Dr. Babasaheb Ambedkar Technological University, Lonere

(Established as a University of Technology in the State of Maharashtra)

(Under Maharashtra Act No. XXIX of 2014)

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Curriculum for First Year
Undergraduate Degree Programme
B. Tech. in Chemical Engineering

With effect from AY 2023-2024

Department of Chemical Engineering

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 rejoin 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 Chemical Engineering with Computer Engineering**" (160-176 credits) enables students to take up five-six or required additional courses of 14 credits in the discipline other than Electronics and Telecommunication Engineering distributed over semesters III to VIII. Here in the case of "**B. Tech in Chemical with Computer Engineering**" (160-176 credits) student is supposed to take up 50% or more courses to complete the 50% or more credits (from assigned 14 credits) from **Computer Engineering minor bucket**. The remaining courses to complete the assigned 14 credits can be covered 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 Chemical Engineering with Honours with Multidisciplinary Minor (180-194 credits) enables students of Chemical Engineering to take up five-six additional courses of 18 to 20 credits in the Chemical 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 Chemical Engineering with Research with Multidisciplinary Minor (180-194 credits) enables students of Chemical Engineering to take up a research project of 18 to 20 credits in the Chemical 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 Chemical Engineering with *other selected discipline in* Engineering (as MDM) with Specialization Minor in Computer Engineering**" (180-194 credits) enables students to take up five-six additional courses of 14 credits in the discipline other than Chemical Engineering(for completion of multidisciplinary minor) and 18 to 20 extra credits in the **Computer Engineering discipline** distributed over semesters III to VIII. Here, the ***other selected discipline* in Engineering should be different from Specialization Minor i.e. Computer Engineering**. This enables students to take up five-six or required additional courses of 18 to 20 credits in the **Computer Engineering** 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.

B.Tech Chemical Engineering

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 atleast 90 Teaching Days, with atleast 40 hours of teaching contact periods in a five to six days session per week. The semester that is typically fromMid-Julyto Novemberis 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 atleast 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 thatUG/PG programme.

2. MandatoryPre-Registrationforhigher semesters:
   In order to facilitate proper planning of the academic activities of a semester, it is essential for 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. UnderGraduate students may be permitted to register for a few selected PostGraduate 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.

CoursePre-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 fulfils the following conditions:

   (a) Satisfied all the Academic Requirements to continue with the programme of Studies without termination;

   (b) Cleared all Institute, Hostel and Library dues and fines (if any) of the previous semesters; (c)Paid all required advance payments of the Institute and hostel for the current semester;(d)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 2020-21, starting from first year B.Tech.**

Percentageof marks	Lettergrade	Gradepoint
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	EF	0.0

2. Class is awarded based on CGPA of all eight semesters of B. Tech Program.

CGPA for pass is minimum 5.0	
CGPA up to <5.50	Pass class

CGPA≥ 5.50 & <6.00	Second Class
CGPA≥ 6.00 & <7.50	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:

1	Mid Semester Exam (MSE) Marks	20
2	Continuous Assessment Marks	20
3	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, 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 2023-24

5. Description of Grades:

EX Grade: An‘EX’ grade stands for outstanding achievement.
AE Grade: The‘EE’grade stands for minimum passing grade.
The students may appear for the remedial examination for the subjects he/she failed for the current semester of admission only and his/her performance will be awarded with EE grade only.
If any of the students remains absent for the regular examination due to genuine reason and the same will be verified and tested by the Dean (Academics) or committee constituted by the University Authority.

AF Grade: The 'FF' grade denotes very poor performance i.e., failure in a course due to poor performance. Students who have been awarded 'FF' grade in a course in any semester must repeat the subject in next semester.

6. Evaluation of Performance:

1. Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA)

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

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

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

Where

'm'is the total number of subjects from first semester onwards upto and including the semester S,'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/her performance as per the above table. -CGPA will be rounded off to the second place of decimal and recorded as such.

Award of Degree of Honours Major Degree

The concept of Major and Minors at B.Tech level is introduced to enhance learning skills of students, acquisition of additional knowledge in domains other than the discipline being pursued by the student, to make the students better employable with additional knowledge and encourage students to pursue cross-discipline research.

A. Eligibility Criteria for Majors

1. The Student should have Minimum CGPA of 7.5upto 4th Semester.
2. Student willing to opt for majors has to register at the beginning of 5th Semester.
3. The Student has to complete 5 additional advanced courses from the same discipline specified in the curriculum. These five courses should be of 4 credits each amounting to 20 credits. The students should complete these credits before the end of last semester.
4. Student may opt for the courses from NPTEL/ SWAYAM platform (if the credits of NPTEL/SWAYAM courses do not match with the existing subject proper scaling will be done).

Student complying with these criteria will be awarded B.Tech (Honours) Degree.

B. Eligibility Criteria for Minors

1. The Student should have Minimum CGPA of 7.5 upto 4th Semester.
2. Student willing to opt for minors has to register at the beginning of 5th Semester.
3. The Student has to complete 5 additional courses from other discipline of their interest, which are specified in the respective discipline. These five courses should be of 4 credits each amounting to 20 credits.
4. Student may opt for the courses from NPTEL/ SWAYAM platform (if the credits of NPTEL/SWAYAM courses do not match with the existing subject proper scaling will be done).

Student complying with these criteria will be awarded with B.Tech Degree in----- Engineering with Minor in ----Engineering.

(For e.g.: B.Tech in Chemical Engineering with Minor in Petrochemical Engineering)

For applying for Honours and Minor Degree the student has to register themselves through the proper system.

ATTENDANCE REQUIREMENTS:

1. All students must attend every lecture, tutorial and practical classes.
2. To account for approved leave of absence (e.g.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.
3. If the student failed to maintain75% attendance, he/she will be detained for appearing the successive examination.
4. The Dean (Academics)/ Principal is permitted to give 10% concession for the genuine reasons as such the case may be.
5. In any case the student will not be permitted for appearing the examination if the attendance is less than 65%.
6. 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.
7. The attendance records are to be maintained by the course instructor and he shall show it to the student, if and when required.

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) Credit's 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 shall also provide the approval or acceptanceletter 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 thestudent.

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

Proposed Course Structure for Chemical Engineering as per NEP-2020

	Course Code	Course Title	Teaching Scheme				Evaluation Scheme				Category
			L	T	P	Cr	CA	MSE	ESE	Total	
SEM-I	23UD1000BS101	Engineering Mathematics-I	3	1	0	4	20	20	60	100	BSC
	23UD1PHYBS102	Engineering Physics	3	0	0	3	20	20	60	100	BSC
	23UD1PHYBSL103	Engineering Physics Lab	0	0	2	1	60		40	100	BSC
	23UD1EGDES104	Engineering Graphics and Design	2	0	0	2	20	20	60	100	ESC
	23UD1EGDESL105	Engineering Graphics and Design Lab	0	0	2	1	60	-	40	100	ESC
	23UD1000ES106B	Programming for Problem Solving	2	0	0	2	20	20	60	100	ESC
	23UD1000ESL107B	Programming for Problem Solving Lab	0	0	2	1	60	-	40	100	ESC
	23UD1000VS108	Communication Skills	2	0	0	2	20	20	60	100	AEC/VEC/ IKS
	23UD1000VSL109	Communication Skills Lab	0	0	2	1	60	-	40	100	AEC/VEC/ IKS
	23UD1000VS111	Design Thinking	2	0	0	2	20	20	60	100	VSEC
	23UD1000CC112A/ 23UD1000CC112B/ 23UD1000CC112C	A. NSS-I B. NCC C. Introduction to Yoga	1	0	2	2	60	-	40	100	CC
		Total	**15**	**1**	**10**	**21**	**420**	**120**	**560**	**1100**	
SEM-II	23UD1000BS201	Engineering Mathematics-II	3	1	0	4	20	20	60	100	BSC
	23UD1CHEBS202	Engineering Chemistry	3	0	0	3	20	20	60	100	BSC
	23UD1CHEBSL203	Engineering Chemistry Lab	0	0	2	1	60	-	40	100	BSC
	23UD1EMES204	Engineering Mechanics	3	0	0	3	20	20	60	100	ESC
	23UD1EMESL205	Engineering Mechanics Lab	0	0	2	1	60	-	40	100	ESC
	23UD1000ES206B	Basic Electrical & Electronics Engineering	2	1	0	3	20	20	60	100	ESC
	23UD1000ESL207B	Basic Electrical & Electronics Engineering Lab	0	0	2	1	60	-	40	100	ESC
	23UD1000ES208	Environmental Science	1	0	0	1	20	20	60	100	ESC
	23UD1000ESL209	Environmental Science Lab	0	0	2	1	60	-	40	100	ESC
	23UD1000VSL210	Workshop-Manufacturing practices	0	0	4	2	60	-	40	100	VSEC
	23UD1507PC210	Introduction to Chemical Engineering	2	0	0	2	20	20	60	100	PCC
	23UD1507IK211	IKS Bucket[#] - General Meteorology	2	0	0	2	60	-	40	100	AEC/VEC/ IKS
	23UD1000CC212A / 23UD1000CC212C / 23UD1000CC212G	A. NSS-II / B. Health and Wellness / C. Study from Still Life	1	0	2	2	60	-	40	100	CC
		Total	**17**	**2**	**14**	**26**	**540**	**120**	**640**	**1300**	

Exit option with:

* Introduction to Chemical Engineering (Internship of 6 weeks in any one relevant field)
* Course on Process Plant Safety
* Course on word processing, spread sheets and power point presentation.

IKS Bucket

A- Indian Art: Materials, Techniques and Artistic Practices

B- General Meteorology

Syllabus for Chemical Engineering (First year)

SEMESTER – I

Engineering Mathematics –I **04 Credits**

Course Objectives:

1. To know the application of the matrix technique (Linear algebra) to find solutions of system of linear equations arising in many engineering problem.
2. To know and apply the concept partial derivatives and their applications to Maxima/ Minima, series expansion of multi valued functions.
3. To understand Computation of Jacobian of functions of several variables and their applications to engineering problems.
4. To identify and sketch of curves in various coordinate system.
5. To evaluate multiple integrals and their applications to area and volume.

Course Outcomes:
Students will be able to:

CO1: Apply the matrix technique (Linear algebra) to find solutions of system of linear equations arising in many engineering problem.

CO2: Demonstrate the concept partial derivatives and their applications to Maxima/ Minima, series expansion of multi valued functions.

CO3: Compute Jacobian of functions of several variables and their applications to engineering problems.

CO4: Identify and sketch of curves in various coordinate system.

CO5: Evaluate multiple integrals and their applications to area and volume.

Unit I: Linear Algebra- Matrices

Inverse of a matrix by Gauss-Jordan method; Rank of a matrix; Normal form of a matrix ; Consistency of non-homogeneous and homogeneous system of linear equations ; Eigen values and eigen vectors ; Properties of eigen values and eigen vectors (without proofs); Cayley-Hamilton's theorem (without proof) and its applications.

Unit II: Partial Differentiation

Partial derivatives of first and higher orders; Homogeneous functions – Euler's Theorem for functions containing two and three variables (with proofs); Total derivatives; Change of variables.

Unit III: Applications of Partial differentiation

Jacobians-properties; Taylor‟s and Maclaurin‟s theorems (without proofs) for functions of two variables; Maxima and minima of functions of two variables; Lagrange‟s method of undetermined multipliers.

Unit IV: Reduction Formulae and Tracing of Curves

Reduction formulae for $\int_0^{\frac{\pi}{2}} \boldsymbol{sin^n x\, dx}$, $\int_0^{\frac{\pi}{2}} \boldsymbol{cos^n x\, dx}$, $\int_0^{\frac{\pi}{2}} \boldsymbol{sin^m x\, cos^n x dx}$, tracing of standard curves given in cartesian, parametric and polar forms.

Unit V: Multiple Integra

Double integration in Cartesian and polar co-ordinates; Evaluation of double integrals by changing the order of integration and changing to polar form; Triple integral; Applications of multiple integrals to find area as double integral , volume as triple integral and surface area.

Text Books

1. Higher Engineering Mathematics by B. S. Grewal, Khanna Publishers, NewDelhi.
2. Advanced Engineering Mathematics by Erwin Kreyszig, John Wiley & Sons, NewYork.
3. A Course in Engineering Mathematics (Vol I) by Dr. B. B. Singh, Synergy Knowledgeware, Mumbai.
4. A Text Book of Applied Mathematics (Vol I & II) by P. N. Wartikar and J. N. Wartikar, Pune Vidyarthi Griha Prakashan,Pune.
5. Higher Engineering Mathematics by H. K. Das and Er. Rajnish Verma, S. Chand & CO. Pvt. Ltd., New Delhi.

Reference Books

1. Higher Engineering Mathematics by B. V. Ramana, Tata McGraw-Hill Publications, New Delhi.
2. A Text Book of Engineering Mathematics by Peter O‟ Neil, Thomson Asia Pte Ltd. , Singapore.
3. Advanced Engineering Mathematics by C. R. Wylie & L. C. Barrett, Tata Mcgraw-Hill Publishing Company Ltd., New Delhi.

General Instructions:

1. The tutorial classes in Engineering Mathematics-I are to be conducted batchwise.
2. Each class should be divided into three batches for the purpose.
3. The internal assessment of the students for 20 marks will be done based on assignments, surprise tests, quizzes, innovative approach to problem solving and percentage attendance.
4. The minimum number of assignments should be eight covering all topics.

Alternative NPTEL/SWAYAM Course:

S. No.	NPTEL Course	Name Instructor	Host Institute
1.	Engineering Mathematics –I	Prof. Jitendra Kumar	IIT Kharagpur

Engineering Physics 03 Credits

Course Objectives:

1. To provide a firm grounding in the basic physics principles and concept to resolve many Engineering and technological problems.
2. To understand and study the Physics principles behind the developments of engineering materials.

Course Outcomes:

Students will be able to:

CO1: Students acquired basic knowledge of differential equation and can create wave equation and analysis of the intensity variation of light due to interference and polarization. Students are able to understand the light propagation in fibre and use of Laser in Science and engineering.

CO2: Students can apply the knowledge of quantum mechanics to set Schrödinger's equations.

CO3: Students will familiar with some of the basic laws related to electromagnetism and Maxwell's equation as well as properties of dielectrics.

CO4: Students are able to understand key principle and application of nuclear physics. Identify planes in crystal and characteristics measurements of cubic system.

CO5: Students are able to explain fundamental concepts of magnetism and they should analyse the properties of semiconducting materials and describe various applications of superconductor.

Unit I: Engineering Optics: Interference: in thin film due to reflected light, wedge shaped film, Newton' Rings, Applications, Polarization: types of polarization, optical activity, specific rotation and Laurentz half shade polarimeter, Lasers: characteristics, Gas Laser, solid state Laser and semiconductor lasers, Applications of Lasers, Optical fibres: Acceptance cone, Numerical aperture, applications, Oscillations: free oscillations, forced oscillations and damped oscillation, resonance and it's condition.

UNIT-II: Quantum Mechanics: Wave and particle duality of radiation – de Broglie concept of matter waves – Wave function and its physical significance, Heisenberg's uncertainty principle and its application – Schrodinger's wave equation – Eigen values and Eigen functions, particle confined in one dimensional infinite square well potential, Introduction to quantum computing.

UNIT-III: Electromagnetism: Differential and integral calculus: Operator, Concept of gradient, divergence and curl, Ampere's law, Faraday law, Gauss–Divergence theorem, integral and differential forms of Maxwell equations and their physical significance, EM waves in free space. Dielectrics: polarization, Types of Dielectric polarization, dielectric constant, polar - non polar dielectrics.

UNIT-IV:

Crystal Structure: Fundamental concepts, Crystal systems Cubic structure: Number of atoms, co-ordination number, packing fraction, Atomic radius, Miller indices, relation between 'ρ' and 'a'. Nuclear Physics**:** Nuclear properties Introduction to mass defect & packing fraction, Nuclear reaction: Q value of Nuclear reaction,- Radioactivity – properties of α, β and γ rays, GM Counter.

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UNIT-V: Physics of Advanced Materials: Types of magnetic materials, ferrites and garnets, magnetic domain and hysteresis curve, Semiconductors, conductivity of semiconductors, Hall Effect Superconductors: definition – Meissner effect – type I & II superconductors, Nanomaterials: introduction and properties – synthesis: top-down and bottom-up approach, Introduction to SCADA, XRD, FESEM, VSM and applications.

Text books:

1. Introduction to Electrodynamics –David R. Griffiths.
2. Concept of Modern Physics – Arthur Beizer. Tata McGraw-Hill Publishing Company Limited.
3. Optics –Ajoy Ghatak. MacGraw Hill Education (India) Pvt. Ltd.
4. Science of Engineering Materials- C.M. Srivastava and C. Srinivasan. New Age International Pvt. Ltd.
5. Solid State Physics – A.J. Dekker. McMillan India –Limited.
6. The Feynman Lectures on Physics Vol I, II, III.
7. Introduction to Solid State Physics – Charles Kittel. John Willey and Sons
8. Engineering Physics –M.N. Avadhanulu and P.G. Kshirsagar.S.Chand & Company LTD.
9. Engineering Physics - R.K. Gaur andS. L. Gupta. Dhanpat Rai Publications Pvt. Ltd.-New Delhi.
10. Fundamental of Physics - Halliday and Resnik. Willey Eastern Limited.
11. Nanotechnology: An Introduction to Synthesis, Properties and Applications of Nanomaterials- Thomas Varghese , K. M. Balakrishna

Engineering Physics Laboratory — 01 Credit

At least 08 experiments should be performed from the following list.

1. Newton's rings - Determination of radius of curvature of Plano convex lens / wavelength of light
2. Wedge Shaped film - Determination of thickness of thin wire
3. Half shade Polarimeter - Determination of specific rotation of optically active material
4. Laser - Determination of wavelength of He-Ne laser light
5. Magnetron Tube - Determination of 'e/m' of electron
6. G.M. Counter - Determination of operating voltage of G.M. tube
7. Crystal Plane – Study of planes with the help of models related Miller Indices
8. Hall Effect - Determination of Hall Coefficient
9. Four Probe Method - Determination of resistivity of semiconductor
10. Measurement of Band gap energy of Semiconductors
11. Experiment on fibre optics
12. B-H Curve Experiment
13. Experiments on SCADA

Engineering Graphics & Design — 02 Credits

Course Objectives:

1. To prepare you to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
2. To prepare you to communicate effectively
3. To prepare you to use the techniques, skills, and modern engineering tools necessary for engineering practice

Course Outcomes:
Students will be able to:
CO1: Introduce the engineering design and its place in society
CO2: Expose to the visual aspects of engineering design
CO3: Expose to engineering graphics standards
CO4: Expose to solid modelling
CO5: Expose to computer-aided geometric design
CO6: Expose to creating working drawings
CO7: Expose to engineering communication

Detailed Syllabus:
Unit I: Traditional Engineering Graphics:
Principles of Engineering Graphics; Orthographic Projection; Descriptive Geometry; Drawing Principles; Isometric Projection; Surface Development; Perspective; Reading a Drawing; Sectional Views; Dimensioning & Tolerances; True Length, Angle; intersection, Shortest Distance.

Unit II: Computer Graphics:

Engineering Graphics Software; -Spatial Transformations; Orthographic Projections; Model Viewing; Co-ordinate Systems; Multi-view Projection; Exploded Assembly; Model Viewing; Animation; Spatial Manipulation; Surface Modelling; Solid Modelling; Introduction to Building Information Modelling (BIM).

Unit III: Introduction to Engineering Drawing

Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales – Plain, Diagonal and Vernier Scales;

Unit IV: Projections

Orthographic Projections: Principles of Orthographic Projections-Conventions - Projections of Points and lines inclined to both planes; Projections of planes inclined Planes - Auxiliary Planes; Projections of Regular Solids: those inclined to both the Planes- Auxiliary Views; Draw simple annotation, dimensioning and scale. Floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc.

Unit V: Sectioning of Solids, Isometric Projections

Sectioning of solids: Section planes perpendicular to one plane and parallel or inclined to other plane. Isometric projections: Isometric scale, drawing of isometric projections from given orthographic views.

Reference/Text Books:

1. N. D. Bhatt, Engineering Drawing, Charotar Publishing House, 46th Edition, 2003.
2. K. V. Nataraajan, A text book of Engineering Graphic, Dhanalakshmi Publishers, Chennai, 2006.
3. K. Venugopal and V. Prabhu Raja, Engineering Graphics, New Age International (P) Ltd, 2008.
4. Dhananjay A. Jolhe, Engineering Drawing with an Introduction to Autocad, Mc GrawHill Education, 2017.

Alternative NPTEL/SWAYAM Course:

S. No.	NPTEL Course	Name Instructor	Host Institute
1.	Engineering Graphics and Design	Prof. Naresh Varma Datla, Prof. S. R. Kale	IIT Delhi

Engineering Graphics & Design Laboratory — 01 Credit

List of Experiments

1. Lines, lettering and dimensioning.
2. Geometrical Constructions.
3. Orthographic projections.
4. Projections of points and straight lines
5. Projections of planes.
6. Projections of solids.
7. Section of solids.
8. Isometric Projections.

Programming for Problem Solving 02 Credits

Course Objective:

To develop logical skills and basic technical skills so that students should be able to solve basic computing problems. The students should be able to learn the basic of any computer programming language.

Course Outcomes:

Students will be able to:

CO1: To formulate simple algorithms for arithmetic and logical problems.

CO2: To translate the algorithms to programs (in C language).

CO3: To test and execute the programs and correct syntax and logical errors.

CO4: To implement conditional branching, iteration and recursion.

CO4: To decompose a problem into functions and synthesize a complete program using divide and conquer approach.

CO5: To use arrays, pointers and structures to formulate algorithms and programs.

CO6: To apply programming to solve matrix addition and multiplication problems and searching and sorting problems.

CO7: To apply programming to solve simple numerical method problems, namely rot finding of function, differentiation of function and simple integration.

Unit I: Introduction

Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.). Introduction to C, Program process development in C, Constant and Variable Name Declaration, Basic Output and Input Statements, and Operators.

Unit II: Control Flow And Array in C

Conditional Branching and Loops Writing and evaluation of conditionals and consequent branching Iteration and loops such as If-else, else-if switch Loops while and for, do-while break and continue to, go to, and Labels. Arrays (1-D, 2-D), Character arrays and Strings

UNIT-III: Introduction to Functions and Structures in C

Functions and Program Structure: Basic of functions, functions returning non-integers external variables scope rules. Basics of structures, structures and functions arrays of structures.

Unit-IV: Introduction to Python

Introduction to Python: The Environment, Python, Desktop, Command Window, Command History Window, Editor/Debugger, Workspace, Current Directory Window, Array Editor, Help WindowVariable and Constant Name Declaration, Basic Output and Input Statements, Operators, Conditional Statements, Looping Statements, Scalars, Vectors, and Matrices (1/2), Creating Functions, Plotting.

Unit-V: Basic Numerical computation with Python

Basic programs for Addition, Subtraction, Multiplication, Division, Exponents and Square Roots using Python, Using the math module for more advanced functions.Basic integration, derivation, and limit, matrix operation using Python.

Text Books:

1. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
2. E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill.

Reference Book:

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

Alternative NPTEL/SWAYAM Course:

S. No.	NPTEL Course	Name Instructor	Host Institute
1.	Problem Solving Through Programming In C	Prof. Anupam Basu	IIT Kharagpur

Programming for Problem Solving Lab — 01 Credit

At least 08 experiments should be performed from the following list:

1. Familiarization with programming environment
2. Simple computational problems using arithmetic expressions
3. Problems involving if-then-else structures
4. Iterative problems e.g., sum of series
5. 1D Array manipulation
6. Matrix problems, String operations
7. Simple functions
8. Programming for solving Numerical methods problems
9. Pointers and structures
10. File operations
11. Python programming

Communication Skills — 02 Credits

Course Objectives:

1. To provide learning environment to practice listening, speaking, reading and writing skills.
2. To assist the students to carry on the tasks and activities through guided instructions and materials.
3. To effectively integrate English language learning with employability skills and training.
4. To provide hands-on experience through case-studies, mini-projects, group and individual presentations.

Course Outcome:

Students will be able to:

CO1: The student will acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills.

Unit I: Vocabulary Building

1.1. The concept of Word Formation
1.2. Root words from foreign languages and their use in English
1.3. Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives.
1.4. Synonyms, antonyms, and standard abbreviations.

Unit II: Basic Writing Skills

1.1. Sentence Structures
1.2. Use of phrases and clauses in sentences
1.3. Importance of proper punctuation
1.4. Creating coherence
1.5. Organizing principles of paragraphs in documents
1.6. Techniques for writing precisely

Unit III: Identifying Common Errors in Writing
1.1. Subject-verb agreement
1.2. Noun-pronoun agreement
1.3. Misplaced modifiers
1.4. Articles
1.5. Prepositions
1.6. Redundancies
1.7. Clichés

Unit IV: Nature and Style of sensible Writing
1.1. Describing
1.2. Defining
1.3. Classifying
1.4. Providing examples or evidence
1.5. Writing introduction and conclusion

Unit V: Writing Practices
1.1. Comprehension
1.2. Précis Writing
1.3. Essay Writing

Oral Communication
(This Module involves interactive practice sessions in Language Lab)

- Listening Comprehension
- Pronunciation, Intonation, Stress and Rhythm
- Common Everyday Situations: Conversations and Dialogues
- Communication at Workplace
- Interviews
- Formal Presentations

Text/Reference Books:

1. AICTE's Prescribed Textbook: English (with Lab Manual) ISBN: 978-93-91505-097
2. Effective Communication Skills. Kul Bhushan Kumar, Khanna Book Publishing, 2022.
3. Practical English Usage. Michael Swan. OUP. 1995.
4. Remedial English Grammar. F.T. Wood. Macmillan.2007
5. On Writing Well. William Zinsser. Harper Resource Book. 2001
6. Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.
7. Communication Skills. Sanjay Kumar and PushpLata. Oxford University Press. 2011.
8. Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press.

Alternative NPTEL/SWAYAM Course:

S. No.	NPTEL Course Name	Instructor	Host Institute
1	English Language for Competitive Exams	Prof. Aysha Iqbal	IIT Madras

2	Technical English for Engineers	Prof. Aysha Iqbal	IIT Madras

Communication Skill Lab 01 Credit

List of Practicals :

1. How to introduce oneself ? (02 hrs)
2. Know your friend (02 hrs)
3. Introduction to Phonemic symbols (02 hrs)
4. Articulation of sounds in English with proper manner (02 hrs)
5. Practice and exercises on articulation of sounds (02 hrs)
6. Read Pronunciations/transcriptions from the dictionary (02 hrs)
7. Practice and exercises on pronunciations of words (02 hrs)
8. Introduction to stress and intonation (02 hrs)
9. Rapid reading sessions (02 hrs)
10. Extempore (02 hrs)
11. Group discussion (02 hrs)
12. Participating in a debate (02 hrs)
13. Presentation techniques (02 hrs)
14. Interview techniques (02 hrs)

Design Thinking 02 Credits

Course Objective: The objective of this Course is to provide the new ways of creative thinking and Learn the innovation cycle of Design Thinking process for developing innovative products which useful for a student in preparing for an engineering career.

Course Outcomes (CO):

Students will be able to:

CO1: Compare and classify the various learning styles and memory techniques and apply them in their engineering education.

CO2: Analyze emotional experience and Inspect emotional expressions to better understand users while designing innovative products.

CO3: Develop new ways of creative thinking and learn the innovation cycle of Design Thinking process for developing innovative products.

CO4: Propose real-time innovative engineering product designs and Choose appropriate frameworks, strategies, techniques during prototype development.

CO5: Perceive individual differences and its impact on everyday decisions and further create a better customer experience.

COURSE CONTENTS:

Unit I: An Insight to Learning and Remembering Memory

Understanding the Learning Process, Kolb's Learning Styles, Assessing and Interpreting, Understanding the Memory process, Problems in retention, Memory enhancement techniques

Unit II: Emotions and Basics of Design Thinking

Understanding Emotions: Experience & Expression, Assessing Empathy, Application with Peers, Definition of Design Thinking, Need for Design Thinking, Objective of Design Thinking, Concepts & Brainstorming, Stages of Design Thinking Process (explain with examples) –Empathize, Define, Ideate, Prototype, Test.

Unit III: Problem Fixing and Process of Product Design

Understanding Creative thinking process, Understanding Problem Solving, Testing Creative Problem Solving, Process of Engineering Product Design, Design Thinking Approach, Stages of Product Design, Examples of best product designs and functions, Assignment – Engineering Product Design.

Unit IV: Prototyping & Testing

What is Prototype? Why Prototype? Rapid Prototype Development process, Testing, Sample Example, Test Group Marketing.

Unit V: Design Thinking & Customer Centricity

Practical Examples of Customer Challenges, Use of Design Thinking to Enhance Customer Experience, Parameters of Product experience, Alignment of Customer Expectations with Product Design.

Text books:

1. Karmic Design Thinking by Prof. Bala Ramadurai,

References:

1. Design: Creation of Artifacts in Society by Prof. Karl Ulrich, U. Penn
2. Change by Design by Tim Brown.

Alternative NPTEL/SWAYAM Course:

S. No.	NPTEL Course	Name Instructor	Host Institute
1.	Understanding Design Thinking and People Centred Design	Prof. Jhumkee Iyengar	IIT Kanpur

NSS-I 02 Credits

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to :

1. Indian constitution, fundamental rights and duties of citizens
2. Health, hygiene and sanitation
3. Environmental issues and its management
4. Indian youth development in different aspects

Course Outcomes (CO):

Students will be able to:

CO1: Understand features of Indian constitution, fundamental rights and duties of citizens
CO2: Explain importance of Health, Hygiene & Sanitation
CO3: Summarize yoga a tool for healthy lifestyle

CO4: Conclude environmental issues and organize its management
CO5: Classify the disasters and youth role in its management

COURSE CONTENTS:

Unit I

Introduction and Basic Concepts of NSS: History, Philosophy, Aims and objectives of NSS Organizational structure, Concept of regular activities, Special camping, Day Camps. Basis of adoption villages/slums, Methodology of conducting survey

Unit II

Youth and Community Mobilization: Definition, Profile of youth, Categories of youth, Issues, Challenges and opportunities for youth, Youth as an agent of social change, Youth-adult partnership, Mapping of community stakeholders, Identifying methods of mobilization, Needs & importance of volunteerism**.**

Unit III

Importance and Role of Youth Leadership: Meaning and types of leadership, Qualities of good leaders; Traits of leadership, Importance and role of youth leadership.

Unit IV

Life Competencies and Skill: Definition and importance of life competencies, Communication, Inter Personal, Problem solving and decision making, Positive thinking, Self-confidence and self-esteem, Life goals, Stress and time management.

Unit V

Social Harmony and National Integration: Indian history and culture, Role of youth in peace-building and conflict resolution, Role of youth in Nation building

Youth Development Programs in India: National Youth Policy, Youth development programs at the National Level, State Level and voluntary sector, Youth-focused and Youth-led organizations.

Introduction to Yoga — 02 Credits

Course Objectives:

1. To learn Message of Vedas and Upanishads
2. To learn Four Streams of Yoga,
3. To learn Shaddarshanas or the SIX systems of Indian Philosophy,
4. To introduce with Hatha Yoga and Patanjali Yoga Sutras
5. To understand Life and message of spiritual masters and Indian Culture
6. To understand Anatomy and Physiology, Yoga and Exercise Physiology

Course Outcomes:

CO1: Students should be able to learn Message of Vedas And Upanishads
CO2: Students should be able to learn Four Streams of Yoga,
CO3: Students should be able to learn Shaddarshanas or the SIX systems of Indian Philosophy,
CO4: Students should be able to introduce with Hatha Yoga and Patanjali Yoga Sutras
CO5: Students should be able to understand Life and message of spiritual masters and Indian Culture
CO6: Students should be able to understand Anatomy and Physiology, Yoga and Exercise Physiology

COURSE CONTENTS:

Unit I: Message of Vedas and Upanishads: Search for Happiness, Search for Reality

Unit II: Streams of Yoga: Bhakti Yoga, Raja Yoga - Antaranga Yoga, Bahiranga Yoga, Karma Yoga -Secrets of Action, Jnana Yoga

Unit III: Shaddarshanas – Nyaya, Vaishesika, Sankhya, Uttaramimamsa, Purvamimamsa

Unit IV: Life and Message of Spiritual Masters –Sri Ramakrishna Paramahamsa, Maa Sharada Devi, Swami Vivekananda, Indian Culture

Unit V: Anatomy and Physiology, Yoga and Exercise Physiology, Yoga & Health - Concept of Health and Pancha Kosha Vivek, Yogic Concept of Health and Disease

Reference:

1. NPTEL/SWAYAM Course:

S. No.	NPTEL Course Name	Instructor	Host Institute
1	Introduction to Yoga and Applications of Yoga	Prof. Sridhar Melukote	Swami Vivekananda Yoga Anusandhana Samsthan

SEMESTER – II

Engineering Mathematics – II 04 Credits

Course Objectives:

1. To know and discuss the need and use of complex variables to find roots, to separate complex quantities and to establish relation between circular and hyperbolic functions.
2. To understand and solve first and higher order differential equations and apply them as a mathematical modelling in electric and mechanical systems.
3. To determine Fourier series representation of periodic functions over different intervals.
4. To demonstrate the concept of vector differentiation and interpret the physical and geometrical meaning of gradient, divergence &curl in various engineering streams.
5. To know and apply the principles of vector integration to transform line integral to surface integral, surface to volume integral &vice versa using Gree's, Stoke's and Gauss divergence theorems.

Course Outcomes:

Students will be able to:

CO1: Discuss the need and use of complex variables to find roots, to separate complex quantities and to establish relation between circular and hyperbolic functions.

CO2: Solve first and higher order differential equations and apply them as a mathematical modelling in electric and mechanical systems.

CO3: Determine Fourier series representation of periodic functions over different intervals.

CO4: Demonstrate the concept of vector differentiation and interpret the physical and geometrical meaning of gradient, divergence &curl in various engineering streams.

CO5: Apply the principles of vector integration to transform line integral to surface integral, surface to volume integral &vice versa using Green"s, Stoke"s and Gauss divergence theorems.

Unit I: Complex Numbers

Definition and geometrical representation ; De-Moivre"s theorem(without proof) ; Roots of complex numbers by using De-Moivre"s theorem ; Circular functions of complex variable – definition ; Hyperbolic functions ; Relations between circular and hyperbolic functions ; Real and imaginary parts of circular and hyperbolic functions ; Logarithm of Complex quantities.

Unit II: Ordinary Differential Equations of First Order and First Degree and Their Applications

Linear equations; Reducible to linear equations (Bernoulli's equation); Exact differential equations; Equations reducible to exact equations ; Applications to orthogonal trajectories , mechanical systems and electrical systems.

Unit III: Linear Differential Equations with Constant Coefficients

Introductory remarks - complementary function, particular integral; Rules for finding complementary functions and particular integrals; Method of variation of parameters; Cauchy's homogeneous and Legendre's linear equations.

Unit IV: Fourier Series

Introductory remarks- Euler's formulae ; Conditions for Fourier series expansion – Dirichlet's conditions ; Functions having points of discontinuity ; Change of interval ; Odd and even functions expansions of odd and even periodic functions ; Half-rangeseries.

Unit V: Vector Calculus

Scalar and vector fields:Gradient, divergence and curl; Solenoidal and irrotational vector fields; Vector identities (statement without proofs); Green's lemma, Gauss's divergence theorem and Stokes' theorem (without proofs).

Text Books:

1. Higher Engineering Mathematics by B. S. Grewal, Khanna Publishers, NewDelhi.
2. Advanced Engineering Mathematics by Erwin Kreyszig, John Wiley & Sons, NewYork.
3. A Course in Engineering Mathematics (Vol II) by Dr. B. B. Singh, Synergy Knowledge ware, Mumbai.
4. A Text Book of Applied Mathematics (Vol I & II) by P. N. Wartikar and J. N. Wartikar, Pune Vidyarthi Griha Prakashan, Pune.
5. Higher Engineering Mathematics by H. K. Das and Er. Rajnish Verma, S. Chand & CO. Pvt. Ltd., New Delhi.

Reference Books:

1. Higher Engineering Mathematics by B. V. Ramana, Tata McGraw-Hill Publications, New Delhi.
2. A Text Book of Engineering Mathematics by Peter O" Neil, Thomson Asia Pte Ltd. , Singapore.
3. Advanced Engineering Mathematics by C. R. Wylie & L. C. Barrett, Tata Mcgraw-Hill Publishing Company Ltd., New Delhi.

General Instructions:

1. The tutorial classes in Engineering Mathematics-II are to be conducted batchwise. Each class should be divided into three batches for the purpose.
2. The internal assessment of the students for 20 marks will be done based on assignments, surprise tests, quizzes, innovative approach to problem solving and percentage attendance.
3. The minimum number of assignments should be eight covering all topics.

Alternative NPTEL/SWAYAM Course:

S. No.	NPTEL Course Name	Instructor	Host Institute
1	Engineering Mathematics II	Prof. Jitendra Kumar	IIT Kharagpur

Engineering Chemistry — 03 Credits

Course Objectives:

1. To impart the knowledge of chemistry in the area of Engineering and Technology.
2. To capable the student to explain the importance of chemistry in various fields of Engineering.
3. To identify the concept of chemistry to lay the ground work for subsequent studies.

Course Outcomes:

Students will be able to:

CO1: Students should be able to understand and explain the basic concepts of Water treatment and capable to explain softening processes and water Characteristics.

CO2: Students should be able to classify and explain various types of Corrosion and should apply methods to minimize the rate of Corrosion.

CO3: Students should be able to classify and explain various types of coals and lubricants, its physical and chemical properties and industrial importance.

CO4: Students should know the concept of Electrochemistry and its importance.

CO5: Student should be able to understand and explain various instrumental methods of Analysis.

Unit I: Water Treatment

Introduction, Hard and soft water, Disadvantages of hard water, Softening of water – Ion exchange process, Hot lime –soda process, Hardness and its determination by EDTA method, Dissolved oxygen (DO) and its determination by Winkler's method, Numerical based on hardness, Sewage water treatment.

Unit II: Corrosion and its Control

Introduction, Fundamental reason of corrosion, Electrochemical corrosion (Wet Corrosion), Mechanism of Wet corrosion, Direct Chemical corrosion (Dry corrosion), Factors affecting the rate of corrosion, Types of corrosion- Pitting corrosion, Microbiological corrosion, Methods to minimize the rate of corrosion- Proper designing, Cathodic and anodic protection method.

Unit III: Fuels and Lubricants

Fuels: Introduction, Classification of fuel, Calorific value of a fuel, Characteristics of a good fuel, Solid fuel- Coal and various types of coal, Analysis of coal- Proximate and Ultimate analysis, Liquid fuel- Refining of petroleum.

Lubricants: Introduction, classification of lubricants - Solid, Semi –solid and Liquid lubricants, Properties of lubricants: Physical properties – viscosity, viscosity index, surface tension, Flash point and Fire point. Chemical properties – acidity, saponification value.

Unit IV: Electrochemistry

Introduction, Electrical conductance, Conductance measurement by Wheatstone bridge method, Cell constant, Conductometric titrations, Glass electrode and its application for pH measurement, Ostwald's theory of acid- base indicator, Rechargeable batteries i) Lithium ion battery, ii) Lithium battery, Fuel cell (H2-O2), Advantages of fuel cell.

Unit V: Instrumental Methods of Analysis

UV-Visible spectroscopy-Introduction, Laws of absorption -Beer's - Lambert's law,
Instrumentation and working of double beam spectrophotometer.
Flame Photometry (Flame emission spectroscopy) - Introduction, Principle and working.
Chromatography- Introduction, Classification, Thin layer chromatography (TLC).
Brief discussion on IR spectroscopy.

Textbooks:

1. Jain P.C & Jain Monica, Engineering Chemistry, Dhanpat Rai& Sons, Delhi, 1992.
2. Bhal &Tuli, Text book of Physical Chemistry, S. Chand & Company, New Delhi.
3. Shikha Agarwal, Engineering Chemistry- Fundamentals and applications, Cambridge Publishers - 2015.
4. Gurudeep Chatwal and Sham Anand, Instrumental methods of Chemical Analysis, Himalaya Publishing House, New Delhi

Reference books:

1. Barrow G.M., Physical Chemistry, McGraw-Hill Publication, New Delhi.
2. O. G. Palanna , Engineering Chemistry, Tata McGraw-Hill Publication, New Delhi.
3. WILEY, Engineering Chemistry, Wiley India, New Delhi 2014.
4. S.S.Dara, Engineering Chemistry, McGraw Hill Publication, New Delhi.
5. Willard, Hobart H.; Merritt, Lynne L., Jr.; Dean, John A. Instrumental Methods of Analysis, American Chemical Society

Engineering Chemistry Lab — 01 Credit

List of Experiments: (Perform any 9 – 10 Experiments)

1. Determination of Hardness of water sample by EDTA method.
2. Determination of Chloride content in water sample by precipitation titration method.
3. Determination of Dissolve Oxygen in water by Iodometric method.
4. Determination of Percent purity of Bleaching Powder.
5. pH – metric Titration (Acid Base titration)
6. Conductometric Titration (Acid Base titration)
7. Surface tension
8. Viscosity
9. To determine Acidity of water sample.
10. To determine Calorific value of a fuel.
11. Determination of Acid value of an oil sample.
12. Determination of Saponification value of an oil sample.
13. To verify Beer's-Lambert's law.
14. To determine Alkalinity water sample.
15. Determination of rate of corrosion of metal.
16. To determine the maximum wavelength of absorption of a given solution by colorimeter.
17. Experiment on Chromatography.

Reference Books:

1. Systematic experiments in Chemistry, A. Sethi, New Age International Publication, and New Delhi.
2. Practical Inorganic Chemistry, A. I. Vogel, ELBS Pub.
3. Practical in Engineering Chemistry, S. S. Dara.

Engineering Mechanics — 03 Credits

Course Objectives:

1. To understand the resolving forces and moments for a given force system.
2. To know and apply Conditions of static equilibrium to analyze given force system.
3. To compute Centre of gravity and Moment of Inertia of plane surfaces.
4. To compute the motion characteristics of a body/particle for a Rectilinear Motion.
5. To know and discuss relation between force and motion characteristics.

Course Outcomes:

Students with be able to:

1. Apply fundamental Laws of Engineering Mechanics
2. Apply Conditions of static equilibrium to analyze given force system
3. Compute Centre of gravity and Moment of Inertia of plane surfaces
4. Compute the motion characteristics of a body/particle for a Rectilinear Motion
5. Know and discuss relation between force and motion characteristics

Teaching Work Load: (3 Theory + 01 Tutorial)/week

Module - 1 Introduction and Fundamental principles — 06 Hours

Introduction: objectives of engineering analysis and design, idealization of engineering problems, simplification

of real 3D problems to 2-D and 1-D domain, basis of assumptions, introduction to types of supports and loads, free body diagram, laws of motion.

Fundamental principles: force systems, resolution and composition of a forces, resultant, couple, moment, Lami's theorem Varignon's theorem.

Module - 2 Equilibrium **06 Hours**

Static equilibrium: analytical and graphical conditions of equilibrium, equilibrium of coplanar concurrent forces, coplanar non concurrent forces, parallel forces. Centroid of composite shapes, moment of inertia of planer sections.

Friction: Coulomb's laws, friction angles, wedge friction, sliding friction.

Module - 3 Beams and Trusses **06 Hours**

Beams: Types of beam, loads and supports, beam reactions for simply supported beams, continuous beams (with 3 supports only)

Simple trusses: Types of trusses, analysis of plane trusses by method of joints and method of sections.

Module- 4 Kinematics of Particle **06 Hours**

Kinematics of linear motion: types of motion, laws of motion, kinematics of particles, rectilinear motion, constant and variable acceleration, study of motion diagrams, motion under gravity, projectile motion, concept of relative velocity.

Module — 5 Kinetics and Work, Power, Energy **06 Hours**

Kinetics of particle: D'A1embert's principle: applications in linear motion, kinetics of rigid bodies, applications in translation.

Work done by a force, potential energy, kinetic energy of linear motion and rotation, work energy equation, conservation of energy, power. Collision of elastic bodies, Impulse momentum principle.

Text Books:

1. S. Timoshenko, D. H. Young, "Engineering Mechanics", McGraw Hill, 1995.
2. Tayal A. K., "Engineering Mechanics", Umesh Publications, 2010.
3. Bhavikatti S. S., Rajashekarappa K. G., "Engineering Mechanics", New Age International Publications, 2nd Edition.
4. Beer, Johnston, "Vector Mechanics for Engineers", Vol. 1: Statics and Vol. 2: Dynamics, McGraw Hill Company Publication, 7th edition, 1995.

Reference Books:

1. Irving H. Shames, "Engineering Mechanics -Statics and Dynamics", Pearson Educations, Fourth edition, 2003.
2. McLean, Nelson, "Engineering Mechanics", Schaum's outline series, McGraw Hill Book Company, N. Delhi, Publication.
3. Singer F. L., "Engineering Mechanics -Statics & Dynamics", Harper and Row Pub. York.
4. Junnarkar S.B., and Shah, H.J. "Applied Mechanics", Charotar Publication House Anand

Alternative NPTEL/SWAYAM Course:

S. No.	NPTEL Course	Name Instructor	Host Institute
1.	Engineering Mechanics	Prof. K. Ramesh	IIT Madras

Engineering Mechanics Lab — 01 Credit

At least 08 experiments should be performed from the following list

1. To verify the law of Force Polygon
2. To verify the law of Moments using Parallel Force apparatus. (simply supported type)
3. To verify the law of moments using Bell crank lever.
4. To determine support reaction for beam.
5. To determine the co-efficient of friction between wood and various surface (like Leather, Wood, Aluminum) on an inclined plane.
6. Simple / compound pendulum.
7. Moment of Inertia of fly wheel
8. To find CG and moment of Inertia of an irregular body using Computation method.
9. Verification of force transmitted by members of given truss.
10. Collision of elastic bodies (Law of conservation of momentum
11. Verification of law of machine by using worm and worm wheel.
12. Any other innovative experiment
13. Assignment on beam reaction with at least 05 examples
14. Application of spreadsheet program for determination of beam reaction, laws of moment, any other topic from the syllabus.

Basic Electrical & Electronics Engineering — 03 Credits

Course Objectives:

1. To know and apply basic ideas and principles of electrical engineering.
2. To Identify protection equipment and energy storage devices.
3. To differentiate electrical and electronics domains and explain the operation of diodes and transistors.
4. To acquire knowledge of digital electronics
5. To design simple combinational and sequential logic circuits.

Course Outcomes:

Students will be able to:

CO1: Apply basic ideas and principles of electrical engineering.
CO2: Identify protection equipment and energy storage devices.
CO3: Differentiate electrical and electronics domains and explain the operation of diodes and transistors.
CO4: Acquire knowledge of digital electronics
CO5: Design simple combinational and sequential logic circuits.

Unit I: Elementary Electrical Concepts:

Fundamental of Electrical system Potential difference, Ohm's law, Effect of temperature on resister, resistance temperature coefficient, Electrical wiring system: Study of different wire gauges and their applications in domestic and industry. Energy Resources and Utilization: Conventional and nonconventional energy resources; Introduction to electrical energy generation from different resources, transmission, distribution and utilization, Advantages & Disadvantages of AC & DC transmission. Concept of Supply Demand, Power Factor, Need of unity factor.

Unit II: Measurement of Electrical Quantities:

Measurement of Voltage, Current, and Power; Measurement of 3 phase power; Study of Energy meters. Study of Electrical Storage devices: Batteries such as Nickel-cadmium (NiCd), Lithium- ion (Li-ion), Lithium Polymer (Li-pol.) batteries. Study of circuit breakers & Actuators (MCB & MPCB, Power Contactors & Aux contactors, Electro-Mechanical & Solid state Relays)

Unit III: Diodes and Circuits:

The P-N Junction Diode, V-I characteristics, Diode as Rectifier, specifications of Rectifier Diodes, Half Wave, Full wave, Bridge rectifiers, Equations for I_{DC},V_{DC},V_{RMS}, I_{RMS}, Efficiency and Ripple Factor for each configuration. Filters: Capacitor Filter, Choke Input Filter, Capacitor Input Filter (Π Filter), Zener Diode, Characteristics, Specifications, Zener Voltage Regulator and Types of Diodes: LED, Photodiode

Unit IV: Semiconductor Devices and Applications:

Transistors: Introduction, Classification, CE, CB, and CC configurations, α, β, concept of gain and bandwidth. Operation of BJT in cut-off, saturation and active regions (DC analysis). BJT as an amplifier, biasing techniques of BJT, BJT as a switch.

Introduction to Digital Electronics: Number System, Basic logic Gates, Universal Gates, Boolean Postulates, De-Morgan Theorems

Reference/Text Books:

1. V. N. Mittal and Arvind Mittal, Basic Electrical Engineering, McGraw-Hill Publication.
2. Brijesh Iyer and S. L. Nalbalwar, A Text book of Basic Electronics, Synergy Knowledge ware Mumbai, 2017.ISBN:978-93-8335-246-3
3. Vincent DelToro, Electrical engineering Fundamentals, PHI Publication, 2nd Edition, 2011.
4. Boylstad, Electronics Devices and Circuits Theory, Pearson Education.
5. Edward Hughes, Electrical Technology, Pearson Education.
6. D. P. Kothari and Nagrath, Theory and Problems in Electrical Engineering, PHI Publication, 2011.
7. B. L. Theraja, Basic Electronics, S. Chand Limited, 2007.
8. Millman Halkias, Integrated Electronics-Analog and Digital Circuits and Systems, McGraw-Hill Publication, 2000.
9. Donald Neaman, Electronic Circuit Analysis and Design, McGraw-Hill Publication, 3rd Edition.
10. Donald Neaman, Electronic Circuit Analysis and Design, McGraw-Hill Publication, 3rd Edition.
11. Printed Circuit Boards Design &Technology, WalterC. Bosshart, McGraw-Hill Publication.

Note: Students are advised to use internet resources whenever required.

Alternative NPTEL/SWAYAM Course:

S. No.	NPTEL Course	Name Instructor	Host Institute
1.	Basic Electrical Technology	Prof. N.K. De, Prof. G.D. Roy, Prof. T.K. Bhattacharya	IIT Kharagpur
2.	Basic Electronics and Lab	Prof. T.S. Natarajan	IIT Madras
3.	Basic Electronics	Prof. Mahesh B. Patil	IIT Bombay

Basic Electrical & Electronics Engineering Lab — 01 Credit

At least 08 experiments should be performed from the following list

1. Measure voltage current and power in 1 phase circuit with resistive load.
2. Measure voltage current and power in R L series circuit.
3. Determine transformation ratio (K) of 1 phase transformer
4. Connect single phase transformer and measure input output quantities.
5. Identify various passive electronic components in the given circuit.
6. Connect resistors, capacitors in series and parallel combination on bread board and measure its value using multimeter.
7. Identify various active electronic component in the given circuit.
8. Test the performance of PN junction diode.
9. Test the performance of Zener diode.
10. Test the performance of NPN transistor.

Environmental Science 01 Credit

Course Objectives

1. To impart the knowledge of environmental education to the students of Engineering and Technology.
2. To explain basic knowledge and concept of causes, effects and control measures of environmental pollution and
3. To understand the role of individual for the protection of Environment.

Course Outcomes

Student should able to:

1. Know and understand about components and segments of environment, ecosystem and its types.
2. Understand and explain various types of air pollution, their effects and control measures.
3. know the various types of water pollution, sources, waste water treatment, effect of water pollution on health
4. understand the sources, effects and control measures of soil & noise pollution
5. Know the sources and types of solid waste, its management and role of individual in pollution prevention.

Unit I: Environment

Introduction, Components of Environment, Types of Environment, Brief discussion on Segments of Environment, Environmental Pollution, Ecosystem-Types of Ecosystem, Components of Ecosystem.

Unit II: Air Pollution

Introduction, Brief discussion on air pollutants, Sources of Air Pollution- Pollutants from Industry, Pollution by Automobiles; Effect of Air Pollutions-Acid rain, Green House Effect, Global warming; Brief discussion on Control of Air Pollution.

Unit III: Water Pollution

Introduction, Types of Water Pollutants, Sources of Water Pollution, Methods to remove impurities in water, Treatment of Waste water, Impact of Water Pollution on Human Health, Water as a carrier for the transmission of diseases.

Unit IV: Soil & Noise Pollution

Sources of Soil Pollution, Harmful effects of Soil Pollution, Control of Soil Pollution, Noise Pollution-Sources, Effects and Control Measures of Noise Pollution.

Unit V: Solid Waste Management

Classification of Solid waste- Sources and Types of Solid Waste, Causes of Solid Waste Solid Waste Management- Disposal of Solid Waste, Recycling of Solid Waste Awareness of Environment, Role of Individuals in Pollution Prevention.

Reference Books:

1. Environmental Science, V. K. Ahluwalia and Sunita Malhotra
2. Environmental Chemistry (sixth edition), A. K. De
3. Essential Environmental Studies, S. P. Mishra and S. N. Pandey

Environmental Science laboratory 01 Credit

List of Experiments:

1. Experiments on Air Pollution.
2. Experiments on Water Pollution.
3. Experiments on Soil Pollution.

Reference Books:

1. Environmental Chemistry (sixth edition), A. K. De
2. A Textbook of Engineering Chemistry, Dr. S. S. Dara and Dr. S. S. Umare
3. Textbook On Experiments & Calculations In Engineering Chemistry: Ss Dara (Author), S Chand & Company Pvt Ltd - He (Publisher)

Workshop-Manufacturing Practices 02 Credits

Course Objectives:

1. To provide exposure to the students with hands on experience on various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering.
2. To have a study and hands-on-exercise on plumbing and carpentry components.
3. To have a practice on gas welding, foundry operations and fitting.
4. To have a study on measurement of electrical quantities, energy and resistance to earth.
5. To have a practice on soldering.

Laboratory Outcomes:

Students will be able to:

1. Upon completion of this laboratory course, students will be able to fabricate components with their own hands.
2. They will also get practical knowledge of the dimensional accuracies and dimensional tolerances possible with different manufacturing processes.
3. By assembling different components, they will be able to produce small devices of their interest.

Workshop Practices

1. Machine shop
2. Fitting shop
3. Carpentry
4. Electrical & Electronics
5. Welding shop
6. Casting
7. Smithy
8. Plastic moulding& Glass Cutting

Examinations could involve the actual fabrication of simple components, utilizing one or more of the techniques covered above.

Text/Reference Books:

1. AICTE's Prescribed Textbook: Workshop / Manufacturing Practices (with Lab Manual) ISBN: 978-93-91505-332.
2. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.
3. Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology", 4th edition, Pearson Education India Edition, 2002.
4. Gowri P. Hariharan and A. Suresh Babu," Manufacturing Technology – I" Pearson Education, 2008.
5. Roy A. Lindberg, "Processes and Materials of Manufacture", 4th edition, Prentice Hall India, 1998.
6. Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGraw Hill House, 2017.

Introduction to Chemical Engineering 02 Credits

Course Outcomes: At the end of the course, the student will be able to:

CO1	Understand the basic concepts of chemical engineering.
CO2	Understand the material and energy balances of chemical processes.
CO3	Understand the analogy among fluid and heat transfer.
CO4	Understand the concepts related to mass transfer operations and chemical kinetics.
CO5	Analyse the effect of pollution on environment.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-		-	✓	✓	-	-	-	-	-
CO2	-	-	-		-	✓	-	-	-	-	-	-
CO3	-	-	-		-	✓	-	✓	-	-	✓	-
CO4	-	-	-		-	✓	-	✓	-	-	✓	-
CO5	-	-	-	✓	-	-	-	-	-	-	✓	✓

Detailed Syllabus:

Unit I Introduction

Introduction to Unit operation and unit Process – Development of flow diagrams – basic tools of chemical engineering.

Unit II Process Calculations

Physiochemical Calculation, Material and Energy balances.

Unit III Transport Processes

Flow of fluids: Basic concept of transfer process, principles and application of flow of fluid and solids

Measuring devices: Density and specific gravity, Viscosity, humidity, pH, Pressure, Temperature, Flow meters, Level indicators.

Heat Transfer: Basic mode of heat transfer, Heat exchangers, Evaporation.

Unit IV Fundamentals of mass transfer and Chemical kinetics

Mass Transfer: Diffusion in Fluids, Distillation, Gas Absorption, Liquid–liquid Extraction, Leaching, Humidification, Dehumidification, Drying and Crystallization, Adsorption.

Chemical Kinetics: Introduction, Thermodynamic review, Determination of the rate equation, Catalysis, Reactors.

Unit V Computer Application, Resources and Production

Computer Application: Modeling and simulation, Computer and their application.

Natural resources and their utilization: Renewable raw materials, Non – Renewable material.Pollution and abatement, Case studies on refineries- Cement, Paper and pulp, Textile and Ceramic industries.

Text Book:

1. S.K. Ghosal S. K. Sanyal and S. Datta Introduction to chemical Engineering TMH Book company 1998.
2. Anderson L.B. and L.A. Wenzel Introduction to chemical Engineering Mcgraw Hill Book Company 1998.

IKS Subjects 02 Credits

Indian Art: Materials, Techniques and Artistic Practices 02 Credits

Course Objectives:

1. To introduce the diversity of art practices and material culture from the Indian subcontinent.
2. To situate these practices against their socio-cultural, political and temporal settings.
3. To support an immersive approach to understanding Indian art.
4. To bring together the recent findings in Indian art

Course Outcomes:
Students will be able to:

CO1: Draw connections between the historical artifacts and contemporary objects from the immediate surroundings.
CO2: Encourage themselves as an art practitioner, aspiring art historians, educators, and those preparing for competitive examinations in India.
CO3: Direct the possible ways of exploring these thematic.

COURSE CONTENT:
Unit I: Clay and Architecture I
Clay: Terracotta and Terracruda, How is clay processed into objects?, Brick structures and urns from the Indus Valley and Megalithic sites in south India, Sculptures of terracotta and bronze from Harappa, Terracruda or unbaked clay-made objects and rituals.
Architecture I: Basics of Buddhist and Jain architecture- Wood, stone and living rock, Stupa, vihara, caves and temples from Shunga, Kushana, Maurya and Gupta periods.

Unit II: Pigment and Architecture II

Pigment: Mineral and vegetal colours- How pigment-based paints are processed and applied to walls Bhimbetka drawings, Murals of Sittanavasal and Ajanta.

Architecture II: Hinduism and temple building- Architectural treatise and utilisation of Vastupurusha mandala for making temples, Temples of Badami Chalukyas, Rashtrakuta, Chola, Chandela and Eastern Ganga dynasties.

Unit III: Stone and Garden

Stone: Memorials, Architectural Remnants and Objects- Types of stone in India: Mathura Sandstone, Deccani Basalt, Rajasthani Marble, Stone carving for architecture, Hero stones and their social significance, Household items and objects in royal court.

Garden: Islam, the garden of paradise and afterlife, Tombs, palace, garden and waterways from the Mughal and Deccani context**,** Regional and foreign flora and fauna in Mughal and Deccani gardens.

Unit IV: Paper and Printing

How does paper affect the character of painting and calligraphy? How are ink and pigments prepared? Jain manuscripts and Islamic treatise, Mughal, Deccani, Rajput and Pahari miniature paintings, Mysore and Tanjore paintings.

Printing: European Interventions -Printmaking techniques and their application in books and images, Bazar paintings of Kalighat and Battala woodcuts**,** Lithograph and Oleograph from Calcutta, Pune and Lucknow

Unit V: Multimedia Approaches

Introduction to the key developments in Indian Art after 1947, Post-independence artistic and design practices, Canvas painting, textile, furniture making between the 1950s and 1990s, Neoliberalism, transnational connections and "new media" approaches, Curatorial and collaborative projects between artists, educators and communities, Biennale, entrepreneurship and expansive notion of "art" after 2010.

Text Books/References:

1. Ali, Daud and Emma Flatt eds. 2020. Garden and landscape practices in pre-colonial India: histories from the Deccan. New Delhi: Routledge.
2. Dehejia, Vidya. 2006. Chola: Sacred Bronzes of Southern India. London: Royal Academy of Arts.
3. Goswamy, B. N., and Eberhard Fischer. 2017. Pahari Paintnings: The Horst Metzger collection in the Museum Rietberg. New Delhi: Niyogi Books.
4. Hardy, Adam. 2007. The Temple Architecture of India. Chichester (GB): J. Wiley and Sons.
5. Huntington, Susan. 1993. The Art of Ancient India: Buddhist, Hindu, Jain. New York: Weatherhill.
6. Koch, Ebba. 2001. Mughal Art and Imperial Ideology: Collected Essays. New Delhi: Oxford University Press.
7. Meister, Michael and M. A. Dhaky. 1999. Encyclopedia of Indian Temple Architecture. New Delhi: Manohar Publishers.
8. Mitter, Partha. 2001. Indian Art. Oxford and New York: Oxford University Press.
9. Sengupta, Paula. 2012. The Printed Picture: Four Centuries of Indian Printmaking. New Delhi: Delhi Art Gallery.
10. Singh, Kavita, ed. 2018. Scent upon a Southern Breeze: the synaesthetic arts of the Deccan. Mumbai: Marg.
11. Subramanyan, K. G. 2007. The Magic of Making: Essays on Art and Culture. Calcutta: Seagull.

General Meteorology 02 Credits

Course Objectives:

1. To give an overview of science of meteorology.
2. Be aware of the working of world meteorological organization and different met communications/telecommunication network in India.
3. To make aware of effect of physical geography and earth's interior on meteorology.

Course Outcomes:

Students will be able to:

CO1: Remember various components of world meteorological organizations. (Remember)

CO2: Understand the met communications, telecommunications network in India and channels used in IAF. (Understand)

CO3: Understand the effect of physical geography, motions of the earth and on meteorological process. (Apply)

CO4: Apply the knowledge of earth's interior to analyse the meteorological phenomena. (Analyze)

CO5: Evaluate the measurement of time in prospective of meteorology. (Evaluate)

COURSE CONTENT:

Unit I: Science of Meteorology- An Overview

Introduction to meteorology, History of meteorology, General circulation.

Unit II: Meteorological Organisation

World meteorological organization (WMO), Regional met centers, Indian Meteorological Department, Met organization in Indian Air force.

Unit III: Motion of Earth and Measurement of Time

Introduction, Orbital and rotational characteristics of earth, Conversion of time and sidereal time.

Unit IV: Physical Geography and Structure of Earth

Insolation, The earth and its interior, Impact of physical geography.

Unit V: Met Telecommunication

Global Telecommunication System, National Data Exchange Network, Meteorological Telecommunications in IAF.

Text Books:

1. WMO Training Manuals.
2. Manual of Meteorology for Air Crew - IAF Publication
3. General Meteorology – Byers HR.

Reference Books:

1. Training Notes. Dept of Meteorology - AFA(Volume – 3)
2. Meteorology for Airman in India Part I – I Met D.

NSS-II 02 Credits

Unit 1: Life Competencies and skill

Definition and importance of life competencies, Communication, Inter Personal, Problem solving and decision making, Positive thinking, Self-confidence and self-esteem, Life goals, Stress and time management

Unit 2: Social Harmony and National Integration
Indian history and culture, Role of youth in peace-building and conflict resolution, Role of youth in Nation building

Unit 3: Youth Development Programmes in India
National Youth Policy, Youth development programmes at the National Level, State Level and voluntary sector, Youth-focused and Youth-led organizations

Health and Wellness — 02 Credits

Course Objectives:

1. To systematically addresses the issues of health, adjustment and well-being.
2. To provide insights from the field of psychology to make your life more satisfying and meaningful.

Course Outcomes:
Students will be able to:
CO1: Learn how to deal with mental distress and disorders
CO2: Understand and enhance positive mental health and wellbeing particularly in the field of psychology.
CO3: Gain happiness and well-being theory and research to enrich the understanding of both negative and positive side of human behaviour.

Unit 1: Psychology of happiness
What is happiness? What makes us happy? Socio-economic factors and happiness; Positive emotions

Unit 2: Can we become happier?
Genetic set-point and hedonic adaptation; Sustainable happiness model and intentional activities

Unit 3: Happiness Activities 1
Expressing gratitude and positive thinking; Love and kindness; Avoiding overthinking and social comparison

Unit 4: Happiness Activities 2
Identifying signature strengths; Achieving happiness with “Flow”.

Unit 5: Is happiness sufficient?
The concept of eudaimonic well-being; Self-determination and motivation

Reference:

1. W. Weiten, and M. A. Lloyd, Psychology Applied to Modern Life: Adjustment in the 21st Century, Wadsworth Publishing, 2007
2. R. Harington, Stress, Health and well-being: Thriving in the 21st century, Wadsworth Publishing, 2013.

3. I. Boniwell, Positive psychology in a nutshell, McGraw-Hill Education, 2012.
4. S. Lyubomirsky, The how of happiness, Penguine Press, 2008.

Alternative NPTEL/SWAYAM Course:

S. No.	NPTEL Course Name	Instructor	Host Institute
1	Psychology of Stress, Health and Well-being	Prof. Dilwar Hussain	IIT Guwahati

Study from Still Life — 02 Credits

Course Objective:
The students should be able to develop potential for creativity, self-expression and visual awareness through painting. The students should be able feel confident with the chosen medium as a means of communicating and generating ideas. Also they should develop observation, recording, manipulation, application skills and understand the basic principles of colour.

Course Outcomes:
Students will be able to:
CO1: Understand the objects shape and form.
CO2: Understand the principle of still life, dimension with tone, texture etc.
CO3: Understand the elements of still life composition and principle of natural and man-made objects etc.
CO4: Develop potential for creativity, self-expression and visual awareness through painting.

Detailed contents:
Unit 1:
Introduction of Course & Still Life, Elements of Art.

Unit 2:
Sketching and Drawing, Geometrical Form & Shape, Symmetrical and Non-symmetrical object sketching.

Unit 3:
Use of Line, Tone & Shading, Single Symmetrical & Non-symmetrical Object still life.

Unit 4:
Nature study with Objects, Vegetable Study with Objects.

Unit 5:
Objects study with Drapery, Group Objects & Nature Study, Object study with Oil colour.

Reference:

1. NPTEL/SWAYAM Course:

S. No.	NPTEL Course	Name Instructor	Host Institute
1.	Study from Still Life	Dr. Lakshaman Prasad	Indira Gandhi National Open University