enhancement Course (VSEC)	Skill Courses	02	02	--	02	--	02	--	--	08
Ability Enhancement Course (AEC -01, AEC-02)	Humanities Social Science and Management (HSSM)	02	--	--	02	--	--	--	--	04
Entrepreneurship/Economics/ Management Courses		--		02	02	--	--	--	--	04
Indian Knowledge System (IKS)			02		--	--	--	--	--	02
Value Education Course (VEC)		--	--	02	02	--	--	--	--	04
Research Methodology	Experiential Learning Courses	--	--	--	--	--	--		04	04
Comm. Engg. Project (CEP)/Field Project (FP)		--	--	02	--	--	--	-	-	02
Project		--	--	--	--	--	--		04	04
Internship/ OJT		--	---			--	--	12	-	12
Co-curricular Courses (CC)	Liberal Learning Courses	02	02		--	--	--	--	-	04
Total Credits (Major)		**20-22**	**20-22**	**20-22**	**20-22**	**20-22**	**20-22**	**20-22**	**20-22**	**160-176**

Student need to follow the Semester-wise Credit distribution structure for Four Year UG Engineering Program as prescribed in the table given above.

- There are seven vertical categories with specific credits distributed in specific semesters.
- Student can choose a Program Elective Course (PEC) in that specific semester from the given subjects.
- Multidisciplinary course (MDM) and Open Elective (OE) courses can be chosen from the MDM and OE Buckets depending on students' choice. Completion of total credits given in the last column of the table for each vertical is mandatory.
- Students can complete 40% of the courses through online platforms like NPTEL/SWAYAM. The NPTEL SWAYAM course content should be at least 80% similar to the course content in the syllabus.

General Rules and Regulations

1. The normal duration of the course leading to B.Tech degree will be EIGHT semesters.
2. The normal duration of the course leading to M.Tech. degree will be FOUR semesters.
3. Each academic year shall be divided into 2 semesters, each of 20 weeks duration, including evaluation and grade finalization, etc. The Academic Session in each semester shall provide for at least 90 Teaching Days, with at least 40 hours of teaching contact periods in a five to six days session per week. The semester that is typically from Mid-July to November is called the ODD SEMESTER, and the one that is from January to Mid-May is called the EVEN SEMESTER. Academic Session may be scheduled for the Summer Session / Semester as well. For 1st year B. Tech and M. Tech the schedule will be decided as per the admission schedule declared by Government of Maharashtra.
4. The schedule of academic activities for a Semester, including the dates of registration, mid-semester examination, end-semester examination, inter-semester vacation, etc. shall be referred to as the Academic Calendar of the Semester, which shall be prepared by the Dean (Academic), and announced at least TWO weeks before the Closing Date of the previous Semester.
5. The Academic Calendar must be strictly adhered to, and all other activities including co-curricular and/or extra -curricular activities must be scheduled so as not to interfere with the Curricular Activities as stipulated in the Academic Calendar.

Registration:

1. Lower and Upper Limits for Course Credits Registered in a Semester, by a Full- Time Student of a UG/PG Programme: A full time student of a particular UG/PG programme shall register for the appropriate number of course credits in each semester/session that is within the minimum and maximum limits specific to that UG/PG programme as stipulated in the specific Regulations pertaining to that UG/PG programme.
2. Mandatory Pre-Registration for higher semesters: In order to facilitate proper planning of the academic activities of a semester, it is essential for the every institute to inform to Dean (Academics) and COE regarding details of total no. of electives offered (Course-wise) along with the number of students opted for the same. This information should be submitted within two weeks from the date of commencement of the semester as per academic calendar.
3. PhD students can register for any of PG/PhD courses and the corresponding rules of evaluation will apply.
4. Under Graduate students may be permitted to register for a few selected Post Graduate courses, in exceptionally rare circumstances, only if the DUGC/DPGC is convinced of the level of the academic achievement and the potential in a student.

Course Pre-Requisites:

1. In order to register for some courses, it may be required either to have exposure in, or to have completed satisfactorily, or to have prior earned credits in, some specified courses.
2. Students who do not register on the day announced for the purpose may be permitted LATE REGISTRATION up to the notified day in academic calendar on payment of late fee.
3. REGISTRATION IN ABSENTIA will be allowed only in exceptional cases with the approval of the Dean (Academic) / Principal.
4. A student will be permitted to register in the next semester only if he fulfills the following conditions:

   i Satisfied all the Academic Requirements to continue with the programme of Studies without termination

   ii Cleared all Institute, Hostel and Library dues and fines (if any) of the previous semesters;

   iii Paid all required advance payments of the Institute and hostel for the current semester;

   iv Not been debarred from registering on any specific ground by the Institute.

Evaluation System:

1. Absolute grading system based on absolute marks as indicated below will be implemented from academic year 2024-25, from 1st year B. Tech.

Percentage of marks	Letter Grade	Grade Point
91-100	EX	10.0
86-90	AA	9.0
81-85	AB	8.5
76-80	BB	8.0
71-75	BC	7.5
66-70	CC	7.0
61-65	CD	6.5
56-60	DD	6.0
51-55	DE	5.5
40-50	EE	5.0
<40	FF	0.0

2. Class is awarded based on CGPA of all eighth semester of B.Tech Program.

CGPA for pass is minimum 5.0	
CGPA upto <5.50	Pass class
CGPA ≥ 5.50&<6.00	Second Class
CGPA ≥ 6.00&<7.5	First Class
CGPA >7.50	Distinction
[Percentage of Marks =CGPA*10.0]	

3. A total of 100 Marks for each theory course are distributed as follows:

Mid Semester Exam (MSE) Marks	20
Continuous Assessment Marks	20
End Semester Examination (ESE) Marks	60

4. A total of 100 Marks for each practical course are distributed as follows:

1.	Continuous Assessment Marks	60
2.	End Semester Examination (ESE)Marks	40

- It is mandatory for every student of B. Tech to score a minimum of 40 marks out of 100, M. Tech to score a minimum of 45 marks out of 100 with a minimum of 20 marks out of 60 marks in End Semester Examination for theory course.
- This will be implemented from the first year of B. Tech starting from Academic Year 2024-25.

5. **Description of Grades**

- EX Grade: An “EX” grade stands for outstanding achievement.
- EE Grade: The “EE” grade stands for minimum passing grade.
- FF Grade: The “FF” grade denotes very poor performance, i.e. failure in a course due to poor performance. The students who have been awarded ‘FF’ grade in a course in any semester must repeat the subject in next semester.

6. **Evaluation of Performance**

a. Semester Grade Point Average (SGPA)

The performance of a student in a semester is indicated by Semester Grade Point Average (SGPA) which is a weighted average of the grade points obtained in all the courses taken by the student in the semester and scaled to a maximum of 10. (SGPI is to be calculated up to two decimal places). A Semester Grade Point Average (SGPA) will be computed for each semester as follows:

$$SGPA = \frac{[\sum_{i=1}^{n} c_i g_i]}{[\sum_{i=1}^{n} c_i]}$$

Where

"*n*" is the number of subjects for the semester,

"c_i" is the number of credits allotted to a particular subject, and

"g_i" is the grade-points awarded to the student for the subject based on his performance as per the above table.

SGPA will be rounded off to the second place of decimal and recorded as such.

b. Cumulative Grade Point Average (CGPA):

An up to date assessment of the overall performance of a student from the time he entered the Institute is obtained by calculating Cumulative Grade Point Average (CGPA) of a student. The CGPA is weighted average of the grade points obtained in all the courses registered by the student since s/he entered the Institute. CGPA is also calculated at the end of every semester (upto two decimal places).Starting from the first semester at the end of each semester (S), a Cumulative Grade Point Average (CGPA) will be computed as follows:

$$CGPA = \frac{[\sum_{i=1}^{m} c_i g_i]}{[\sum_{i=1}^{m} c_i]}$$

Where,

"m" is the total number of subjects from the first semester onwards up to and including the semester S,

"ci" is the number of credits allotted to a particular subject, and

"gi" is the grade-points awarded to the student for the subject based on his/her performance as per the above table.

CGPA will be rounded off to the second place of decimal and recorded as such.

7. Attendance Requirements:

a. All students must attend every lecture, tutorial and practical classes.

b. To account for approved leave of absence (eg. representing the Institute in sports, games or athletics; placement activities; NCC/NSS activities; etc.) and/or any other such contingencies like medical emergencies, etc., the attendance requirement shall be a minimum of 75% of the classes actually conducted. If the student failed to maintain 75% attendance, he/she will be detained for appearing the successive examination. The Dean

(Academics)/ Principal is permitted to give 10% concession for the genuine reasons as such the case may be. In any case the student will not be permitted for appearing the examination if the attendance is less than 65%.

c. The course instructor handling a course must finalize the attendance 3 calendar days before the last day of classes in the current semester and communicate clearly to the students by displaying prominently in the department and also in report writing to the head of the department concerned.

d. The attendance records are to be maintained by the course instructor and he shall show it to the student, if and when required.

8. Transfer of Credits:

The courses credited elsewhere, in Indian or foreign University/Institutions/ Colleges/Swayam Courses by students during their study period at DBATU may count towards the credit requirements for the award of degree. The guidelines for such transfer of credits are as follows:

a. 20 % of the total credit will be considered for respective calculations.

b. Credits transferred will be considered for overall credits requirements of the programme.

c. Credits transfer can be considered only for the course at same level i.e UG, PG etc.

d. A student must provide all details (original or attested authentic copies) such as course contents, number of contact hours, course instructor /project guide and evaluation system for the course for which he is requesting a credits transfer. He/she shall also provide the approval or acceptance letter from the other side. These details will be evaluated by the concerned Board of Studies before giving approval. The Board of Studies will then decide the number of equivalent credits the student will get for such course(s) in DBATU. The complete details will then be forwarded to Dean for approval.

e. A student has to get minimum passing grades/ marks for such courses for which the credits transfers are to be made.

f. Credits transfers availed by a student shall be properly recorded on academic record(s) of the student.

g. In exceptional cases, the students may opt for higher credits than the prescribed.

Dr. Babasaheb Ambedkar Technological University, Lonere

B. Tech Electronics and Computer Engineering /

B. Tech Electronics and Computer Science

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Second Year Teaching and Evaluation Scheme

Semester III												
Sr. No.	**Course Category**	**Course Code**	**Course Title**	**Teaching Scheme**			**Evaluation Scheme**				**Credit**
				L	**T**	**P**	**CA**	**MSE**	**ESE**	**Total**	
1	BSC	25AF1000BS301	Engineering Mathematics-III	3	0	0	20	20	60	100	3
2	PCC	25AF1844PC302	Analog and Digital Electronics	3	0	0	20	20	60	100	3
3	PCC	25AF1844PC303	Principles of Data Structure	3	0	0	20	20	60	100	3
4	PCC Lab	25AF1844PC304L	Analog and Digital Electronics Lab	0	0	2	60	--	40	100	1
5	OE	25AF1XXXOE305	**Open Elective Bucket****	2	0	0	20	20	60	100	2
6	MDM	25AF1844MD306	**MDM Bucket***	2	0	0	20	20	60	100	2
7	EEM	25AF1000AE307A 25AF1000AE307B	A. Employability and Skill Development B. Innovation and Entrepreneurship	2	0	0	20	20	60	100	2
8	VEC	25AF1000VE308	Life of Chhatrapati Shivaji Maharaj	1	0	0	50	--	--	50	1
9	PCC Lab	25AF1844PC309L	Principles of Data Structure Lab	0	0	2	60	--	40	100	1
10	VEC	25AF1UHVVE310	Universal Human Values II	3	0	0	20	20	60	100	3
11	CEP/FP	25AF1844CP311	Community Engagement Project (CEP)	0	0	4	60	--	40	100	2
			Total	**19**	**0**	**8**				1050	**23**

NOTE: * Refer to Multidisciplinary Minor Bucket of other Departments
**** Refer to Open Elective Bucket available on University Website**

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Second Year Teaching and Evaluation Scheme

Semester IV											
Sr. No.	**Course Category**	**Course Code**	**Course Title**	**Teaching Scheme**			**Evaluation Scheme**				**Credit**
				L	**T**	**P**	**CA**	**MSE**	**ESE**	**Total**	
1	PCC	25AF1844PC401	Microcontroller and Applications	3	0	0	20	20	60	100	3
2	PCC Lab	25AF1844PC402L	Microcontroller and Applications Lab	0	0	2	60	--	40	100	1
3	PCC	25AF1844PC403	Object Oriented Programming	3	0	0	20	20	60	100	3
4	PCC Lab	25AF1844PC404L	Object Oriented Programming Lab	0	0	2	60	--	40	100	1
5	OE	25AF1XXXOE405	**Open Elective Bucket****	3	0	0	20	20	60	100	3
6	MD Minor	25AF1844MD406	**MDM Bucket***	2	0	0	20	20	60	100	2
7	VEC	25AF1COIVE407	Constitution of India	2	0	0	50	--	--	AU	AU
8	VEC	25AF1000VE408	Life of Bharatratna Dr. Babasaheb Ambedkar	1	0	0	50	--	--	50	1
9	EEM	25AF1000HM409	Patents and IPR	2	0	0	20	20	60	100	2
10	HSSM	25AF1000AE410A 25AF1000AE410B 25AF1000AE410C	A. Marathi B. Hindi C. Sanskrit	2	0	0	20	20	60	100	2
11	VSEC	25AF1844VS411A 25AF1844VS411B	A. Web Development B. PCB Designing	0	0	4	60	--	40	100	2
12	PCC	25AF1844PC412	Operating Systems	3	0	0	20	20	60	100	3
			Total	**21**	**0**	**08**				1050	**23**

NOTE: * Refer to Multidisciplinary Minor Bucket
**** Refer to Open Elective Bucket**

SECOND YEAR

SEMESTER III

25AF1000BS301	Engineering Mathematics-III	03 Credits

Course Objectives:

The objective of this course is to provide students with:

1. Linear differential equations of higher order using analytical methods and numerical methods applicable to Control systems and Network analysis.
2. Transforms such as Fourier transform, Laplace transform and applications to Communication systems and Signal processing.
3. Vector differentiation and integration required in Electro-magnetics and Wave theory.
4. Complex functions, conformal mappings, contour integration applicable to Electrostatics, Digital filters, Signal and Image processing.

Course Outcomes:

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

CO1: Solve higher order linear differential equation using appropriate techniques for modelling and analyzing electrical circuits.

CO2: Solve problems related to Fourier transform, Laplace transform and applications to Communication systems and Signal processing.

CO3: Obtain Interpolating polynomials, numerically differentiate and integrate functions, numerical solutions of differential equations using single step and multi-step iterative methods used in modern scientific computing.

CO4: Perform vector differentiation and integration, analyze the vector fields and apply to Electromagnetic fields.

CO5: Analyze conformal mappings, transformations and perform contour integration of complex functions in the study of electrostatics and signal processing.

Unit-I: Laplace Transform **08 Hours**

Definition – conditions for existence; Transforms of elementary functions; Properties of Laplace transforms - Linearity property, first shifting property, second shifting property, transforms of functions multiplied by t^n, scale change property, transforms of functions divided by t, transforms of integral of functions, transforms of derivatives; Evaluation of integrals by using Laplace transform; Transforms of some special functions- periodic function, Heaviside-unit step function, Dirac delta function.

Unit-II: Inverse Laplace Transform **08 Hours**

Introductory remarks; Inverse transforms of some elementary functions; General methods of finding inverse transforms; Partial fraction method and Convolution Theorem for finding inverse Laplace transforms; Applications to find the solutions of linear differential equations and simultaneous linear differential equations with constant coefficients.

Unit-III: Fourier Transform **08 Hours**

Definitions – integral transforms; Fourier integral theorem (without proof); Fourier sine and cosine integrals; Complex form of Fourier integrals; Fourier sine and cosine transforms; Properties of Fourier transforms; Parseval's identity for Fourier Transforms.

Unit-IV: Partial Differential Equations and Their Applications **08 Hours**

Formation of Partial differential equations by eliminating arbitrary constants and functions; Equations solvable by direct integration; Linear equations of first order (Lagrange's linear equations); Method of separation of variables – applications to find solutions of one dimensional heat flow equation and one dimensional wave equation.

Unit-V: Functions of Complex Variables **08 Hours**

Analytic functions; Cauchy- Riemann equations in Cartesian and polar forms; Harmonic functions in Cartesian form; Cauchy's integral theorem; Cauchy's integral formula; Residues; Cauchy's residue theorem (All theorems without proofs).

Text Books

1. Higher Engineering Mathematics by B. S. Grewal, Khanna Publishers, NewDelhi.
2. Higher Engineering Mathematics by H. K. Das and Er. Rajnish Verma, S. Chand & CO. Pvt. Ltd., New Delhi.
3. A course in Engineering Mathematics (Vol III) by Dr. B. B. Singh, Synergy Knowledge ware, Mumbai.
4. Higher Engineering Mathematics by B. V. Ramana, Tata McGraw-Hill Publications,
5. New Delhi.

Reference Books

1. Advanced Engineering Mathematics by Erwin Kreyszig, John Wiley & Sons, NewYork.
2. A Text Book of Engineering Mathematics by PeterO'Neil, Thomson Asia Pte Ltd., Singapore.
3. Advanced Engineering Mathematics by C. R. Wylie & L. C. Barrett, Tata McgrawHill Publishing Company Ltd., NewDelhi.
4. Integral Transforms and their Engineering Applications by Dr. B. B. Singh, Synergy Knowledge ware, Mumbai.
5. Integral Transforms by I. N. Sneddon, Tata McGraw-Hill, NewYork.

24AF1844PC302	Analog and Digital Electronics	03 Credits

Course Objectives:

The objective of this course is to provide students with

1. Concepts of Semiconductor devices like BJT and MOSFET, its characteristics, parameters & applications
2. Knowledge of Operational amplifier, concept, parameters & applications
3. Boolean algebra, Karnaugh-Maps and its application to the design and characterization of combinational logic Circuits.
4. The principles of logic design and use of simple memory devices, flip-flops, and sequential circuits.

Course Outcomes:

After completing this course, students will be able to

CO1: Analyze the MOSFET based amplifiers with and without feedback.

CO2: Explore and deploy basic configurations of Op-amp and explain relevant parameters.

CO3: Apply the knowledge of number systems and Boolean algebra for simplification of logic equations.

CO4: Design and implement combinational logic circuits.

CO5: Design and implement Sequential logic circuits.

Unit-I: MOSFET Circuits and applications **08 Hours**

Types of MOSFETs, Construction, working, and characteristics. Common Source amplifier, CS/CD/CG Configurations, Common source amplifier, MOSFET as switch, MOSFET as resistor/diode. Concept of Feedback – Types of Negative Feedback amplifiers, Oscillators: Barkhausen Criterion, Wein Bridge & Phase shift oscillator.

Unit-II: Operational Amplifier **08 Hours**

Block diagram of Op-Amp, Op-amp characteristics (AC & DC), and Op-amp parameters. Inverting amplifier, non-inverting amplifier, Voltage follower, Summing amplifier, Differential amplifier, Comparator, Schmitt trigger, Square & triangular wave generator, Precision rectifiers.

Unit-III: Basics of Digital Electronics **08 Hours**

Number system & codes: Binary Number base conversion, Octal & hexadecimal numbers, complements, signed binary numbers, binary codes-BCD codes, gray codes, ASCII Character Code. Boolean algebra: Basic Theorems, Sum-of-Product, Product-of-Sum, up to 4 variable K-map. Don’t care condition, Code convertors.

Unit-IV: Combinational Circuit Design **08 Hours**

NAND and NOR Implementation, Adders and Subtractors, look ahead carry, BCD Adder, Digital Comparator, Parity generators/checkers, Multiplexers, Encoders, De-multiplexers and Decoders and their use in combinational logic designs.

Unit-V: Sequential Circuit Design **08 Hours**

1 Bit Memory Cell, Clocked SR, JK, MS J-K flip flop, D and T flip-flops. Use of preset and clear terminals, Excitation Table for flip flops. Application of Flip- flops: Registers, Shift registers, Sequence Generators, ripple counters, up/down counters, synchronous counters, Basics of State Machines

Text Books:

1. Donald Neaman, "Electronic Circuits – Analysis and Design" Third edition, McGraw Hill. 2019.
2. R.P. Jain, Kishor Sarawadekar, "Modern Digital Electronics", Fifth edition, McGraw Hill, 2022.

Reference Books:

1. Jacob Millman, Christos Halkias, Chetan Parekh "Integrated Electronics", Second Edition, McGraw Hill, 2018
2. Ramakant Gayakwad, "Op Amps & Linear Integrated Circuits", Pearson Education. Fourth Edition, 2015.
3. Anand Kumar, "Fundamentals of Digital Circuits", Fourth Edition, Prentice Hall of India, 2016

24AF1844PC303	Principles of Data Structure	03 Credits

Course Objectives:

The objective of this course is to provide students with

1. A fundamental understanding of the concepts of data structure
2. Analysis of performance based on time and space complexity, asymptotic notations, best, average and worst cases
3. Representation of linear data structure and their storage
4. A foundational understanding of stacks and queues, linked list
5. The essential groundwork for implementation of trees and graph theories.

Course Outcomes:

After completing this course, students will be able to

CO1: Understand the concepts of linear data structures, their representations, and perform various operations to assess their behavior, efficiency, and algorithmic complexity.

CO2: Demonstrate the working of stacks and queues and apply operations to various applications

CO3: Analyze and compare the time complexity of various searching, sorting, and traversal algorithms to evaluate their efficiency.

CO4: Examine non-linear data structures, implement traversal techniques, and apply algorithms to perform essential operations effectively.

CO5: Apply dynamic programming and competitive programming techniques, such as bit manipulation, divide and conquer, and hashing, to solve complex computational problems.

Unit-I: Data Structures **08 Hours**

Introduction: Need of DS, Abstract Data Types, Types of Data Structures: Linear and NonLinear, Operations on Data Structures: Traversing, Searching, Sorting, Deletion, Insertion.

Linear Data Structure: Linear Lists: Linked Lists, Types, and Representation of Linear Lists in memory, traversing a Linked List, Searching a Linked List, Memory Allocation: Insertion of Node into a Linked List, Deletion of Node from Linked List, Circular Linked Lists, and Doubly Linked Lists.

Unit-II: Stacks and Queues **08 Hours**

Stacks: Introduction to Stacks, Memory Representation of stack using array and Link List, Operations: Push, Pop, StackFull, StackEmpty, and Stack Overflow & Underflow.

Stack Applications: Reversing a List, Expression Evaluation: Infix, Prefix, Postfix, Conversion, and Evaluation.

Queues: Introduction to Queues, Memory Representation of Queue using array, Types of Queues: Linear Queue, Circular Queue, Priority Queue, and Queue Operations: Insert and Delete, QueueFull, QueueEmpty, and Applications of Queue.

Unit-III: Non Linear Data Structures: Trees & Graphs **08 Hours**

Trees – Definitions-Degree of Tree / Node, Depth / Height of Tree, In-degree, Out-degree, Path, tree representation, properties of trees, Types of Tree: Binary tree, Binary tree representation, Binary Tree Properties, Binary Tree Implementation, Binary Tree Traversals: In-order, Pre-order, Post-order , BST, Applications of trees.

Graphs - Graph Introduction, Graph theory terminology, Directed Graph, Undirected Graph, Representation of graphs, Path Matrix, Traversing a graph: Breadth- First search, Depth-Final search, Adjacency Matrix of Directed and Undirected Graph, Applications.

Unit-IV: Algorithms **08 Hours**

Introduction to Algorithms, Asymptotic analysis Big-O, Big-Theta and other notations, Algorithm Analysis-Worst, Average and Best case analysis, Algorithm Complexity: Time & Space Complexity tradeoff.

Types of Algorithms: Sorting: Bubble Sort, Insertion sort, Quick Sort, Selection sort, Merge-sort. **Searching**: Sequential and binary searches. Hashing Schemes.

Unit-V: Competitive and Dynamic Programming **08 Hours**

Competitive Programming: Bit Manipulation Techniques, Divide & Conquer, Two Pointer & Sliding, Window Problems, Hashing Techniques (Chaining, Open Addressing).

Dynamic Programming: Memoization vs Tabulation. Classical Problems: Fibonacci, Knapsack, Longest Common Subsequence (LCS), Longest Increasing Subsequence (LIS)

Text Books:

1. Ellis Horowitz, S. Sahni, D. Mehta, Fundamentals of Data Structures in C++, Universities Press, 2008
2. Mark Allen Weiss, Data Structures and Algorithm Analysis in C++, Pearson Education, 2014

Reference Books:

1. Bjarne Stroustrup, the C++ Programming Language, 2013.
2. Bjarne Stroustrup, Programming: Principles and Practice Using C++, 2014.
3. Gayle McDowell, Cracking the Coding Interview, 6th edition

NPTEL Courses:

1. NPTEL Course **"Data Structures and Algorithms Design**", by Prof. Nitin Saxena, IIT Kanpur https://nptel.ac.in/courses/106104697
2. NPTEL Course **"Programming in Modern C++",** By Prof. Partha Pratim Das, IIT Kharagpur https://onlinecourses.nptel.ac.in/noc22_cs43/preview

25AF1844PC304L	Analog and Digital Electronics Lab	01 Credits

Course Outcomes:

After completing this course, students will be able to:

CO1: Measure the parameters of semiconductor devices and plot their characteristics**.**

CO2: Implement and analyse BJT, MOSFET and Op-Amp based circuits.

CO3: Implement and verify the operation of various combinational logic circuits.

CO4: Implement and verify the operation of various sequential logic circuits.

List of Experiments:

Analog Electronics (Any four):

1. To measure following Op- amp parameters & compare with specifications given in data sheet. [Any two Practical Op-Amp can be used for comparison. eg. LM741, OP07, LF351, LF356] a) Input bias current b) Input offset current c) Input offset voltage d) Slew rate e) CMRR.
2. To design, build & test integrator using Op-amp for given frequency.
3. To design, build & test Schmitt trigger using Op-Amp.
4. Design, build & test square and triangular waveform generator using Op-Amp.
5. To design, build single stage CS amplifier & verify dc operating point.
6. To build & test single stage CS amplifier, plot frequency response. Calculate Av, Ri, Ro & bandwidth
7. To build and test BJT based RC coupled amplifier for its frequency response.
8. To build and test RC phase shift oscillator and calculate oscillating frequency.

Digital Electronics (Any four):

1. Study of code converter circuits:
    a. Design and implement 4 bit Binary to Gray code convertor using logic gates
    b. Design and implement 4-bit Gray to Binary code convertor using logic gates
    c. Design and implement 4-bit BCD to EX-3 code convertor using logic gates
    d. Design and implement EX-3 to BCD code convertor using logic gates
2. Study of IC-74LS153 as a Multiplexer:
    a. Design and implement 8:1 MUX using IC-74LS153 & verify its truth table.
    b. Design & implement the given 4 variable functions using IC74LS153. Verify its truth-table

3. Study of IC-74LS138 as a Demultiplexer / Decoder:
    a. Design and implement full adder and subtractor function using IC-74LS138
    b. Design & implement 3-bit code converter using IC-74LS138. (Gray to Binary/Binary to Gray
4. Study of IC-74LS83 as a BCD adder:
    a. Design and implement 1 digit BCD adder usingIC-74LS83
    b. Design and implement 4-bit Binary Adder and subtractor using IC-74LS83
5. Study of IC-74LS85 as a magnitude comparator:
    a. Design and implement 4-bit comparator
    b. Design and implement 8-bit comparator
6. Study of Flip-flop circuits
    a. Verify the truth table of SR, JK, D and T-type of Flip-flops
7. Study of Counter ICs (74LS90/74LS93):
    a. Design and implement MOD-N and MOD-NN using IC-74LS90 and draw timing diagram.
    b. Design and implement MOD-N and MOD-NN using IC-74LS93 and draw timing diagram
8. Design & implement ring counter and twisted ring counter using IC 74HC194

25AF1000HM307A	Employability and Skill Development	02 Credits

Course Objectives:

The objective of this course is to provide students with

1. To develop analytical abilities.
2. To develop communication skills.
3. To introduce the students to skills necessary for getting, keeping and being successful in a profession.
4. To expose the students to leadership and team-building skills.

Course Outcomes:

After completing this course, students will be able to

CO1: Develop soft skills and communication skills for job applications

CO2: Inculcate the interpersonal skills and etiquettes.

CO3: Write proper technical and non-technical documents with use of grammar.

CO4: Master the presentation skill and be ready for facing interviews

CO5: Build team and lead it for problem solving.

Unit-I: Soft Skills & Communication basics **06 Hours**

Soft skills vs. hard skills, Skills to master, Interdisciplinary relevance, Global and national perspectives on soft skills, Resume, Curriculum vitae, How to develop an impressive resume, Different formats of resume – Chronological, Functional, Hybrid, Job application or cover letter, Professional presentation- planning, preparing and delivering presentation.

Unit-II: Interpersonal Skills **06 Hours**

Critical Thinking, Assertiveness, Decision Making, Problem Solving, Negotiation, Building Confidence, Time Management, Personal Presentation, Assertiveness, negotiation, avoiding Stress. Commercial Awareness: Professional etiquettes and manners.

Unit-III: Grammar and Comprehension: **06 Hours**

English sentences and phrases, Technical writing, Paragraph writing, Story writing, Reproduction of a story, Letter writing and e-mail writing.

Unit-IV: Skills for interviews: **06 Hours**

Interviews- types of interviews, preparatory steps for job interviews, interview skill tips, Group discussion- importance of group discussion, types of group discussion, difference between group discussion, panel discussion and debate, tips for successful participation in group discussion, Listening skills: virtues of listening, fundamentals of good listening.

Unit-V: Problem Solving Techniques **06 Hours**

Problem solving model: 1. Define the problem, 2. Gather information, 3. Identify various solution, 4. Evaluate alternatives, 5. Take actions, 6. Evaluate the actions. Problem solving skills: 1. Communicate. 2. Brain storming, 3. Learn from mistakes.

Text Books:

1. R. Gajendra Singh Chauhan, Sangeeta Sharma, “Soft Skills- An integrated approach to maximize personality”, Wiley
2. Wren and Martin, "English grammar and Composition", S. Chand Publications.
3. R. S. Aggarwal, "A modern approach to verbal reasoning", S. Chand Publications.
4. Philip Carter, "The Complete Book of Intelligence Test", John Willey & Sons Ltd.

Reference Books:

1. Philip Carter, Ken Russell, "Succeed at IQ test", Kogan Page.
2. Eugene Ehrlich, Daniel Murphy, "Schaum’s Outline of English Grammar", McGraw
3. Hills.
4. David F. Beer, David A. McMurrey, “A Guide to Writing as an Engineer”, ISBN: 978-1-118-30027-5 4th Edition, 2014, Wiley.

NPTEL Courses:

1. Soft Skill Development, IIT Kharagpur, Prof. Priyadarshi Patnaik, Prof. V. N. Giri, Prof. D. Suar https://onlinecourses.nptel.ac.in/noc25_hs142/preview
2. Employment Communication A Lab based course, IIT Kharagpur, Prof. Seema Singh, https://onlinecourses.nptel.ac.in/noc21_hs06/preview

25AF1000HM307B	Innovation and Entrepreneurship	02 Credits

Course Objectives:

1. To build inspiration, aspiration, knowledge, skills, networks, practical experience, and confidence to Start-up a new Venture.

Course Outcomes:

After completing this course, students will be able to:

CO1: Develop entrepreneurial mind-set and attributes;

CO2: Apply process of problem-opportunity identification and feasibility assessment through developing a macro perspective of the real market, industries, domains and customers

CO3: Analyse Customer and Market segmentation, estimate Market size.

CO4: Initiate Solution design, Prototype for Proof of Concept. Understand MVP development and validation techniques to determine Product-Market fit.

CO5: Craft initial Business and Revenue models, financial planning and pricing strategy for profitability and financial feasibility of a venture.

Unit-I: Entrepreneurship Fundamentals & Context **06 Hours**

Meaning and concept, attributes and mindset of entrepreneurial and intrapreneurial leadership, role models in each and their role in economic development. Gamified role play based exploration aligned to one's short term career aspiration and ambition. An understanding of how to build entrepreneurial mindset, skillsets, attributes and networks while on campus.

Core Teaching Tool: Simulation, Game, Industry Case Studies (Personalized for students – 16 industries to choose from), Venture Activity

Unit-II: Problem & Customer Identification **06 Hours**

Understanding and analysing the macro Problem and Industry perspective, technological, socio-economic and urbanization trends and their implication on new opportunities. Identifying passion, identifying and defining problem using Design thinking principles.

Analysing problem and validating with the potential customer. Iterating problem-customer fit. Understanding customer segmentation, creating and validating customer personas. Competition and Industry trends mapping and assessing initial opportunity.

Core Teaching Tool: Several types of activities including: Class, game, Gen AI, „Get out of the Building" and Venture Activity.

Unit-III: Solution design & Prototyping **06 Hours**

Understanding Customer Jobs-to-be-done and crafting innovative solution design to map to customer's needs and create a strong value proposition. Developing Problem-solution fit in an iterative manner. Understanding prototyping and MVP. Developing a feasibility prototype with differentiating value, features and benefits. Initial testing for proof-of-concept and iterate on the prototype.

Core Teaching Tool: Venture Activity, nocode Innovation tools, Class activity

Unit-IV: Opportunity Assessment and Sizing **06 Hours**

Assess relative market position via competition analysis, sizing the market and assess scope and potential scale of the opportunity.

Core Teaching Tool: Class and Venture Activity

Unit-V: Business & Financial Model, Go-to-Market Plan **06 Hours**

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 analysing 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 Lifecycle to Funding Options.

Core Teaching Tool: Founder Case Studies – Sama and Securely Share; Class activity and discussions; Venture Activities.

Reference Books

1. Robert D. Hisrich, Michael P. Peters, Dean A. Shepherd, Sabyasachi Sinha (2020). Entrepreneurship, McGrawHill, 11th Edition.
2. Ries, E. (2011). The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses. Crown Business.
3. Osterwalder, A., & Pigneur, Y. (2010). Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers. John Wiley & Sons
4. Chowdhry Ajay, (2023) Just Aspire: Notes on Technology, Entrepreneurship and the Future.
5. Simon Sinek (2011) Start With Why, Penguin Books limited
6. Brown Tim (2019) Change by Design Revised & Updated: How Design Thinking Transforms Organizations and Inspires Innovation, Harper Business
7. Namita Thapar (2022) The Dolphin and the Shark: Stories on Entrepreneurship, Penguin Books Limited
8. Collins Jim, Porras Jerry, (2004) Built to Last: Successful Habits of Visionary Companies
9. Burlington Bo, (2016) Small Giants: Companies That Choose to Be Great Instead of Big
10. Saras D. Sarasvathy, (2008) Effectuation: Elements of Entrepreneurial Expertise, Elgar Publishing Ltd

Web Resources

Learning resource- IgniteX Course Wadhwani platform

25AF1000VE308	Life of Chhatrapati Shivaji Maharaj	01 Credit

Course Objectives:

The objective of this course is to provide students with

1. Analyze Chhatrapati Shivaji Maharaj's leadership qualities, strategic thinking, and management skills.
2. Develop critical thinking and problem-solving skills through case studies and discussions.
3. Recognize the relevance of the Chhatrapati's principles and values in modern times.

Course Outcomes:

After completing this course, students will be able to:

CO1: Explain Chhatrapati Shivaji Maharaj's military strategies, conquests, and establishment of the Maratha Empire.

CO2: Evaluate the Chhatrapati's leadership qualities, such as courage, vision, human values and adaptability.

CO3: Apply the Chhatrapati's principles, such as decentralization and social welfare, to modern engineering challenges.

Unit-I: Shivaji Maharaj as a Great Conqueror **05 Hours**

Master Strategist and innovator in Military Tactics, Guerrilla Warfare (Ganimi Kava), Fortress Strategy, Avoidance of Direct Confrontation, Diplomacy and Alliances, Naval Power.

Unit-II: Shivaji Maharaj's Management and leadership strategies **05 Hours**

Architecture and metallurgy of Raigad Fort, Use of Light Cavalry, Intelligence Network, Asymmetric Warfare, Logistics and Supply Chains, Fortifications and Military Architecture.

Unit-III: Shivaji Maharaj's views on Democracy and Nationalism **05 Hours**

Shivaji Maharaj's views about Women's rights, their dignity and religious views, His views on Democracy & Nationalism.

Text Books / References:

1. Desai, Ranjeet, "Shriman Yogi", Mehta Publishing House. 2018.
2. Kurundkar, Narhar. "Chatrapati Shivaji Maharaj Jeevan Rahasya". Deshamukh and Company. 2024.
3. Sarkar, Jadunath, "Shivaji and His Times by Jadunath Sarkar", Classic Book on the Life and History of the Maratha Emperor. Nandy Books. 2024.
4. Keluskar, Krushnaji Arjun. "Chhatrapati Shivaji Maharaj". Sudhir Prakashan. 2020.
5. Bedekar, Ninad. "Kalatil Vyavsthapan Tatve". 2015.

25AF1844PC309L	Principles of Data Structure Lab	01 Credits

Course Objectives:

The objective of this course is to provide students with:

1. A fundamental understanding of the concepts of data structure.
2. Understanding of Sorting Algorithms.
3. Analysis of performance on the basis of time and space complexity, asymptotic notations, best, average and worst cases
4. A foundational understanding of stacks and queues.
5. The essential groundwork for implementation of trees and graph theories

Course Outcomes:

After completing this course, students will be able to:

CO1: Implement and analyze the time complexity of various searching, sorting, and traversal algorithms through hands-on experiments to evaluate their efficiency in different scenarios.

CO2: Design and implement programs using linear data structures (arrays, linked lists, stacks, and queues) to perform insertion, deletion, and searching operations, and analyze their efficiency through experimental evaluation.

CO3: Develop and execute programs using non-linear data structures (trees and graphs) by applying traversal techniques and performing operations such as insertion, deletion, and searching to understand their practical applications.

CO4: Apply dynamic programming and competitive programming techniques, including bit manipulation, divide & conquer, sliding window, and hashing, to solve real-world computational problems efficiently through practical implementation.

List of Experiments:

1. Implement following data structures using Standard Template Library (STL) to manipulate data elements.
   a. Vector (create, access (front, back, at), alter, loop through, insert, and delete).
   b. List (create, access (front, back, at), alter, loop through, insert, and delete).
   c. Stack (create, access, alter, loop through, insert, and delete).
   d. Queue (create, access, alter, loop through, insert, and delete).
   e. Set ((create, access, add, remove, loop through, unique, and sort).
   f. Map (create, access, alter, loop through, insert, and delete).
2. Design and implement a function in C++ to evaluate an infix expression directly, without converting it to postfix. The function should correctly handle spaces, parentheses (), Operator precedence, and associativity.
3. Implement a C++ program for a ticket booking system where customers arrive at a counter and wait in a queue. The program should allow customers to join the queue (enqueue), process a customer when they buy a ticket (dequeue), and display the current queue status.

4. Create a C++ program using a circular linked list to implement a simple music playlist. Each song should have a title and duration. The program should support adding a song, deleting a song, moving to the next song, and displaying the current playlist in a loop.
5. Design and implement a C++ program to manage a student database using a Binary Search Tree (BST). Each node of the BST should store student details such as Roll Number, Name, and Marks. The BST should support the following operations:
    a. Insert a new student record (based on Roll Number as the key).
    b. Delete a student record by Roll Number.
    c. Search for a student by Roll Number.
    d. Display the student records using Inorder, Preorder, and Postorder traversal (both recursively and non-recursively).
    e. Find the student with the highest and lowest marks using BST properties.
    f. Find the total number of students (size of BST).
6. Design and implement a C++ program to model a simple social network using a graph. Each person is represented as a node, and a connection (friendship) between two people is represented as an edge. The program should allow the following operations:
    a. Add a new person to the network.
    b. Create a friendship connection between two people.
    c. Find all friends of a given person using Breadth-First Search (BFS).
    d. Find if a connection exists between two people using Depth-First Search (DFS).
    e. Display the entire social network (Graph Representation: Adjacency List or Matrix).
7. Design a C++ program to solve the following real-world applications using DP:
    a. DNA Sequence Matching – Use LCS to find similarities between two DNA sequences.
    b. Stock Market Analysis – Use LIS to determine the longest period of increasing stock prices.

25AF1UHVVE310	Universal Human Values - II	03 Credits

Course Objectives:

1. To help the students appreciate the essential complementarily between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
2. To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.
3. To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behaviour and mutually enriching interaction with Nature.

Course Outcomes:

By the end of the course, students are expected to become more aware of themselves, and their surroundings (family, society, nature); they would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.

They would have better critical ability. They would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society). It is hoped that they would be able to apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.

This is only an introductory foundational input. It would be desirable to follow it up by

a) Faculty-student or mentor-mentee programs throughout their time with the institution

b) Higher level courses on human values in every aspect of living.

Unit-I: Introduction to Value Education **07 Hours**

Understanding Value Education, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity the Basic Human Aspirations, Right Understanding, Relationship and Physical Facility, Happiness and Prosperity Current Scenario, Method to Fulfil the Basic Human Aspirations

Unit-II: Harmony in the Human Being **07 Hours**

Understanding Human being as the Co-existence of the Self and the Body, Distinguishing between the Needs of the Self and the Body, The Body as an Instrument of the Self, Understanding Harmony in the Self, Harmony of the Self with the Body, Programme to ensure self-regulation and Health.

Unit-III: Harmony in the Family and Society **07 Hours**

Harmony in the Family the Basic Unit of Human Interaction, Values in Human-to-Human Relationship, 'Trust' the Foundational Value in Relationship, 'Respect' as the Right Evaluation Understanding Harmony in the Society, Vision for the Universal Human Order

Unit-IV: Harmony in the Nature/Existence **07 Hours**

Understanding Harmony in the Nature, Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature, Realizing Existence as Co-existence at All Levels, The Holistic Perception of Harmony in Existence

Unit-V: Implications of the Holistic Understanding a Look at Professional Ethics **07 Hours**

Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct, A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order - Competence in Professional Ethics, Holistic Technologies, Production Systems and Management Models-Typical Case Studies, Strategies for Transition towards Value-based Life and Profession

Text Book and Teachers Manual

a. The Textbook

A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1

b. The Teacher's Manual

Teachers‟ Manual for A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2

Reference Books

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

25AF1844CP311	Community Engagement Project (CEP)	02 Credits

Course Objectives:

The objective of this course is to provide students with

1. Opportunities to engage with their local community, fostering empathy, teamwork, and problem solving skills while contributing positively to their surroundings.
2. An understanding of the challenges faced by the local community and the role of engineering in addressing those challenges.
3. The ability to apply technical knowledge and skills to design solutions or interventions that create a positive impact on the community.
4. The skills to evaluate and critically analyze the outcomes of their engagement activities, deriving actionable insights for sustainable impact.

Course Outcomes:

After completing this course, students will be able to:

CO1: Identify and Analyze community needs and challenges by engaging with stakeholders and evaluating real-world problems.

CO2: Design and Implement practical, creative, and context-specific solutions using engineering principles to address community issues.

CO3: Reflect and evaluate the effectiveness of their interventions and articulate lessons learned through reports and presentations.

Course Guidelines

A community engagement project is intended to instill social responsibility and to connect students with local communities to address real-life challenges and promote sustainable development. Students are expected to contribute to the community by sharing their learning outcomes and solve/propose solutions to societal/community problems. The motto of the community engagement project is ‘Campus to Community’. Students are expected to identify socially relevant problems/projects under the guidance of teacher and solve or propose solutions. These projects foster collaboration, empathy, and social responsibility.

Projects may include, but not limited to, diverse areas such as health, where students can organize free check-up camps or mental health awareness drives; livelihood, through skill-sharing or micro entrepreneurship support; and education, via digital literacy workshops, mobile libraries, or career guidance camps. Environmentally impactful projects include rainwater harvesting awareness and solar lighting in villages. Moreover, projects like documenting local history or organizing cultural exchange events help preserve and celebrate community identity. Such initiatives not only benefit society but also provide participants with practical experience, leadership skills, and a deeper understanding of civic duties. Through these engagements, communities become active partners in development, creating a more inclusive and resilient society.

A. Project Scope:

The CEP should focus on addressing a specific community or societal issue. Projects may fall under the following themes:

1. Education and Awareness: Conduct workshops or awareness drives on topics like digital literacy, environmental sustainability, mental health, or career planning for local stakeholders.
2. Technology for Social Good: Develop a simple prototype or solution that addresses a real-world problem (e.g., a water saving device, simple mobile apps, or tools for community use).
3. Environmental Sustainability: Organize clean-up drives, tree plantations, recycling campaigns, or energy conservation initiatives.
4. Health and Wellness: Promote health through awareness programs on hygiene, nutrition, and exercise.
5. Skill Development: Teach basic computer or technical skills to students, staff, or the community.

B. Step-by-Step Execution Plan:

1. Planning Phase:
    a. Team Formation: Form a team of 3-4 students with a balance of skills and interests. The group should be cohesive, sharing and caring, contribute to the task assigned.
    b. Project Selection: Choose a project theme and define a clear objective that aligns with community needs.
    c. Proposal Submission: Submit a one-page project proposal outlining:
        - Title of the project.
        - Objective and expected outcome.
        - Plan of execution (timeline and activities).
        - Required resources (if any).
        - Get approval from the designated faculty mentor.
2. Execution Phase:
    a. Phase 1 Activities
        - Conduct initial outreach and engage with the community or target participants.
        - Implement planned activities with close teamwork and documentation.
    b. Phase 2 Activities
        - Continue engagement and collect feedback from the participants.
        - Begin summarizing the outcomes of the project.
3. Reporting Phase:
    a. Documentation: Create a detailed report containing:
        - Title, objective, and scope of the project.
        - Activities conducted and timeline.
        - Outcomes and community feedback.
        - Photos/videos of the activities (if permitted).
        - Challenges faced and how they were addressed.

b. Presentation:
- Each team will present their project to a panel of faculty members or peers, showcasing their efforts and outcomes.
- Duration of presentation: 5-7 minutes per team.

C. Evaluation Criteria:

Projects will be evaluated based on:

1. Relevance: How well the project aligns with community needs.
2. Impact: The tangible and intangible benefits delivered to the community.
3. Innovation: Creativity in the approach or solution provided.
4. Teamwork: Collaboration and effective delegation within the group.
5. Documentation & Presentation: Clarity, depth, and overall delivery of the report and presentation.

D. Guidelines for Conduct:

1. Behavior: Students should display professionalism, punctuality, and respect.
2. Safety: Follow all safety protocols during on-campus or fieldwork activities.
3. Feedback: Collect feedback from participants to measure the success and identify areas for improvement.

E. Best Practices:

1. Maintain a positive attitude and open communication with the community.
2. Respect cultural norms and values of the participants.
3. Adapt your plan based on real-time needs or challenges.
4. Faculty mentors has to be assigned to each group to guide them throughout the project.
5. The task carried out need to be maintained in field work diary by each group.

Reference Books:

1. Dostilio, L. D., et al. The Community Engagement Professional's Guidebook: A Companion to The Community Engagement Professional in Higher Education. Stylus Publishing, 2017.
2. Waterman, A. Service-Learning: A Guide to Planning, Implementing, and Assessing Student Projects. Routledge, 1997.
3. Beckman, M., and Long, J. F. Community-Based Research: Teaching for Community Impact. Stylus Publishing, 2016.
4. IDEO.org. Design Thinking for Social Innovation. IDEO Press, 2015.
5. Sherrod, L. R., Torney-Purta, J., and Flanagan, C. A. (Eds.). Handbook of Research on Civic Engagement in Youth. Wiley, 2010.

For Planning and Conducting Projects:

1. UNESCO: Education for Sustainable Development: https://www.unesco.org
2. EPICS (Engineering Projects in Community Service): https://engineering.purdue.edu/EPICS
3. Ashoka: Innovators for the Public: https://www.dfcworld.com
4. Design for Change: https://www.dfcworld.com
5. Community Tool Box (University of Kansas): https://ctb.ku.edu
6. UN SDG (Sustainable Development Goals) Knowledge Platform: https://sdgs.un.org/
7. Campus Compact: https://www.compact.org/

SEMESTER IV

25AF1844PC401	Microcontroller and Applications	03 Credits

Course Objectives:

The objective of this course is to provide students with

1. Comprehensive understanding of microcontroller architectures
2. Learn 8051 and STM32 platforms and programming using embedded c.
3. Explore internal structures, development environments, peripheral interfacing, and real-time programming techniques using industry-standard protocols
4. Develop working skills to use tools for application-based embedded system design.

Course Outcomes:

After completing this course, students will be able to:

CO1: Describe the architecture, features, and selection criteria of 8051 microcontrollers.

CO2: Implement interrupt programming for Timer/Counter, Serial communication and external and internal interrupts.

CO3: Interface various peripheral devices with 8051 microcontroller for real world applications.

CO4: Understand STM32 architecture and develop programs for STM32 microcontrollers

CO5: Interface and program the STM32 microcontroller with various peripherals and develop embedded C programming.

Unit-I: Introduction to 8051 Microcontroller **08 Hours**

Brief History, Classification of MCS-51family based on their features (8051, 8052, 8031, 8751, AT89C51), Pin configuration, Processor Architecture and Instruction Set: Registers of 8051, Inbuilt RAM, Register banks, stack, on-chip and external program code memory ROM, power reset and clocking circuits, I/O port structure, GPIO Programming using embedded C.

Unit-II: Timer/Counter, Serial Port and Interrupts of 8051 **08 Hours**

Basics of Timers & Counters, Timer Types and Modes of Operation, Interrupt vs Polling, Types of interrupts, Register used for interrupts initialization, External interrupts, Timer interrupts. Introduction to serial communication, RS232 standard, RS422 Standard, 1488 and 1489 standard, Max 232/233 Driver, Serial Communication Interrupts, [Timer/Counter, Serial Communication and Interrupt programming using embedded C].

Unit-III: I/O Port and Peripheral Interfacing with 8051 **08 Hours**

LEDs, Relays and Opt-isolators interfacing, DC motor interfacing Stepper motor interfacing, and PWM using 8051. 7-Segment and LCD Interfacing, Analog to Digital converters (ADC) & Digital to Analog Converter (DAC) basics. ADC, DAC and Temperature Sensor interfacing

Unit-IV: STM32 Architecture and Programming **08 Hours**

STM32 MCU family, ARM architecture, Difference between STM32F1, F4, L series, STM32F411: - Features, Functional Overview: - ARM Cortex-M with FPU core, Memory & Bus Architecture, Power Controller, Reset & Clock control, Direct Memory Access (DMA) controller, Interrupts, Timers and Watchdogs. ARM Thumb, Instruction Set. Language support (Assembly, C, C++ and Micro Python). Programming: - GPIO, Serial monitor, generate time delay using timer.

Unit-V: Interfacing Applications with STM32 **08 Hours**

Interfacing with STM32 and its programming: - LCD Interfacing, transfer and receive data from PC, read analog voltage and display on serial port, signal generator using DAC, IR sensor interfacing, control AC device using relay module with STM32, control servo motor angle using PWM.

Textbooks:

1. Mazidi, M. A., Mazidi, J. G., & McKinlay, R. D. (2006). The 8051 microcontroller and embedded systems: using Assembly and C (Vol. 626). Pearson/Prentice Hall.
2. Predko, M., Programming and customizing the 8051 microcontroller. McGraw-Hill, Inc.
3. Muhammad Ali Mazidi, STM32 ARM Programming, McGraw Hill

Reference Books

1. Ayala, K. J. (2010). The 8051 Microcontroller and Embedded Systems: Using Assembly and C. Cengage Learning.
2. Beginning STM32, William Grey, Apress

NPTEL Courses:

1. Microprocessors And Microcontrollers, IIT Kharagpur Prof. Santanu Chattopadhyay https://nptel.ac.in/courses/108105102
2. Microcontrollers and Applications, IIT Kanpur by Dr. S. P. Das https://nptel.ac.in/courses/117104072

25AF1844PC402L	Microcontroller and Applications Lab	01 Credits

Course Objectives:

The objective of this course is to provide students with

1. Comprehensive understanding of embedded C programming for 8051 and STM32 microcontrollers
2. Skills to learn 8051 and STM32 platforms for programming microcontrollers.
3. Develop various applications using 8051 and STM32 to solve real world problems.

Course Outcomes:

After completing this course, students will be able to:

CO1: Implement interrupt programming for Timer/Counter and Serial communication.

CO3: Interface various peripheral devices with 8051 microcontroller for real world applications.

CO3: Develop programs for STM32 microcontrollers using embedded c.

CO4: Interface and program the STM32 microcontroller with various peripherals and develop embedded applications.

Any four experiment each for 8051 microcontroller and STM32 to be included:

8051 Microcontroller:

1. Interface 8-LEDs with 8051 and Use conditional statements to rotate 8-LEDs blinking from left to right using embedded C.
2. Interface 7-segment display with 8051 and display 0-9 using embedded C
3. Interface 16x2 LCD with 8051 and display your name on LCD using embedded C.
4. Interface DC motor with 8051 through motor driver and control its speed and direction.
5. Interface any analog sensor using ADC with 8051 and measure its equivalent physical value.
6. Interface DAC convertor with 8051 and generate sine wave.
7. Generate time delay using Timer with any timer mode.
8. Interface Switch with 8051 and interrupt the operation of any port using external interrupt with switch.
9. Transmit and Receive data using RS232 communication between 8051 and Computer.

STM32 Microcontroller:

1. Transmit and receive characters via UART and view on terminal using STM32.
2. Use PWM to control motor speed using variable duty cycle using STM32
3. Measure distance using Ultrasonic sensor interfaced to STM32.
4. Measure temperature in Centigrade and Fahrenheit using LM35 temperature sensor interfaced with STM32.
5. Control AC devices through relays interfaced with STM32.
6. Control LED blinking using time delay generated by timer of STM32

25AF1844PC403	Object Oriented Programming	03 Credits

Course Objectives:

The objective of this course is to provide students with

1. To lay the foundation for fundamentals of Java language.
2. To define class and object in object-oriented programming and to implement various concepts such as constructors, destructors, operator overloading, friend functions using JAVA language.
3. To state principles of OOP in JAVA such as encapsulation, data hiding, inheritance, polymorphism, interface, and packages,
4. To describe the concept of collection framework and exception handling in JAVA.

Course Outcomes:

After completing this course, students will be able to

CO1: Explain various features of JAVA and JAVA programming structure. **Elaborate** fundamental concepts of JAVA including tokens, data types, and variables & typecasting of variables, statements, and expressions, classes, objects, methods, access specifier, keywords, and constructor.

CO2: Define abstract method and classes, string classes and wrapper classes. **Implement** method and constructor overloading, inheritance using classes and code reusability using packages.

CO3: Implement multiple inheritance using interface and code reusability using packages.

CO4: Demonstrate exception handling in Java using try, catch, and finally blocks to ensure robust and error-free program execution.

CO5: Explain the concepts and usage of the Collection Framework for efficient data storage, retrieval, and manipulation using various collection classes and interfaces.

Unit-I: Introduction to JAVA Programming **08 Hours**

Types of Programming Languages and Comparison of C++ and Java, Fundamentals of JAVA: - Java features, JDK, JRE, and JVM, overview of Java language, simple Java program, and Java program structure. Installing and configuring Java. Java tokens, Java statements, constants, concepts of variables, data types, and operators. Arrays, statements and expressions, mathematical functions. Access specifiers, class and object, functions, constructor and its type, final, static, and this keywords, garbage collection, and finalize method.

Unit-II: Implementation of OOPs Concepts **08 Hours**

Method and Classes: - Classes and Objects, OOP principles, Encapsulation, Abstraction, Inheritance and Polymorphism, Static variables and methods, reference variables and methods. Polymorphism: - Introduction, types of polymorphism, function and constructor overloading. Object as superclass: Object class methods, importance and implementation of toString() , equals(), hashCode() methods, Immutability of objects Wrapper classes: - Byte, Double, Float, Integer, Long, Short, Autoboxing and unboxing. Fundamental Classes: String, StringBuilder, Objects, Arrays, Math; Inheritance: - Types of inheritance, method overloading and overriding, dynamic method dispatch.

Unit-III: Interface, Packages and Exception Handling **08 Hours**

Multiple Inheritance: - Interface, abstract method implementation, default and static method in interface, functional interface. Common interfaces: Comparable, Comparator, Iterable, Iterator, Runnable. Packages: - Definition, types of packages, creation of package, accessing of package element. Exception Handling: Exception hierarchy, Errors, Checked and un-checked exceptions. Exception propagation, try-catch-finally block, throws clause and throw keyword, multiple catch statements. Creating user defined checked and unchecked exceptions.

Unit-IV: Java GUI Programming **08 Hours**

Event handling using Abstract Window Toolkit (AWT) & Swings Components: **AWT:** Component, container, window, frame, panel, and use of AWT controls: labels, buttons, checkbox, checkbox group, textfield, textarea, Use of layout managers: flowLayout, borderLayout, gridLayout, gridBagLayout, menubars, menus, file dialog, **Introduction to swing**: Swing features, difference between AWT and Swing. Swing components: Icons and Labels, TextField, ComboBox, Button, Checkbox, RadioButton, Advanced Swing Components: Tabbed Panes, Scroll Panes, Trees, Tables, Progress bar, tool tips, **Introduction to Event Handling**: The delegation Event Model: Event sources, Event listeners Event classes: The action event class, the Item event class, the Key event class, the mouse event class, text event, Event listener interfaces: ActionListener, ItemListener, KeyListener, MouseListener, MouseMotion, TextListener

Unit-V: Java Collection Framework **08 Hours**

Java Collection Framework: Introduction to JAVA Collection Framework and their use. Commonly used collections with implementations: List (ArrayList, LinkedList), Set (HashSet, Linked HashSet, Tree Set), Map (HashMap, Linked HashMap, Tree Map), Concept of hashing.

Text Books:

1. R. Nageswara Rao, Core Java: An Integrated Approach, Dream Tech Press, 2016
2. E Balagurusamy, Programming with JAVA, Tata McGraw Hill, 6th Edition.
3. Herbert Schildt, Java: The complete reference, Tata McGraw Hill, 7th Edition.

Reference Books:

1. T. Budd, Understanding OOP with Java, Pearson Education, 2nd Updated Edition.
2. Y. Daniel Liang (2010), Introduction to Java programming, Pearson Education, India, 7th Edition.

NPTEL Courses:

1. Programming in Java, IIT Kharagpur, Prof. Debasis Samanta https://nptel.ac.in/courses/106105191
2. Data Structure and algorithms using Java, IIT Kharagpur Prof. Debasis Samanta https://nptel.ac.in/courses/106105225

25AF1844PC404L	Object Oriented Programming Lab	01 Credits

Experiment List:

1. Implement a calculator with simple arithmetic operations such as add, subtract, multiply, divide, factorial etc. using switch case and other JAVA concepts like class, object, method and constructor
2. Write a Java program to create and sort arrays of Integers and Strings (Ascending/Descending)
3. Write a JAVA program that performs the following operations on a given string:
    a. Count the number of vowels and consonants.
    b. Replace all spaces with a specific character
    c. Convert the string to uppercase and lowercase using String.
    d. Reverse the string using String Buffer or String Builder.
4. Demonstrate the concept of inheritance for an e-commerce system for product management
    a. Create a base class product with attributes product ID, name, and price.
    b. Create subclasses Electronics, Clothing, and Groceries.
        i. Electronics should include an attribute warranty period.
        ii. Clothing should include an attribute size.
        iii. Groceries should include an attribute expiry date.

    Implement an apply discount () method in the base class and override it in each subclass to apply category-specific discounts.
5. Build multiple inheritance by implementing interface features for following online payment system.
    a. Create an interface card payment with methods process Card Payment () and refund Card Payment ().
    b. Create another interface UPI payment with methods process UPI payment () and refund UPI Payment ().
    c. Create a class payment gateway that implements both interfaces to support multiple payment methods.

    Demonstrate the working of the payment gateway by calling methods from both interfaces.
6. Implement exception handling for a user login system with username and password validation.
    a. Throw a custom exception Invalid Credentials Exception if the username or password is incorrect.
    b. Handle Null Pointer Exception if either the username or password is null.

    Catch and log any other generic exceptions for debugging purposes.
7. Build a product inventory system for a store using Array List.

a. Each product should have a name, ID, and price.

b. Implement features to add new products, update prices, and remove products.

Sort products by price or name using a custom comparator.

8. Develop a program to manage employee records using HashMap.

a. Use the employee ID as the key and the employee's name as the value.

b. Perform operations like adding, updating, deleting, and searching employees

Display all employees in alphabetical order of their names

25AF1COIVE407	Constitution of India	02 Credits (AU)

Course Objectives:

1. To acquaint the students with legacies of constitutional development in India and help them to understand the most diversified legal document of India and philosophy behind it.
2. To make students aware of the theoretical and functional aspects of the Indian Parliamentary System.
3. To channelize students‟ thinking towards basic understanding of the legal concepts and its implications for engineers.
4. To acquaint students with latest intellectual property rights and innovation environment with related regulatory framework.
5. To make students learn about role of engineering in business organizations and e-governance.

Course Outcomes:

After completing this course, students will be able to:

CO1: Identify and explore the basic features and modalities about Indian constitution.

CO2: Differentiate and relate the functioning of Indian parliamentary system at the center and state level.

CO3: Differentiate different aspects of Indian Legal System and its related bodies.

CO4: Discover and apply different laws and regulations related to engineering practices. CO5: Correlate role of engineers with different organizations and governance models.

Constitution of India – Basic features and fundamental principles

The Constitution of India is the supreme law of India. Parliament of India cannot make any law which violates the Fundamental Rights enumerated under the Part III of the Constitution. The Parliament of India has been empowered to amend the Constitution under Article 368, however, it cannot use this power to change the “basic structure” of the constitution, which has been ruled and explained by the Supreme Court of India in its historical judgments. The Constitution of India reflects the idea of “Constitutionalism” – a modern and progressive concept historically developed by the thinkers of “liberalism” – an ideology which has been recognized as one of the most popular political ideology and result of historical struggles against arbitrary use of sovereign power by state. Historic revolutions in France, England, America and particularly European Renaissance and Reformation movement have resulted into progressive legal reforms in the form of “constitutionalism” in many countries. The Constitution of India was made by borrowing models and principles from many countries including United Kingdom and America. The Constitution of India is not only a legal document but it also reflects social, political and economic perspectives of the Indian Society. It reflects India’s legacy of “diversity”. It has been said that Indian constitution reflects ideals of its freedom movement, however, few critics have argued that it does not truly incorporate our own ancient legal heritage and cultural values. No law can be “static” and therefore the Constitution of India has also been amended more than one hundred times. These amendments reflect political, social and economic developments since the year 1950. The Indian judiciary and particularly the Supreme Court of India has played an historic role as the guardian of people. It has been protecting not only basic ideals of the Constitution but also

strengthened the same through progressive interpretations of the text of the Constitution. The judicial activism of the Supreme Court of India and its historic contributions has been recognized throughout the world and it gradually made it "as one of the strongest court in the world".

Course Content:

1. Meaning of the constitution law and constitutionalism
2. Historical perspective of the Constitution of India
3. Salient features and characteristics of the Constitution of India
4. Scheme of the fundamental rights
5. The scheme of the Fundamental Duties and its legal status
6. The Directive Principles of State Policy – Its importance and implementation
7. Federal structure and distribution of legislative and financial powers between the Union and the States
8. Parliamentary Form of Government in India – The constitution powers and status of the President of India
9. Amendment of the Constitutional Powers and Procedure
10. The historical perspectives of the constitutional amendments in India
11. Emergency Provisions : National Emergency, President Rule, Financial Emergency
12. Local Self Government – Constitutional Scheme in India
13. Scheme of the Fundamental Right to Equality
14. Scheme of the Fundamental Right to certain Freedom under Article 19
15. Scope of the Right to Life and Personal Liberty under Article 21.

Suggested Readings:

1. Brij Kishore Sharma: Introduction to the Indian Constitution, PHI, New Delhi, latest edition.
2. Granville Austin: The Indian Constitution: Cornerstone of a Nation. 1966, Oxford Clarendon Press.
3. Subhash C. Kashyap: Our Constitution: An Introduction to India‟s Constitution and constitutional Law, NBT, 2018.
4. PM Bakshi: The Constitution of India, Latest Edition, Universal Law Publishing.
5. V.K. Ahuja: Law Relating to Intellectual Property Rights (2007)
6. Suresh T. Viswanathan: The Indian Cyber Laws, Bharat Law House, New Delhi-88
7. P. Narayan: Intellectual Property Law, Eastern Law House, New Delhi
8. Prabudh Ganguli: Gearing up for Patents: The Indian Scenario, Orient Longman.
9. BL Wadehra: Patents, Trademarks, Designs and Geological Indications.Universal Law Publishing - LexisNexis.
10. Intellectual Property Rights: Law and Practice, Module III by ICSI (only relevant sections)
11. Executive programme study material Company Law, Module II, by ICSI (The Institute of Companies Secretaries of India) (Only relevant sections i.e., Study 1, 4 and 36). https://www.icsi.edu/media/webmodules/publications/Company%20Law.pdf
12. Handbook on e-Governance Project Lifecycle, Department of Electronics & Information Technology, Government of India, https://www.meity.gov.in/writereaddata/files/eGovernance_Project_Lifecycle_Participant_Handbook-5Day_CourseV1_20412.pdf

13. Companies Act, 2013 Key highlights and analysis by PWC. https://www.pwc.in/assets/pdfs/publications/2013/companies-act-2013-keyhighlights-and-analysis.pdf

Referred Case Studies:

- Keshavanand Bharati V. State of Kerala, AIR 1973 SC 1461.
- Maneka Gandhi V. Union of India AIR, 1978 SC 597.
- S.R. Bammai V. Union of India, AIR 1994 SC 1918.
- Kuldip Nayyar V. Union of India, AIR 2006 SC312.
- A.D.M. Jabalpur V. ShivkantShakla, AIR 1976 SC1207.
- Remshwar Prasad V. Union of India, AIR 2006 SC980.
- Keshav Singh in re, AIR 1965 SC 745.
- Union of India V. Talsiram, AIR 1985 SC 1416.
- Atiabari Tea Estate Co.V. State of Assam, AIR 1961SC232.
- SBP & Co. Vs. Patel Engg. Ltd. 2005 (8) SCC 618.
- Krishna Bhagya Jala Nigam Ltd. Vs. G. Arischandra Reddy (2007) 2 SCC 720.
- Oil & Natural Gas Corporation Vs. Saw Pipes Ltd. 2003 (4) SCALE 92 – 185.

**(Other relevant case studies can be consulted by the teacher as per the topic).

Prescribed Legislations:

1. Information Technology Act, 2000 with latest amendments.
2. RTI Act 2005 with latest amendments.
3. Information Technology Rules, 2000
4. Cyber Regulation Appellate Tribunal Rules, 2000

Suggested aid for Students and Pedagogic purpose

- RSTV debates on corporate law, IPR and patent issues
- NPTEL lectures on IPR and patent rights

Episodes of 10 -part mini TV series "Samvidhan: The Making of Constitution of India" by RSTV.

25AF1000VE408	Life of Bharatratna Dr. Babasaheb Ambedkar	01 Credit

Course Objectives:

1. Analyze Dr. Ambedkar's role in shaping India's constitution and social justice movements
2. Recognize the relevance of his principles in contemporary engineering and societal contexts
3. Develop critical thinking and problem-solving skills through case studies and discussions

Course Outcomes:

After completing this course, students will be able to:

CO1: Explain Dr. Ambedkar's key contributions to the Constitution of India, establishment of human values and social reform

CO2: Identify and analyze his leadership qualities and strategic thinking

CO3: Evaluate the impact of his legacy on Maharashtra's culture, politics, and economy

Unit-I: Socio-political Context **05 Hours**

Introduction to the Socio-political Context of Dr. Babasaheb Ambedkar's Era, British Colonialism, Indian National Movement, Caste Hierarchy, Untouchability, Social Reform Movements, Role in the Indian freedom struggle

Unit-II: The Contribution of Dr. Babasaheb Ambedkar **05 Hours**

Contribution to the Constitution of India, Vision for Social Justice and Empowerment

Unit-III: Legacy and Relevance Today **05 Hours**

Dr. Ambedkar and Marxism: An Exploration of his Thoughts on Marxism, Common Ground with Marxism, Focus on Class Struggle, Caste vs Caste, Primacy of Caste in Indian Society, Economic Ideas and Policies

Text Books / Reference:

1. Keer, Dhananjay. Dr. Babasaheb Ambedkar Life and Mission. Popular Prakashan. 1954.
2. Ambedkar, B. R. Annihilation of Caste. Fingerprint Publishing. 2023.
3. Ambedkar, B. R. Buddha or Karl Marx. Infinite Words. 2024.
4. Ambedkar, B. R. The Problem of Rupee: It’s Origin and it’s Solution. Sudhir Prakashan. 2021.

25AF1000HM409	Patents and IPR	02 Credits

Course objectives

1. To explore the historical development and significance of patents in fostering innovation.
2. To familiarize students with the legal frameworks governing patents.
3. To Identify and evaluate the criteria for patentability, including novelty, non-obviousness, and industrial applicability.
4. To understand the role of prior art in the patent examination process.
5. To understand the challenges and opportunities associated with filing patents globally.

Course outcomes:

After completing this course, students will be able to:

CO1: Demonstrate proficiency in patent categorization and practical patent procedures.
CO2: Utilize patent databases effectively.
CO3: Grasp the significance of IPR and its historical context.
CO4: Stay updated on the latest IPR developments, especially in biological systems and computer software.
CO5: Apply acquired knowledge and problem-solving skills to real-world cases related to patents and IPR.

Unit-I: Patents **06 Hours**

Designs, Trade and Copyright, Classification of patents in India, Categories of Patent, Special Patents, Patent document, Granting of patent, Rights of a patent, Patent Searching, Patent Drafting, filing of a patent, different layers of the international patent system, Utility models.

Unit-II: Patent Rights **06 Hours**

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

Unit-III: Overview of Intellectual Property **06 Hours**

Introduction of IPR, Need for intellectual property right (IPR), IPR in India – Genesis and Development IPR in abroad.

Unit-IV: New Developments in IPR **06 Hours**

Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge, Case Studies.

Unit-V: Case studies **06 Hours**

Case studies related to patents and IPR

Text/Reference Books:

1. Feroz Ali, The Law of Patents, LexisNexis
2. Indian Patent Law and Practice by K.C. Kankanala, A.K. Narasani, and V. Radhakrishnan, Oxford India, 2012
3. Ronald D. Slusky, Invention Analysis and Claiming – A Patent Lawyer's Guide, Second Edition, American Bar Association, 2012.

25AF1000AE410	Modern Indian Languages^	02 Credits

25AF1000AE410A

उपयोजित मराठी/ व्यावहारिक मराठी अभ्यासक्रम

Course Objectives:

- मराठी भाषेचा ऐतिहासिक प्रवास, तिच्या निर्मितीतील संस्कृत, प्राकृत आणि अपभ्रंश भाषांचा प्रभाव समजून घेणे.
- मराठी लेखनाचे नियम, व्याकरण व शुद्धलेखन यांची अचूकता आत्मसात करणे.
- सर्जनशील आणि औपचारिक लेखन कौशल्ये विकसित करणे.
- भाषांतर तत्त्वे, प्रक्रिया आणि सांस्कृतिक संदर्भ यांचा विचार करून मराठीतून इंग्रजी आणि इंग्रजीतून मराठी भाषांतर करण्याचे कौशल्य प्राप्त करणे.

Course Outcomes:

- विद्यार्थी मराठी भाषेच्या ऐतिहासिक प्रवासाची समज वाढवतील आणि तिच्या विकासातील टप्पे स्पष्टपणे सांगू शकतील.
- शुद्ध व प्रमाणबद्ध लेखन करण्याची क्षमता प्राप्त होईल.
- विविध प्रकारच्या लेखन शैली आत्मसात करून सृजनशील, विश्लेषणात्मक आणि औपचारिक लेखन करू शकतील.
- अचूक, स्पष्ट आणि भाषिक-सांस्कृतिक दृष्टिकोनातून योग्य भाषांतर करू शकतील.
- व्यावसायिक आणि साहित्यिक भाषांतरात प्रावीण्य मिळवू शकतील.

घटक- १. मराठीचा उगम आणि विकास

- मराठीचा उगम आणि विकास
- मराठी भाषेवर संत परंपरेचा प्रभाव- ज्ञानेश्वर, तुकाराम, नामदेव आणि एकनाथ यांच्या रचनांचा अभ्यास.
- मराठीत बखरी लेखन व इतिहासदर्शन.
- आधुनिक मराठी आणि सुधारणा चळवळी- टिळक, फुले, आणि आगरकर यांचे योगदान.

घटक- २. स्वातंत्र्यानंतरची मराठी भाषा

- महाराष्ट्र राज्य निर्मिती व मराठीचा अधिकृत दर्जा.
- डिजिटल युगातील मराठी भाषा : ब्लॉग, सोशल मीडिया आणि ई-साहित्य.
- मराठी भाषा संरक्षणासाठी उपाययोजना.
- शिक्षणव्यवस्थेतील मराठीचा वापर.
- जागतिक स्तरावर मराठी भाषेचा प्रभाव.

घटक-३. मराठी लेखनाचे नियम आणि व्याकरण

- संधि
- वाक्यप्रकार (विधानार्थी वाक्य, प्रश्नार्थी वाक्य, आज्ञार्थी वाक्य इ.)
- विरामचिन्हे आणि त्यांचे उपयोग
- शुद्धलेखन
- समानार्थी शब्द (पर्यायवाची शब्द), विरुद्धार्थी शब्द

घटक-४. लेखन कौशल्य

- लेखन कौशल्याचा परिचय- लेखन कौशल्याचे महत्त्व आणि आवश्यकता
- पत्रलेखन
- निबंध लेखन
- वृत्तलेखन (वृत्तपत्रीय लेखन)
- इतिवृत्त लेखन
- सारांश लेखन

घटक- ५. भाषांतर (मराठीतून इंग्रजी आणि इंग्रजीतून मराठी)

- भाषांतराचा मूलभूत परिचय- भाषांतराची व्याख्या आणि स्वरूप, महत्त्व आणि उपयोग, भाषांतराचे प्रकार इ.
- पारिभाषिक शब्दावली
- मराठीतून इंग्रजी आणि इंग्रजीतून मराठी भाषांतर.

संदर्भ साहित्य

1. प्रशासनिक लेखन, भाषा संचालनालय , महाराष्ट्र शासन, मुंबई १९६६
2. सुगम मराठी व्याकरण व लेखन - मो.रा. वाळंबे
3. "अनुवाद सिद्धांत आणि प्रयोग" – डॉ. भालचंद्र नेमाडे (लोकवाङ्मय गृह प्रकाशन)
4. मराठी भाषा आणि साहित्याचा इतिहास – वि.का. राजवाडे प्रकाशक : राजवाडे संशोधन मंडळ, धुळे
5. भाषांतर : सिद्धांत आणि प्रयोग – डॉ. अशोक केळकर प्रकाशक : लोकवाङ्मय गृह, मुंबई

25AF1000AE410B

सामान्य हिंदी / व्यावहारिक हिंदी पाठ्यक्रम

पाठ्यक्रम उद्देश्य (Course Objectives):

- हिंदी भाषा के उद्भव, विकास और ऐतिहासिक प्रवृत्तियों को समझाना।
- हिंदी व्याकरण और लेखन कौशल में दक्षता प्रदान करना।
- प्रशासन, शिक्षा और संचार में हिंदी के व्यावहारिक उपयोग को स्पष्ट करना।
- अनुवाद कौशल विकसित करना, जिससे तकनीकी एवं व्यावसायिक संचार सुगम हो।

अपेक्षित परिणाम (Course Outcomes):

- विद्यार्थी हिंदी भाषा के ऐतिहासिक और आधुनिक विकास को समझेंगे।
- हिंदी व्याकरण और लेखन के नियमों में दक्षता प्राप्त करेंगे।
- व्यावसायिक, प्रशासनिक और तकनीकी लेखन में हिंदी का प्रयोग कर सकेंगे।
- अनुवाद के सिद्धांतों को सीखकर अंग्रेजी और हिंदी के बीच प्रभावी अनुवाद कर सकेंगे।

इकाई – १. हिंदी भाषा का उद्भव और स्रोत

- हिंदी भाषा की उत्पत्ति और स्वरूप
- संस्कृत, प्राकृत और अपभ्रंश से हिंदी का विकास
- हिंदी की प्रमुख बोलियाँ (ब्रज, अवधी, खड़ी बोली, भोजपुरी, राजस्थानी आदि)
- हिंदी पर फारसी, अरबी और अंग्रेज़ी भाषाओं का प्रभाव

इकाई- २. स्वातंत्र्योत्तर काल में हिंदी भाषा

- प्रशासन, शिक्षा और संचार माध्यमों में हिंदी की भूमिका
- राजभाषा के रूप में हिंदी – संवैधानिक स्थिति और व्यावहारिक उपयोग
- हिंदी का वैश्विक विस्तार और डिजिटल माध्यमों में हिंदी की उपस्थिति
- प्रशासन और संचार माध्यमों में हिंदी

इकाई- ३. हिंदी भाषा लेखन के नियम और व्याकरण

- वर्णमाला
- शब्द-भेद
- संधि
- वाक्य रचना
- वर्तनी
- उपसर्ग, प्रत्यय और शब्द निर्माण की प्रक्रिया
- विराम चिन्हों का प्रयोग
- पर्यायवाची शब्द
- विलोम शब्द

इकाई- ४. लेखन कौशल

- पत्र लेखन
- प्रतिवेदन (रिपोर्ट) लेखन
- विज्ञप्ति, नोटिस और परिपत्र लेखन
- निबंध लेखन
- सार लेखन

इकाई- ५. अनुवाद (अंग्रेजी से हिंदी और हिंदी से अंग्रेजी)

- अनुवाद : सिद्धांत और परंपरा
- अनुवाद : क्षेत्र, प्रकार
- पारिभाषिक शब्दावली
- अंग्रेजी से हिंदी और हिंदी से अंग्रेजी अनुवाद

संदर्भ ग्रंथ:

- "हिंदी भाषा का उद्भव और विकास" – डॉ. हरीशचंद्र वर्मा (लोकभारती प्रकाशन)
- "हिंदी भाषा का इतिहास" – डॉ. रामविलास शर्मा (राजकमल प्रकाशन)
- "भारत में राजभाषा हिंदी" – डॉ. विश्वनाथ प्रसाद (भारतीय राजभाषा परिषद)
- "हिंदी व्याकरण और रचना" – डॉ. हरीशचंद्र वर्मा (लोकभारती प्रकाशन)
- "हिंदी लेखन कौशल" – डॉ. रमेश गुप्ता (साहित्य भवन)
- "अनुवाद विज्ञान और सिद्धांत" – डॉ. ओमप्रकाश (राजकमल प्रकाशन)

25AF1000AE410C

संस्कृत अभ्यासक्रम

Course Objectives:

- संस्कृत भाषेचा ऐतिहासिक प्रवास
- संस्कृत लेखनाचे नियम, व्याकरण आत्मसात करणे.
- दैनंदिन संवादासाठी लागणारे काही शब्द यांचा अभ्यास करणे.

Course Outcomes:

- विद्यार्थी संस्कृत भाषेच्या ऐतिहासिक प्रवासाची समज वाढवतील आणि तिच्या विकासातील टप्पे स्पष्टपणे सांगू शकतील.
- शुद्ध व प्रमाणबद्ध लेखन करण्याची क्षमता प्राप्त होईल.
- विविध प्रकारच्या लेखन शैली आत्मसात करून लेखन करू शकतील.
- अचूक, स्पष्ट आणि भाषिक-सांस्कृतिक दृष्टिकोनातून योग्य भाषांतर करू शकतील.

1. Introduction to Sanskrit

- Importance and history of Sanskrit
- Sanskrit alphabets (Varnamala)
- Swaras (Vowels)
- Vyanjanas (Consonants)
- Pronunciation and script (Devanagari)

2. Basic Grammar

- Nouns, pronouns, Grammatical numbers, Grammatical genders, Grammatical person
- Verbs, Tenses, Sandhi (Combination of letters)
- Karaka (Case system) – Nominative, Accusative, Instrumental, etc.
- Vibhakti (Declensions of nouns and pronouns)
- Linga (Gender: Masculine, Feminine, Neuter)
- Vakya Rachana (Sentence construction)

3. Simple Vocabulary and Sentence Formation

- Basic words and their meanings (nature, family, animals, objects, etc.)
- Greetings and basic conversational phrases
- Formation of simple sentences

4. Selected Sanskrit Shlokas and Subhashitas

- Recitation and meaning of simple verses from Bhagavad Gita, Hitopadesha, or Panchatantra
- Common proverbs (Subhashitas)

5. Reading and Writing Practice

- Reading simple Sanskrit texts
- Writing small paragraphs in Sanskrit

25AF1000VS411A	Web Development	02 Credits

Course Objectives:
The objective of this course is to provide students to

- Learn HTML, CSS, and responsive design for creating user-friendly websites.
- Master JavaScript and Bootstrap for dynamic, interactive web development.
- Explore CSS animations, APIs, AJAX, and SEO for advanced web techniques.

Course Outcomes:
After completing this course, students will be able to:

1. Create web pages using HTML and CSS concepts
2. Develop responsive web pages using advanced concepts of HTML and CSS
3. Create interactive web pages using javascripts
4. Optimize website using SEO Tools

Unit-I Fundamentals of Web Design

HTML and CSS Basics: Introduction to Web Design: History and Principles, Why Web Design Matters: Applications and Careers, HTML Basics: Understanding Tags and Attributes, Building Your First Webpage: Structure and Content, Adding Links and Images to Webpages

An Introduction on CSS: Using Inline, Internal, and External CSS, CSS Essentials: Selectors, Properties, Styling Text with CSS: Fonts, Colors, and Sizes, Understanding the Box Model: Margins, Padding, and Borders

Unit-II Advanced HTML and CSS

HTML Forms: Inputs, Buttons, and Text Areas, Working with Tables: Structuring Tabular Data, Embedding Multimedia: Audio and Video, CSS Positioning: Static, Relative, Absolute, and Fixed, Grid and Flexbox Layout, Responsive Web Design: Why It Matters

Unit-III Interactive Web Development

JavaScript Basics: JavaScript Introduction: What and Why? Java script Essentials: Mastering variables and data types, Loops, Conditional Statements and Functions, The DOM: Connecting JavaScript to HTML, Event Listeners and Handling User Interactions

Unit-IV Advanced Web Design Techniques

Advanced Techniques: CSS Animations: Adding Movement to Your Website, Scalable Vector Graphics and using it in Websites, APIs and Displaying Data Dynamically Using APIs

Unit-V Accessibility and Optimization:

Web Accessibility: Principles and Standards, Introduction to SEO: Basics and Benefits, Optimizing HTML, CSS, Lazy Loading: Optimizing Page Load Times and SEO Tools for Analyzing Webpages

Text/Reference Books:

1. Jason Beaird and Alex Walker - The Principles of Beautiful Web Design, SitePoint, 2020 (4th Edition).
2. Jennifer Robbins - Learning Web Design: A Beginner's Guide to HTML, CSS, JavaScript, and Web Graphics, O'Reilly Media, 2018.
3. Keith J. Grant - CSS in Depth, Manning Publications, 2018.
4. V.K. Jain - Multimedia and Animation, Khanna Publishing House, Edition 2018.
5. Ze- Nian Li and M.S. Drew, Fundamental of Multimedia, Second Edition, Pearson Education, 2014
6. Jon Duckett - JavaScript and JQuery: Interactive Front-End Web Development, Wiley, 2014.
7. Jon Duckett - HTML and CSS: Design and Build Websites, Wiley, 2011.

NPTEL/MOOC Courses:

1. Web-designing and multimedia Technology by Dr. B. Yogameena, National Institute of Technical Teachers' Training and Research, Chennai. https://onlinecourses.swayam2.ac.in/ntr25_ed108/preview
2. CIT-003: Web Based Technologies and Multimedia Applications, By Prof. P.V. Suresh, Indira Gandhi National Open University, New Delhi IGNOU. https://onlinecourses.swayam2.ac.in/nou25_cs17/preview

25AF1000VS411B	PCB Designing	02 Credits

Course Objectives:

The objective of this course is to:

1. Develop skills in starting projects, using design tools, and creating net lists.
2. Understand and implement PCB manufacturing techniques.
3. Find the faults and understand PCB assembly.
4. Understand Soldering Techniques and Quality Control
5. Learn to build accurate library parts for effective PCB layouts.

Course Outcomes:

After completing this course, students will be able to:

CO1: Find faults in the designs.
CO2: Understand PCB assembly.
CO3: Implement PCB manufacturing techniques.
CO4: Build accurate library parts for effective PCB layouts.

Unit 1: Printed circuit Board Design:

Various types of Printed Circuit Boards: Single Sided Boards, Double Sided Plated through Hole Boards, multilayer Boards, and Process of PCB design and product development flow. Schematic Design: Starting a project, Working with schematic design tools, Schematic drawing from circuit, Rules for PCB Design, Standards for PCB Design, Placing, editing, and connecting parts and electrical symbols, Creating a net list, Exporting and importing schematic data, Basic Circuit simulation using EDA tool.

Unit 2: PCB Layout Design

Study of technical terms in layout design, Board outline Design, components placement, Details of layers, Routing methods, Copper Pour, Adding reference texts, Build library parts (footprints, schematic symbols), Manufacturing Output files generation.

Unit 3: PCB Manufacturing Techniques

Film Master Generation method: Study of photographic Film, Properties of material used in Manufacturing of PCBs. Cleaning Method of base materials. PCB Manufacturing Methods: Method of Screen Printing for pattern transfer. Method of Wet film and Dry film for single and Double Sided Board Manufacturing. Plating, etching, punching, drilling, milling and routing.

Unit 4: **Study of-Fault Finding methods of PCBs**

Repairing techniques, De-soldering techniques, PCB Assembly Techniques: Components Preparation Method, Lead identification of components. Component mounting techniques, Lead Forming methods. Leaded through hole assembly and Surface Mount Assembly. Mixed Assembly Techniques of through hole and SMDs. Manual Assembly method, Semiautomatic and automatic Assembly method.

Unit 5: Soldering Techniques:

Materials used in Soldering Process. Types of soldering techniques. Soldering Methods – Manual and Mass soldering Techniques. Tools for soldering and de-soldering. Study of soldering defect and rectification. Testing for quality control. Introduction to SMD soldering methods, placing methods of SMDs, study of material for SMD soldering. Rework and Repairing methods.

Text/Reference Books:

1. Printed Circuit Board Designer's Reference: Basics, by Christopher T. Robertson, Prentice Hall, 2003
2. Complete PCB Design Using OrCAD Capture and PCB Editor 2nd Edition, Kindle Edition, by Kraig Mitzner, Bob Doe, Alexander Akulin, Anton Suponin, Dirk Müller.
3. PCB Design for Real-World EMI Control By: Bruce R. Archambeault, James Drewniak, Bruce R Archambeault, Springer, 2002.

NPTEL Courses:

1. Electronic Systems Design: Hands-on Circuits and PCB Design with CAD Software By Prof. Ankur Gupta, IIT Delhi, https://onlinecourses.nptel.ac.in/noc25_ee163/preview
2. ESim - EDA tool for circuit design, simulation, analysis and PCB design By Prof Kannan Moudgalya, IIT Bombay, https://onlinecourses.swayam2.ac.in/aic20_sp59/preview

25AF1844PC412	Operating Systems	03 Credits

Course Objectives:

The objective of this course is to:

1. Understand the fundamental architecture of computer systems—including CPU design, memory management, and I/O systems—and their interaction with operating systems
2. Gain insight into the internal working of operating systems and their management of processes, memory, and files in modern computing environments.
3. Learn system-level programming and optimization techniques that bridge the gap between hardware and software, including efficient utilization of resources.
4. Analyze various process and resource management techniques used in different operating systems and apply them in real-world system design and programming.

Course Outcomes:

After completing this course, students will be able to:

CO1: Describe the architecture of computer systems including CPU, memory hierarchy, and I/O systems and understand their operational interactions.

CO2: Analyze and implement basic operating system functionalities, including process management, memory management, and file systems.

CO3: Explain and debug system-level programs in an operating system environment (e.g., Unix/Linux), working with processes, memory, and I/O devices.

CO4: Evaluate and apply scheduling, synchronization, and resource management techniques in both theoretical and practical settings, including multi-core and distributed systems.

Unit-I: Fundamental Concepts **08 Hours**

Basic Computer Organization and Architecture: On Neumann architecture vs. Harvard architecture, Components of a computer: CPU, memory, I/O devices, Buses and data transfer mechanisms, Instruction sets and addressing modes. CPU Design and Function: Central Processing Unit (CPU): ALU, control unit, and registers, Fetch Decode-Execute cycle, Pipelining and parallelism in modern processors, Superscalar architecture and its performance improvements

Memory Hierarchy: Primary, secondary, and cache memory, Memory mapping techniques: Paging and segmentation, Virtual memory and its management technique. Introduction to Operating Systems: Types of operating systems: Batch, time-sharing, real-time, embedded, distributed, Key functions of an OS: Process management, memory management, file management, I/O system management.

Unit-II Operating Systems Services **08 Hours**

Process Management: Process concept, process states, and control blocks (PCB), Process scheduling algorithms: FCFS, SJF, Round Robin, Priority Scheduling, Threading and multithreading concepts, Interprocess communication (IPC): Pipes, shared memory, message

queues. **Memory Management:** Contiguous and non-contiguous memory allocation, Paging and segmentation, Virtual memory management: page tables, page faults, and replacement algorithms (LRU, FIFO, and Optimal), Fragmentation: Internal and external. **File Systems and Storage Management:** File system concepts: Files, directories, and permissions, File allocation methods: Contiguous, linked, and indexed, Disk management and disk scheduling algorithms (FCFS, SSTF, SCAN), Virtual File System (VFS) and file system mounting.

Unit-III Concurrency & Security in Operating Systems **08 Hours**

Process Synchronization and Concurrency: Critical section problem and race conditions, Synchronization mechanisms: Semaphores, mutexes, and monitors, Deadlock: Detection, prevention, and recovery, Resource allocation graphs (RAG) and Banker's algorithm.

Security and Protection in Operating Systems security models: Authentication, authorization, encryption, Protection mechanisms and access control lists (ACLs), Malware, viruses, and OS vulnerabilities, and Secure OS design principles.

Unit –IV APIs and Case Studies **08 Hours**

System Calls and APIs: Introduction to system calls in Unix/Linux: Process control, file manipulation, memory management, Writing system-level programs in C: File I/O, memory allocation, and process control.

OS Implementation: Overview of UNIX/Linux architecture and components, Windows OS architecture: Process management, threading, and memory management. Case study: Analysis of Android OS for mobile computing.

Unit- V Distributed Systems and RTOS: **08 Hours**

Concepts of distributed operating systems and message-passing, Resource management and synchronization in distributed systems. Real-Time Operating Systems (RTOS): Scheduling algorithms and their applications in embedded systems.

Text Books:

1. Computer Organization and Design: The Hardware/Software Interface RISC-V Edition by David A. Patterson and John L. Hennessy, Publisher - Morgan Kaufmann, 2017
2. Operating System Concepts by Abraham Silberschatz, Peter B. Galvin, and Greg Gagne

Reference Books:

1. Computer Systems: A Programmer's Perspective by Randal E. Bryant and David R. O'Hallaron.
2. Operating Systems: Design and Implementation by Andrew S. Tanenbaum and Herbert Bos.

NPTEL Course:

1. Operating System Fundamentals, By Prof. Santanu Chattopadhyay IIT Kharagpur https://onlinecourses.nptel.ac.in/noc24_cs108/preview
2. Introduction to Operating Systems, IIT Madras, Prof. Chester Rebeiro https://nptel.ac.in/courses/106106144