

# **Science and Research Pathway (C-20)**

# V SEMESTER



**Government of Karnataka**  
**DEPARTMENT OF COLLEGIATE AND TECHNICAL EDUCATION**

<b>Pathway</b>	Science and Research	<b>Semester</b>	V
<b>Course Code</b>	20SC51T	<b>Type of Course</b>	Pathway
<b>Course Name</b>	Applied Mathematics	<b>Contact Hours</b>	6 hours/week 78 hours/semester
<b>Teaching Scheme</b>	L:T:P :: 4:2:0	<b>Credits</b>	6
<b>CIE Marks</b>	50	<b>SEE Marks</b>	50

**1. Rationale:**

The subject of mathematics is important as a prerequisite and requirement as most topics in engineering courses widely employ these fundamentals. Calculus, differential equation, is designed for its applications in engineering and technology. The student shall learn various techniques in Differential calculus, Ordinary and partial differential equations, Linear algebra, Integral calculus, Vector calculus and Numerical methods use these techniques to solve engineering problems.

**2. Course Outcomes:** At the end of the Course, the student will be able to:

<b>CO-01</b>	Apply the knowledge of calculus to solve problems related to polar curves & curvature and its applications in determining the bentness of a curve.
<b>CO-02</b>	Apply the notion of partial differentiation to calculate rate of change of multivariate functions and solve problems related to Jacobians and ODE's of first and higher order.
<b>CO-03</b>	Employ linear algebra techniques & integration to diverse situations in physics, engineering and other mathematical contexts.
<b>CO-04</b>	Identify & solve problems in engineering using the concept of calculus & integral of vectors, PDE's.
<b>CO-05</b>	Analyse and evaluate the accuracy of a few common numerical methods.

**3. Suggested specification table with CO & PO mapped, hours & marks (Theory)**

<b>CO's</b>	<b>Course Outcome</b>	<b>PO Mapped</b>	<b>CL</b>	<b>Teaching hours</b>	<b>Total Marks</b>
<b>CO1</b>	Apply the knowledge of calculus to solve problems related to polar curves & curvature and its applications in determining the bentness of a curve.	<b>1</b>	<b>L3, L4</b>	<b>8</b>	<b>20</b>
<b>CO2</b>	Apply the notion of partial differentiation to calculate rate of change of multivariate functions and solve problems related to Jacobians and ODE's of first and higher order.	<b>1</b>	<b>L3, L4</b>	<b>12</b>	<b>20</b>
<b>CO3</b>	Employ linear algebra techniques & integration to diverse situations in physics, engineering and other mathematical contexts.	<b>1</b>	<b>L3, L4</b>	<b>8</b>	<b>20</b>

CO4	Identify & solve problems in engineering using the concept of calculus & integral of vectors, PDE's.	1	L3, L4	12	20
CO5	Analyse and evaluate the accuracy of a few common numerical methods	1	L3, L4	12	20
<b>Total</b>				<b>52</b>	<b>100</b>

#### 4. Course Content

Week	CO	PO	Lecture (Knowledge Criteria)	Tutorial (Activity Criteria)
			4 hours/week	2 hour/week
1	1	1	<b>Differential Calculus – 1 &amp; 2</b> Polar curves, Angle between the radius vector and the tangent Angle between polar curves Pedal equations. Problems	
2	1	1	<b>Curvature and radius of curvature</b> Radius of curvature in Cartesian form Radius of curvature in Parametric form Radius of curvature in Pedal form. Problems Indeterminate forms - L'Hospital's rule	
3	2	1	<b>Partial differentiation</b> , total derivative-differentiation of composite functions. Jacobian and problems Taylor's and Maclaurin's series expansion for one variable (Statement only) – Problems	
4	2	1	<b>Ordinary Differential Equations (ODE's) of first order</b> Linear Differential Equation Bernoulli's Differential Equation Exact Equation Equations reducible to exact differential equations.	
5	2	1	<b>Nonlinear differential equations:</b> Introduction to general and singular solutions Solvable for p only; Clairaut's equations, reducible to Clairaut's equations. Problems. <b>Ordinary Differential Equations of higher order</b> Higher-order linear ODE's with constant coefficients (Problems on homogeneous differential equation with constant coefficients) Inverse differential operator, method of variation of parameters.	
6	3	1	<b>Linear Algebra</b> Elementary row transformation of a matrix, Rank of a matrix. Consistency and Solution of system of linear equations; <ul style="list-style-type: none"> <li>● Gauss-elimination method</li> <li>● Gauss-Jordan method and</li> </ul>	

7	3	1	<p><b>Integral Calculus</b>  <b>Multiple Integrals:</b> Evaluation of double and triple integrals, Evaluation of double integrals by change of order of integration, changing into polar coordinates.  <b>Beta and Gamma functions:</b>            Definitions, properties, relation between Beta and Gamma functions. Problems.</p>
8	4	1	<p><b>Vector Calculus</b>  <b>Vector Differentiation:</b> Scalar and vector fields. Gradient, directional derivative, curl and divergence - physical interpretation. Problems.  <b>Vector Integration:</b>            Line integrals, Surface integrals.</p>
9	4	1	<p>Applications to work done by force and flux.            Statement of Green's theorem. Problems.  <b>Partial Differential Equations (PDE's)</b>            Formation of PDE's by elimination of arbitrary constants and functions. Solution of nonhomogeneous PDE by direct integration.</p>
10	4	1	<p>Homogeneous PDEs involving derivative with respect to one independent variable only.            Solution of Lagrange's linear PDE.            Derivation of one-dimensional heat equation and wave equation.</p>
11	5	1	<p><b>Numerical methods -1</b>            Solution of polynomial and transcendental equations: Regula-Falsi and Newton-Raphson methods (only formulae). Problems.            Finite differences, Interpolation using Newton's forward formulae. Problems.</p>
12	5	1	<p>Newton's divided difference formula and Lagrange's interpolation formula (All formulae without proof). Problems.  <b>Numerical integration:</b> Simpson's (1/3)rd and (3/8)th rules(without proof). Problems.</p>
13	5	1	<p><b>Numerical methods -2</b>            Numerical solution of ordinary differential equations of first order and first degree: Taylor's series method, Modified Euler's method, Runge-Kutta method of fourth order.</p>
<b>Total in hours</b>			<b>52</b>
			<b>26</b>

**NOTE 1:** The course content shall be delivered through lectures, PowerPoint presentations & video demonstrations.

**NOTE 2:** The TUTORIAL (Activity criteria) shall be conducted / executed by the student and to be submitted in portfolio evaluation of activities through rubrics to the faculty.

**Table 1: Suggestive activities for tutorials**

Sl. No.	Activity
1	Derivatives of arc-length Center and circle of curvature.
2	Radius of curvature in Polar form. Evolute and involute.
3	Maxima and minima for a function of two variables. Problems. Euler's Theorem and problems.
4	Applications of ODE's - Orthogonal trajectories & Newton's law of cooling.
5	Applications of ODE's: L-R circuits. Solvable for x and y. Applications to oscillations of a spring and L-C-R circuits.
6	Approximate solution by Gauss-Seidel method. Eigenvalues and Eigenvectors - Rayleigh's power method to find the dominant Eigenvalue and Eigenvector.
7	Applications to find: Area and Volume by double integral. Problems. Center of gravity
8	Solenoidal and irrotational vector fields. Problems
9	Stoke's theorem. Problems. Volume integral and Gauss divergence theorem.
10	Solution of one-dimensional heat equation and wave equation by the method of separation of variables.
11	Interpolation using Newton's backward difference formulae. Problems Bisection method, Lagrange's inverse Interpolation.
12	Romberg's Methods Weddle's rule.
13	Milne's predictor-corrector formula (No derivations of formulae). Problems. Adam-Bashforth method.

**5. CIE and SEE Assessment Methodologies**

Sl. No	Assessment	Test Week	Duration In minutes	Max marks	Conversion
1.	CIE-1 Written Test	4	80	30	Average of three tests 30
2.	CIE-2 Written Test	9	80	30	
3	CIE-3 Written Test	13	80	30	
4.	CIE-4 (MCQ/Quiz)	6	60	20	Average of three 20
5	CIE-5 (Open book Test)	11	60	20	
6	CIE-6 Portfolio evaluation of Activity through Rubrics	1-13		20	
Total CIE Marks					50
Semester End Examination written examination as per BTE			180	100	50
<b>Total Marks</b>					<b>100</b>

**6. Format for CIE written Test**

Course Name	Applied Mathematics	Test	I/II/III	Sem	V
Course Code	20SC51T	Duration	80 Min	Marks	30
<b>Note: Solve one full question from each section. Each full question carries 10 marks.</b>					
Section	Assessment Questions	Cognitive Levels	Course Outcome	Marks	
I	1 a) Find the angle between the radius of vector and tangent to the curve $r = a(1 - \sin\theta)$ b) Find the Pedal equation $r = (1 + \cos\theta)$ .	L3, L4	CO1	5+5=10	
	2 a) Show that the following pairs of polar curve intersecting orthogonally $r^n(\cos n\theta) = a^n$ , $r^n(\sin n\theta) = b^n$ . b) Find the Pedal equation of curve $r = ae^{\theta \cot \alpha}$ .	L3, L4	CO1	5+5=10	
II	3 a) Find the radius of curvature of $x^3 + y^3 = 3axy$ at $(\frac{3a}{2}, \frac{3a}{2})$ b) Evaluate $\lim_{x \rightarrow 0} \frac{\log(x - \frac{\pi}{2})}{\tan x}$ .	L3, L4	CO1	5+5=10	
	4 a) Find the radius of curvature of the polar curve $\frac{2a}{r} = 1 + \cos\theta$	L3, L4	CO1	5+5=10	

	b) Evaluate $\lim_{x \rightarrow 0} \frac{(a^x + b^x)^{1/x}}{2}$ .			
III	5 a) If $u = f(y - z, z - x, x - y)$ then show that $\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} + \frac{\partial u}{\partial z} = 0$ . b) Expand $\sqrt{1 + \cos 2x}$ using Maclaurin's series.	L3, L4	CO2	5+5=10
	6 a) If $u = \frac{yz}{x}, v = \frac{zx}{y}, w = \frac{xy}{z}$ then show that $\frac{\partial(u,v,w)}{\partial(x,y,z)} = 4$ b) Expand $y = \tan x$ as a Taylor's series expansion in the powers of $a = \frac{\pi}{2}$ .	L3, L4	CO2	5+5=10

Note for the Course coordinator: Each question may have one, two or three subdivisions. Optional questions in each section carry the same weightage of marks, Cognitive level and course outcomes.

### 7. Rubrics for Assessment of Activity (Qualitative Assessment)

Sl. No.	Dimension	Beginner	Intermediate	Good	Advanced	Expert	Students Score
		2	4	6	8	10	
1		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	8
2		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	6
3		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	2
4		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	2
Average Marks= (8+6+2+2)/4=4.5							5

**Note:** Dimension and Descriptor shall be defined by the respective course coordinator as per the activities

### 8. Reference:

Sl. No.	Description
1	V. Ramana: "Higher Engineering Mathematics" McGraw-Hill Education, 11th Ed.
2	Srimanta Pal & Subodh C. Bhunia: "Engineering Mathematics" Oxford University Press, 3rd Reprint, 2016.
3	N.P Bali and Manish Goyal: "A textbook of Engineering Mathematics" Laxmi Publications, Latest edition.
4	C. Ray Wylie, Louis C. Barrett: "Advanced Engineering Mathematics" McGraw – Hill Book Co. New York, Latest ed.
5	Gupta C.B, Sing S.R and Mukesh Kumar: "Engineering Mathematic for Semester I and II", McGraw Hill Education (India) Pvt. Ltd 2015.
6	H.K.Dass and Er. Rajnish Verma: "Higher Engineering Mathematics" S.Chand Publication (2014).
7	James Stewart: "Calculus" Cengage publications, 7th edition, 4th Reprint 2019.



**9. SEE Scheme of Evaluation**

<b>Pathway : Science and Research</b> <b>Course: Applied Mathematics</b> <b>Course code: 20SC51T</b>		<b>Sem: V</b> <b>Marks: 100</b> <b>Duration: 3hrs</b>
<b>Solve any FIVE full questions, choosing ONE full question from each SECTION. Each full question carries 20 marks.</b>		
SECTION – A		
1	a) Show that the angle between the pair of curves $r = 6\cos\theta$ and $r = 2(1 + \cos\theta)$ is $\pi/6$ .	7
	b) Find the pedal equation of the curve $r^n = a^n \cos n\theta$ .	7
	c) Find the radius of curvature at any point on the curve $y = a \log \sec (x/a)$ .	6
2	a) Show that the pairs of curves $r = a(1 + \cos\theta)$ and $r = b(1 - \cos\theta)$ intersect each other orthogonally.	6
	b) Evaluate $\lim_{x \rightarrow 0} \left[ \frac{a^x + b^x + c^x}{3} \right]^{\frac{1}{x}}$	7
	c) Find the radius of curvature at any point of the cycloid $x = a(\theta + \sin\theta), y = a(1 - \cos\theta)$ .	7
SECTION – B		
3	a) Obtain the Maclaurin's series expansion of $f(x) = \tan^{-1} x$ .	6
	b) Solve $(2x + y + 1)dx + (x + 2y + 1)dy = 0$	7
	c) Show that the equation $xp^3 - yp^2 + 1 = 0$ .	7
4	a) Using Maclaurin's expansion, prove that $\sqrt{1 + \sin 2x} = 1 + x - \frac{x^2}{2} - \frac{x^3}{6} + \frac{x^4}{24}$ .	6
	b) Solve $(r \sin\theta - r^2)d\theta - \cos\theta dr = 0$ .	7
	c) Using the method of variation of parameters, solve $\frac{d^2y}{dx^2} - 2\frac{dy}{dx} + y = e^x \log x$ .	7
SECTION – C		
5	a) Find the rank of $\begin{bmatrix} 2 & -1 & -3 & -1 \\ 1 & 2 & 3 & -1 \\ 1 & 0 & 1 & 1 \\ 0 & 1 & 1 & -1 \end{bmatrix}$	6
	b) Solve the following system of equations by Gauss – Jordan method: $x + y + z = 10, 2x - y + 3z = 19, x + 2y + 3z = 22$	7
	c) Evaluate $\int_0^\infty \int_0^\infty e^{-(x^2+y^2)} dx dy$ by change into polar coordination.	7
6	a) For what values $\lambda$ and $\mu$ the system of equations $x + 2y + 3z = 6; x + 3y + 5z = 9; 2x + 5y + \lambda z = \mu$ , has (i) no solution (ii) a unique solution and (iii) infinite number of solutions	6
	b) Solve the following system of equations by Gauss – Elimination method: $x + y + z = 9, 2x + y + z = 0, 2x + 5y + 7z = 52$	7
	c) Evaluate $\int_{-1}^1 \int_0^z \int_{x-z}^{x+z} (x + y + z) dy dx dz$	7

SECTION – D														
7	a) If $\vec{F} = \nabla(x^3 + y^3 + z^3 - 3xyz)$ find $div \vec{F}$ and $curl \vec{F}$ .	6												
	b) Form the PDE by eliminating the arbitrary constant $a$ and $b$ from $2z = \frac{x^2}{a^2} + \frac{y^2}{b^2}$ .	7												
	c) Solve $(y + z)p + (z + x)q = x + y$ .	7												
8	a) Find the directional derivative of $\phi = x^2 + y^2 + 2z^2$ and $(1,2,3)$ along the direction of line $\vec{PQ} = 4i - 2j + k$ .	6												
	b) Use Green's theorem to find the area between the parabolas $y^2 = 4x$ and $x^2 = 4y$ .	7												
	c) Derive the expression for one dimensional wave equation.	7												
SECTION – E														
9	a) Compute the fourth root of 12 correct to 3 decimal places using Regular Falsi method.	6												
	b) Using Lagrange's interpolation formula to fit a polynomial for the following data: <table border="1" style="margin-left: 20px;"> <tr> <td><math>x</math></td> <td>2</td> <td>10</td> <td>17</td> </tr> <tr> <td><math>y</math></td> <td>1</td> <td>3</td> <td>4</td> </tr> </table>	$x$	2	10	17	$y$	1	3	4	7				
$x$	2	10	17											
$y$	1	3	4											
	c) Using Taylor's series method, find $y(4.1)$ given $\frac{dy}{dx} = \frac{1}{x^2+y}$ and $y(4) = 4$ .	7												
10	a) Use an appropriate interpolation formula to compute $y(82)$ and $y(92)$ for the data <table border="1" style="margin-left: 20px;"> <tr> <td><math>x</math></td> <td>80</td> <td>85</td> <td>90</td> <td>95</td> <td>100</td> </tr> <tr> <td><math>y</math></td> <td>5026</td> <td>5674</td> <td>6362</td> <td>7088</td> <td>7854</td> </tr> </table>	$x$	80	85	90	95	100	$y$	5026	5674	6362	7088	7854	7
$x$	80	85	90	95	100									
$y$	5026	5674	6362	7088	7854									
	b) Use Simpson's 1/3 <sup>rd</sup> to find the value of $\int_0^{0.6} e^{-x^2} dx$ by taking six parts.	6												
	c) Given $\frac{d^2y}{dx^2} - x^2 \frac{dy}{dx} - 2xy = 1, y(0) = 1, y'(0) = 0$ . Evaluate $y(0.1)$ using Runge Kutta method of 4 <sup>th</sup> order.	7												
<b>Total Marks</b>		<b>100</b>												



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<b>Pathway</b>	Science and Research	<b>Semester</b>	V
<b>Course Code</b>	20SC52T	<b>Type of Course</b>	Pathway
<b>Course Name</b>	Applied Science	<b>Contact Hours</b>	8 hours/week 104 hours/semester
<b>Teaching Scheme</b>	L:T:P :: 4:0:4	<b>Credits</b>	6
<b>CIE Marks</b>	50	<b>SEE Marks</b>	50

**1. Rationale:**

Most of the engineering subjects are based on physical sciences which comprises both physics and chemistry. This course consists of both which is a prerequisite and requirement as most topics in engineering courses widely employ these fundamentals and is designed for its applications in engineering and technology. Topics covered are SHM, modern physics & quantum mechanics, lasers and optics, corrosion and its control etc.

**2. Course Outcomes:** At the end of this course, students will be able to:

<b>CO-01</b>	Apply knowledge of oscillation, shock waves & wave – particle dualism in various fields.
<b>CO-02</b>	Compute Eigenvalues, Eigen functions using Time independent 1-D Schrodinger's wave equation & correlate principles & applications of lasers & fiber optics.
<b>CO-03</b>	Analyse the importance of electrical conductivity phenomena in solid materials & understand few measurement techniques.
<b>CO-04</b>	Apply the concepts of electrochemistry and corrosion & it's control in the field of engineering.
<b>CO-05</b>	Illustrate the fundamental principles of water chemistry, applications of volumetric and analytical instrumentation.

## 3. Suggested specification table with CO &amp; PO mapped, hours &amp; marks (Theory)

CO's	Course Outcome	PO Mapped	CL	Teaching hours	Total Marks
CO1	Apply knowledge of oscillation, shock waves & wave – particle dualism in various fields.	1	L3, L4	12	20
CO2	Compute Eigenvalues, Eigen functions using Time independent 1-D Schrodinger's wave equation & correlate principles & applications of lasers & fiber optics.	1	L3, L4	12	20
CO3	Analyse the importance of electrical conductivity phenomena in solid materials & understand few measurement techniques.	1	L3, L4	12	20
CO4	Apply the concepts of electrochemistry and corrosion & it's control in the field of engineering.	1	L3, L4	8	20
CO5	Illustrate the fundamental principles of water chemistry, applications of volumetric and analytical instrumentation.	1	L3, L4	8	20
<b>Total</b>				<b>52</b>	<b>100</b>

## 4. Course Content

Week	CO	PO	Lecture (Knowledge Criteria)	Practice (Performance Criteria)
			4 hours/week	4 hours/week (2 hours/batch twice in a week)
1	1	1	<b>Oscillations and Waves:</b> <b>Free Oscillations:</b> Basics of SHM, derivation of differential equation for SHM, Mechanical simple harmonic oscillators (spring constant by series and parallel combination), Equation of motion for free oscillations, Natural frequency of oscillations. <b>Damped Oscillations:</b> Theory of damped oscillations (derivation), Over damping, critical & under damping (only graphical representation), Quality factor.	Refer 5. Practice
2	1	1	<b>Forced Oscillations:</b> Theory of forced oscillations (derivation), Resonance & sharpness of resonance.	

			<p><b>Shock waves:</b> Mach number, Properties of Shock waves, Construction and working of Reddy shock tube, Applications of shock waves, Numerical problems.</p>
3	1	1	<p><b>Modern Physics &amp; Quantum Mechanics:</b> Introduction to blackbody radiation spectrum - Wien's law, Rayleigh Jean's law, Stefan -Boltzmann law and Planck's law (qualitative), Deduction of Wien's law and Rayleigh Jean's law from Planck's law. Wave-Particle dualism, de-Broglie hypothesis, de-Broglie wavelength. Heisenberg's uncertainty principle and its physical significance.</p>
4	2	1	<p>Application of uncertainty Principle-Non-existence of electron in the nucleus (relativistic case), Wave Function-Properties, Physical significance, Probability density, Normalization, Eigen values and Eigen functions. Time independent Schrödinger wave equation. Particle in a box - Energy Eigen values and probability densities, Numerical problems.</p>
5	2	1	<p><b>Lasers:</b> Interaction of radiation with matter, Einstein's coefficients (derivation of expression for energy density). Requisites of a Laser system. Conditions for Laser action. Principle, Construction and working of CO<sub>2</sub> and semiconductor Lasers. Application of Lasers in Defence (Laser range finder) and medical applications- Eye surgery and skin treatment.</p>
6	2	1	<p><b>Optical Fibers:</b> Propagation mechanism, angle of acceptance, Numerical aperture, Modes of propagation, Types of optical fibers, Attenuation and Mention of expression for attenuation coefficient. Discussion of block diagram of point to point communication, Optical fiber sensors- Intensity based displacement sensor and Temperature sensor based on phase modulation, Merits and demerits, Numerical problems</p>
7	3	1	<p><b>Electrical Conductivity in Solids:</b> <b>Classical free electron theory:</b> Drude- Lorentz theory &amp; Assumptions, Expression for electrical conductivity (no derivation), Failures of classical free-electron theory. <b>Quantum free electron theory:</b> Assumptions, Density of states (no derivation), Fermi-energy, Fermi factor &amp; its temperature dependence, Fermi - Dirac Statistics, Expression for electrical conductivity (derivation), Merits of Quantum free electron theory.</p>

8	3	1	<p><b>Physics of Semiconductors:</b> Fermi level in intrinsic semiconductors, Expression for concentration of electrons in conduction band, Holes concentration in valance band (only mention the expression), Conductivity of semiconductors (derivation), Hall effect, Expression for Hall coefficient (derivation).</p> <p><b>Dielectrics:</b> Electric dipole, Dipole moment, Polarization of dielectric materials, Types of polarizations. Qualitative treatment of Internal field in solids for one dimensional infinite array of dipoles (Lorentz field). Claussius-Mossotti equation (derivation), Numerical problems.</p>
9	3	1	<p><b>Material Characterization Techniques and Instrumentation:</b> <b>Introduction to materials:</b> Nanomaterials and nanocomposites. Principle, construction and working of X-ray Diffractometer, crystal size determination by Scherrer equation. Principle, construction, working and applications of - X-ray Photoelectron Spectroscopy (XPS), Scanning Electron Microscope (SEM).</p>
10	4	1	<p><b>Electrochemistry:</b> Introduction, EMF of a cell, Free Energy, Single electrode potential- Derivation of Nernst equation, Numerical problems based on Nernst Equation (<math>E</math>, <math>E_o</math> &amp; <math>E_{cell}</math>).</p> <p><b>Reference Electrodes:</b> Introduction, construction, working and applications of calomel electrode, ion selective electrodes: Introduction, construction, working and applications of Glass electrode, determination of pH using Glass electrode.</p>
11	4	1	<p><b>Corrosion and it's control:</b> Introduction, Electrochemical theory of corrosion, Factors affecting the rate of corrosion: ratio of anodic to cathodic areas, nature of corrosion product, nature of medium – pH, conductivity and temperature. Types of corrosion - Differential metal and differential aeration (pitting and water line). <b>Corrosion control:</b> Anodizing – Anodizing of aluminium, Cathodic protection - sacrificial anode and impressed current methods, Metal coatings – Galvanization. Corrosion Penetration Rate (CPR), numerical problems on CPR.</p>
12	5	1	<p><b>Water Chemistry, chemical analysis and Instrumental methods of analysis</b> <b>Water chemistry:</b> Introduction, sources and impurities in water, Potable water; meaning and specifications (as per WHO standards), Hardness of water, types, Determination of hardness using EDTA titration, numerical problems on hardness of water.</p>

			Definition of Biological oxygen demand (BOD) and Chemical Oxygen Demand (COD), Determination of COD of waste water sample and Numerical problems on COD.	
13	5	1	<b>Methods of Chemical Analysis:</b> <b>Volumetric Analysis:</b> Introduction, principles of titrimetric analysis, Requirement of titrimetric analysis, primary and secondary standards. Requirement of a primary standard solution, Units of standard solutions- Definition of normality, molarity, molality, mole fraction, ppm. <b>Instrumental methods of analysis:</b> Introduction, Theory, Instrumentation and applications of Colorimetry, Flame Photometry, Potentiometry, Conductometry (Strong acid with strong base, weak acid with a strong base, mixture of strong acid and a weak acid with a strong base)	
<b>Total in hours</b>			<b>52</b>	<b>52</b>

### 5. Practice

<b>Conduct any 9 experiments:</b>	
1	Determination of spring constants by Series and Parallel combination.
2	Determination of the rigidity modulus of the material by the torsional pendulum.
3	Study series and parallel LCR resonance and hence calculate inductance, bandwidth, and quality factor.
4	To verify Stefan's Law.
5	I-V Characteristics of Photodiode.
6	Determine acceptance angle and numerical aperture of an optical fiber.
7	Determine the wavelength of the laser source using diffraction grating elements.
8	Determine the Fermi energy of metal (copper).
9	To find the resistivity of a semiconductor using the Four Probe method.
10	To determine the dielectric constant by charging and discharging the capacitor.
11	Determination of Magnetic field intensity along the axis of a circular coil carrying current.
12	Forced mechanical oscillations and resonance.
<b>Conduct any 4 experiments</b>	
13	Determination of pKa value of a given weak acid using a pH meter.
14	Estimation of percentage of iron in the given rust solution using standard Potassium Dichromate solution (External indicator method)

15	Estimation of FAS Potentiometrically using standard $K_2Cr_2O_7$ solution.
16	Estimation of Acids in acid mixture Conductometrically.
17	Estimation of Total hardness of water by EDTA complexometric method.
18	Determination of Chemical oxygen demand of industrial waste water.
19	Estimation of the percentage of iron in the given rust solution using standard Potassium Dichromate solution (External indicator method).

### 6. CIE and SEE Assessment Methodologies

Sl. No	Assessment	Test Week	Duration In minutes	Max marks	Conversion
1	CIE-1 Written Test	4	60	20	Average of two written tests 20
2	CIE-2 Written Test	9	60	20	
4	CIE-3 Skill Test-practice (Exp. 1-12)	6	180	100	Reduce to 30 & take average of three skill tests-practice 30
5	CIE-4 Skill Test-practice (Exp. 1-12)	11	180	100	
6	CIE-5 Skill Test-practice (Exp. 13-19)	13	180	100	
Total CIE Marks					50
Semester End Examination (Theory)			180	100	50
<b>Total Marks</b>					<b>100</b>

### 7. Format for CIE written Test

Course Name	Applied Science	Test	I/II	Sem	V
Course Code	20SC52T	Duration	60 Min	Marks	20
<b>Note:</b> Answer one full question from each section. Each full question carries 10 marks.					
Section	Assessment Questions	Cognitive Levels	Course Outcome	Marks	
I	1 a) Define SHM. Derive differential equation for SHM. b) Write any four applications of shock waves.	L3, L4	CO1	6+4=10	
	2 a) Derive an expression for force constant (spring constant) for parallel combination of two springs. b) The distance between two pressure sensors in a shock tube is 200 mm. The time taken by a shock wave to travel this distance is 0.4ms. If the velocity of sound under the same condition is 340 m/s. Find the Mach number of the shock wave.	L3, L4	CO1	6+4=10	



II	3 a) State Wein's law and Rayleigh-Jeans law and mention their draw backs. b) The kinetic energy of an electron is equal to the energy of a photon with a wavelength of 560 nm. Calculate the de Broglie wavelength of the electron.	L3, L4	CO1, CO2	6+4=10
	4 a) Derive Time Independent Schrodinger wave equation. b) A particle having mass of $0.5\text{MeV}/c^2$ has a kinetic energy of 100 eV. Calculate the deBroglie wavelength, where c is the velocity of light.	L3, L4	CO1, CO2	7+3=10
Note for the Course coordinator: Each question may have one, two or three subdivisions. Optional questions in each section carry the same weightage of marks, Cognitive level and course outcomes.				

### 8. Reference:

Description
1. Introduction to Mechanics — M.K. Verma: 2nd Ed, University Press(India) Pvt Ltd, Hyderabad 2009. 2. Lasers and Non Linear Optics – B.B. Laud, 3rd Ed, New Age International Publishers 2011. 3. LASERS Principles, Types and Applications by K.R. Nambiar-New Age International Publishers. 4. Solid State Physics-S O Pillai, 8th Ed- New Age International Publishers-2018. 5. Shock waves made simple- Chintoo S Kumar, K Takayama and KPJ Reddy: Willey India Pvt. Ltd. New Delhi 2014. 6. Materials Characterization Techniques-Sam Zhang, Lin Li, Ashok Kumar, CRC Press, First Edition, 2008. 7. Characterization of Materials- Mitra P.K. Prentice Hall India Learning Private Limited. 8. Nanoscience and Nanotechnology: Fundamentals to Frontiers – M.S.Ramachandra Rao & Shubra Singh, Wiley India Pvt Ltd. 1. Engineering Lab Manual by WBUT-New Age International Publishers. 2. Applied Physics Lab Manual by Anoop Sing Yadav
1. B.S. Jai Prakash, R. Venugopal, Sivakumaraiah & PushpaIyengar.- Chemistry for Engineering Students”, Subash Publications, Bangalore.5th Edition, 2014 2. F.W. Billmeyer, Text Book of Polymer Science, John Wiley & Sons, 4th Edition, 1999. 3. Principles of Physical Chemistry, B.R. Puri, L.R. Sharma & M.S. Pathania, S. Nagin Chand & Co., 41 Edition, 2004. 4. G.A. Ozin& A.C. Arsenault, “Nanotechnology A Chemical Approach to Nanomaterials”. RSC Publishing, 2005. 1. G.H Jeffery, J Bassett, J Mendham and R.C. Denney Vogel's A.I. A text book of quantitative analysis, Dorling Kindersley (India) Pvt., Ltd. 35th edition, 2012. 2. Gary D Christian, Analytical Chemistry, Wiley India, 6th edition, 2015. 3. T. Pradeep, A Text book of Nanoscience and Nanotechnology, McGraw Hill Education (India) Pvt., Ltd., 1st edition, 2015

### 9. CIE Skill Test Scheme of Evaluation (Practice)

SL. No.	Particulars/Dimension	Marks
1	Observation	30
2	Conduction	30
3	Output and interpretation of result	20
4	Viva-voce	20
<b>Total Marks</b>		<b>100</b>

**10. SEE Scheme of Evaluation (Theory)**

<b>Pathway:</b> Science and Research Pathway		<b>Sem:</b> V
<b>Course:</b> Applied Science		<b>Marks:</b> 100
<b>Course code:</b> 20SC52T		<b>Duration:</b> 3hrs
1. Answer any <b>FIVE</b> full questions, choosing <b>ONE</b> full question from each <b>SECTION</b> . Each full question carries <b>20 marks</b> .		
2. Draw neat sketches where ever necessary.		
3. Constants: Speed of Light “c” = $3 \times 10^8 \text{ ms}^{-1}$ , Boltzmann Constant “k” = $1.38 \times 10^{-23} \text{ JK}^{-1}$ , Planck’s Constant “h” = $6.625 \times 10^{-34} \text{ Js}$ , Acceleration due to gravity “g” = $9.8 \text{ ms}^{-2}$		
4. Permittivity of free space “ $\epsilon_0$ ” = $8.854 \times 10^{-12} \text{ F m}^{-1}$ .		
SECTION – A		
1	a) Applying Hooke’s law arrive at the equations for the effective spring constants of Series combinations of springs.	7
	b) With a neat diagram, explain the construction and working of Reddy’s shock tube.	7
	c) The kinetic energy of an electron is equal to the energy of a photon with a wavelength of 560 nm. Calculate the de Broglie wavelength of the electron.	6
2	a) What are damped oscillations. Discuss the theory of damped oscillations. Represent overdamping, critical damping and under damping by graph.	10
	b) Deduce Rayleigh-Jeans law from Planck’s Law of radiation.	5
	c) Compare the Mach number of a Jet fighter traveling with $2000 \text{ km hr}^{-1}$ with that of a bullet traveling with a velocity of $400 \text{ ms}^{-1}$ in the same medium given the speed of sound in the medium $330 \text{ ms}^{-1}$ .	5
SECTION – B		
3	a) Assuming the time independent Schrodinger’s wave equation discuss the solution for a particle in one dimensional potential well of infinite height and hence obtain the normalized wave equation.	8
	b) Calculate the number of photons emitted per pulse of duration 1 microsecond given the power output of LASER 3 mW and the wavelength of laser 632.8 nm.	5
	c) With neat diagram explain the working of Intensity based displacement sensor using optical fiber.	7
4	a) Obtain the expression for energy density using Einstein’s A and B Coefficients and hence draw infer on the relation $B_{12}=B_{21}$ .	8
	b) Estimate the attenuation in an optical fiber of length 500m when a light signal of power 100mW emerges out of fiber with a power 90Mw.	5
	c) Show that electron does not exists inside the nucleus by Heisenberg uncertainty Principle.	7
SECTION – C		
5	a) Calculate the probability that an energy level at 0.2eV below Fermi level is occupied at temperature 500K	6
	b) What is Hall effect. Obtain the expression for the Hall coefficient.	7
	c) Interpret the construction and working of X-Ray diffractometer.	7

6	a) An elemental solid dielectric material has polarizability $7 \times 10^{-40} \text{ Fm}^{-2}$ . Assuming the internal field to be Lorentz, calculate the dielectric constant for the material if the material has $3 \times 10^{28}$ atoms/ $\text{m}^3$ .	5
	b) Deduce the expression for electrical conductivity of a conductor using the quantum free electron theory of metals.	7
	c) Describe the construction and working of Scanning Electron Microscope with the help of a neat diagram.	8
SECTION – D		
7	a) Calculate the single electrode potential of Cu electrode at $27^\circ\text{C}$ when the standard potential of Cu is 0.34V and $[\text{Cu}^{2+}]$ 0.1M.	7
	b) Interpret the factors affecting the rate of corrosion (i) Nature of corrosion product, (ii) Ratio of anodic to cathodic areas & (iii) pH	6
	c) What is cathodic protection? Explain sacrificial anode and impressed voltage methods of cathodic protection	7
8	a) For the cell, $\text{Fe}/\text{Fe}^{2+} (0.01\text{M})//\text{Ag}^+ (0.1\text{M})/\text{Ag}$ write the cell reaction and calculate the EMF of the cell at 298K, if standard electrode potentials of Fe and Ag electrodes are - 0.44V and 0.8 V respectively.	7
	b) Interpret: (i) Differential metal corrosion & (ii) Water-line corrosion	7
	c) What is anodizing? Interpret the process of anodizing of Al	6
SECTION – E		
9	a) In a COD test, $30.5 \text{ cm}^3$ and $15.5 \text{ cm}^3$ of 0.05 N FAS solutions were consumed for blank & sample titration respectively. The volume of test sample used was $25 \text{ cm}^3$ . Calculate the COD of the sample solution.	7
	b) Write the principles and requirement of titrimetric analysis.	7
	c) Interpret the theory, instrumentation and applications of Colorimeter.	6
10	a) $25 \text{ m}^3$ of hard water sample titrated against 0.01M EDTA solutions consumed $18.0 \text{ cm}^3$ of EDTA solution. $25 \text{ cm}^3$ same sample of hard water was boiled, filtered and titrated against 0.01M EDTA solution consumed $12.0 \text{ cm}^3$ EDTA solution. Calculate total, permanent and Temporary hardness of the water sample.	7
	b) Define the following units of standard solution. i) Molarity ii) Normality iii) ppm	6
	c) Explain applications of Conductometry: i) Strong acid Vs Strong base      ii) Weak acid Vs Strong base	7
<b>Total Marks</b>		<b>100</b>

**11. Equipment list with Specification for a batch of 20 students**

Sl. No.	Particulars with Specification	Quantity
1	Spring constant stand with scale Springs + Spare Springs (Total 4 nos.) Weight set	1
2	Torsional pendulum stand with circular disk Digital Stop Clock	1
3	Series and parallel resonance with digital ac milli-ammeter 200KHz bandwidth, Two L , Three C and Three R values Matching Signal Generator	1
4	DC Regulated power supply with current variation, Digital Voltmeter, Digital Ammeter and Electric Bulb	1
5	Single power supply 0-4V, Digital dc milli-- ammeter (0-2mA), Digital dc voltmeter 0-20V, Light arrangement	1
6	Semiconductor diode laser X-Y Bed with fixed screen moveable chuck OFC patch cord 1.5m	1
7	Laser & power supply (5 years warranty) Single window grating 500 LPI, Screen, grating holder & measuring tape	1
8	Constant current source, Digital milli-ammeter 0- 20mA, Digital milli-voltmeter 0-200mV & Copper coil with glass enclosure, Digital thermometer Electric kettle & Stand	1
9	Resistivity of semiconductor by four probe kit Four probe arrangement & Heater	1
10	With digital stop clock, power supply and digital, voltmeter	1
11	Circular coil apparatus with compass Regulated battery eliminator Digital ammeter Rheostat and connecting wire	1
12	Electrically maintained tuning fork, Melde's coil, Thread, Scale pan & Pulley on stand Melde's coil power supply & Weight set	1



**Government of Karnataka**  
**DEPARTMENT OF COLLEGIATE AND TECHNICAL EDUCATION**

<b>Pathway</b>	Science and Research	<b>Semester</b>	V
<b>Course Code</b>	20RM53T	<b>Type of Course</b>	Pathway
<b>Course Name</b>	Research Methodology	<b>Contact Hours</b>	8 hours/week 104 hours/semester
<b>Teaching Scheme</b>	L:T:P :: 4:0:4	<b>Credits</b>	6
<b>CIE Marks</b>	50	<b>SEE Marks</b>	50

**1. Rationale:**

This course aims to give students a broad understanding of research methodology, which includes qualitative and quantitative methods. Provides in-depth knowledge of research process such as research design, research project drafting, research process planning and scientific writing, in order to prepare students for writing research papers and also develops the practical skills to solve real-world problems. This course also aims at providing an opportunity for students to establish or advance their understanding of research through critical exploration of research ethics and approaches.

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

<b>CO-01</b>	Identify research methodologies, review recent scholarly literature & write bibliographies as per standards.
<b>CO-02</b>	Formulate & evaluate research question or to state a hypothesis.
<b>CO-03</b>	Collect, analysis and interpret data.
<b>CO-04</b>	Identify research strategies.
<b>CO-05</b>	Write effective research proposals.

**3. Suggested specification table with CO & PO mapped, hours & marks (Theory)**

CO's	Course Outcome	PO Mapped	CL	Teaching hours (L)	Total Marks
CO1	Identify research methodologies, review recent scholarly literature & write bibliographies as per standards.	3,5,7	L1, L2, L3, L4	8	20
CO2	Formulate & evaluate research question or to state a hypothesis.	3,5,7	L1, L2, L3, L4	8	20
CO3	Collect, analysis and interpret data.	3,5,7	L1, L2, L3, L4	16	20
CO4	Identify research strategies available to them	3,5,7	L1, L2, L3, L4	8	20
CO5	Write effective research proposals	3,5,7	L1, L2, L3, L4	12	20
<b>Total</b>				<b>52</b>	<b>100</b>

**4. Course Content**

Week	CO	PO	Lecture (Knowledge Criteria)	Practice (Performance Criteria)
			4 hours/week	4 hours/week (2 hours/batch twice in a week)
1	1	3,5,7	<b>Introduction to engineering research</b> Research: what does it mean? Differentiate between engineering research from research in science. Aim of the research Research objectives & characteristics Research methods vs methodology Types of research Research process	<ul style="list-style-type: none"> <li>● Collect existing research reports* to reflect your own discipline.                              *Sources: From various engineering institution/organisation/consultancy /R &amp; D dept. etc.,</li> <li>● Discussion on what methodologies have been used in the report. At the end, student should be aware of methods.</li> </ul>
2	1	3,5,7	<b>Reviewing the Literature</b> Literature review and its importance. Review patent, copyright, other sources of technologies, proceedings and product information published by engineering societies, Sources of information Literature Searching Techniques Writing the literature review Create bibliography (APA Standards)	<ul style="list-style-type: none"> <li>● Guide students on how to read the articles, journals, papers, e-books etc. &amp; to find literature and discuss some tips on Search Strategy (i.e., Develop effective keywords, advanced search techniques, Boolean operators &amp; basic criteria for evaluating information.)</li> <li>● Perform literature survey (provides a quick summary/overview of recent research in a topic.)</li> </ul>
3	2	3,5,7	<b>Developing a statement of purpose</b> Research Problem	<ul style="list-style-type: none"> <li>● Literature survey contd.</li> </ul>

			<p>Sources of research problem                  Errors in selecting a research problem                  Investigations of a research problem                  Selecting the problem                  Statement of the Problem                  What are Research Questions?                  Investigating Questions (To find out if similar products already exist, to discover any regulatory and standards issues, such as intellectual property issues, safety or environmental issues, that are pertinent to the new product design.)                  Examples of Good Research Questions in correlation with the research problem.  <b>Constructing hypotheses</b>                  The definition of a hypothesis with examples                  The functions of a hypothesis</p>	<ul style="list-style-type: none"> <li>●Literature survey contd. Choose a research topic to reflect your own discipline.</li> </ul>
4	2	3,5,7	<p>The testing of a hypothesis                  Types of hypothesis                  Errors in testing a hypothesis  <b>Identifying variables</b>                  What is a variable?                  The difference between a concept and a variable                  Types of variable  <b>Scales of measurement</b>                  Types of measurement scale                  The nominal or classificatory scale                  The ordinal or ranking scale                  The interval scale                  The ratio scale</p>	<ul style="list-style-type: none"> <li>●Presentation on literature survey done (student has to tell which topic he has chosen and why?)</li> <li>●Identify the research problem that you are addressing on chosen research topic and do a background search to identify your research question(s), State the research problem. Construct/develop hypothesis on your research question.</li> </ul>
5	3	3,5,7	<p><b>Methods of data collection (revise)</b>                  Differences in the methods of data collection in quantitative and qualitative research.                  Collecting data using primary sources:                  Observation method,                  Interview method,                  Collection of Data through Questionnaires                  Collection of Data through Schedules                  Difference between Questionnaires and Schedules  <b>Some Other Methods of Data Collection</b>                  Collecting data using secondary sources                  Problems with using data from secondary sources                  Online database for secondary sources                  Selection of appropriate method for Data Collection                  Authenticate data (secondary sources)  <b>Data analysis with statistical techniques</b>  <b>Descriptive Statistics (revise)</b></p>	<ul style="list-style-type: none"> <li>●Student will carry out research process for his/her chosen research topic.</li> </ul>

6	3	3,5,7	<p><b>Population, census, sample and types of sample.</b></p> <p><b>Inferential statistics</b> z-test, t-tests for comparing two means, F-test. Chi-square test.</p>	<ul style="list-style-type: none"> <li>● <b>Review 1:</b> Finalisation of Research methodology (with existing facilities) &amp; Literature survey.</li> <li>● Discuss the statistical methods/test used by the researcher (from collected research reports) to collect &amp; analyse data.</li> </ul>
7	3	3,5,7	<p><b>Analysis of Variance (ANOVA):</b> ANOVA, one way ANOVA, Two way ANOVA, ANOVA to analyse variances between multiple groups, what does the analysis of variance reveal? when to use ANOVA.</p>	<ul style="list-style-type: none"> <li>● Explore on software tools (SPSS or excel) used to analyse data.</li> <li>● Student will carry out research process for his/her chosen research topic.</li> </ul>
8	3,4	3,5,7	<p><b>Correlation and Regression:</b> Correlation, Correlation coefficient, Regression Analysis, Uses of Correlation and Regression</p> <p><b>Research proposal</b> What is a research proposal? Why a research proposal? The research proposal process The elements/format of a research proposal</p>	<ul style="list-style-type: none"> <li>● Student will carry out research process for his/her chosen research topic.</li> </ul>
9	4	3,5,7	<p><b>Research Design</b> What is a research design? Different Research Designs Experimental, quasi-experimental, Descriptive, Correlational</p>	<ul style="list-style-type: none"> <li>● Student will carry out research process for his/her chosen research topic.</li> </ul>
10	4	3,5,7	<p><b>The Research Strategies</b> What are the Research Strategies? Which Strategy to Choose? Biography, Case Studies, Experiments, Ethnography, Phenomenology, Ground Theory (GT), Action Research, Mixed-methods</p>	<ul style="list-style-type: none"> <li>● Student will carry out research process for his/her chosen research topic.</li> </ul>
11	4	3,5,7	<p><b>Ethical Issues related to Research:</b> Intellectual Property Rights (IPRs) &amp; Research ethics, Nature, Importance and Protection of (IPRs); Patents and patent drafting, Geographical indications-new developments in IPR, Copyrights, Trademarks (Brands), Trade Secrets, Standards and codes.</p> <p><b>Plagiarism</b> Detection of Plagiarism by using Different Online Tools</p>	<ul style="list-style-type: none"> <li>● For the gathered data, perform the statistical analysis and interpret the results.</li> <li>● Perform a plagiarism check for your research project using some free online tools available.</li> </ul>
12	5	3,5,7	<p><b>Research Paper (APA format)</b> Research paper writing structure</p>	<ul style="list-style-type: none"> <li>● Format research paper in word</li> <li>● <b>Review II:</b> Presentation on (a) Results (b) Discussion of Results</li> </ul>



			Title page, Abstract, Introduction, Methods, Results, Discussion, Literature cited, Figures and tables and references. Citations and references	(c) Conclusions. Submission of draft copy of research report.
13	5	3,5,7	<b>Research presentation</b> Presentation Tips Oral presentation Conference presentations Poster presentations	● <b>Review-III:</b> Submission of Research Report.
<b>Total in hours</b>			<b>52</b>	<b>52</b>

#### 4. CIE and SEE Assessment Methodologies

Sl. No	Assessment	Test Week	Duration In minutes	Max marks	Conversion
1.	CIE-1 Written Test	4	60	20	Average of three tests 20
2.	CIE-2 Written Test	11	60	20	
3	CIE-3 Evaluation of finalised Research methodology based on rubrics	6	60	30	Average of two 30
4	CIE-4 Evaluation of finalised Literature survey based on rubrics	9	60	30	
5	CIE-5 Evaluation of Paper presentation based on rubrics	13	60	30	
<b>Total CIE Marks</b>					<b>50</b>
Semester End Examination (Theory)			180	100	50
<b>Total Marks</b>					<b>100</b>

**5. Format for CIE written Test**

<b>Course Name</b>	Research methods	<b>Test</b>	I/II	<b>Sem</b>	V
<b>Course Code</b>	20RM53T	<b>Duration</b>	60 Min	<b>Marks</b>	20
<b>Note: Answer any one full question from each section. Each full question carries 10 marks.</b>					
<b>Section</b>	<b>Assessment Questions</b>	<b>Cognitive Levels</b>	<b>Course Outcome</b>	<b>Marks</b>	
I	1 a) Distinguish between research methods and research methodology? b) Identify the types of research.	L4	CO1	5+5=10	
	2 a) Compare Qualitative vs. Quantitative Research b) List and explain the steps of research process?	L3, L4	CO1	4+6=10	
II	3 a) What is research problem? Organise the points observed while defining a research problem? b) What is hypothesis? Explain different types of hypotheses.	L1, L2, L4	CO2	5+5=10	
	4 a) Interpret various issues involved in selecting a research problem. b) List the types of measurement scales.	L3, L4	CO2	6+4=10	
<b>Note for the Course coordinator: Each question may have one, two or three subdivisions. Optional questions in each section carry the same weightage of marks, Cognitive level and course outcomes.</b>					

**6. Rubrics for Assessment of Research Paper & Presentation (Qualitative Assessment)**

Sl. No.	Dimension	Beginner	Intermediate	Good	Advanced	Expert	Students Score
		2	4	6	8	10	
1		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	8
2		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	6
3		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	2
4		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	2
Average Marks=(8+6+2+2)/4=4.5							<b>5</b>

**Note:** Dimension and Descriptor shall be defined by the respective course coordinator as per the activities

**7. References:**

1	Kothari, C.R., Research Methodology: Methods and Techniques. New Age International. 418p, 1990.
2	R.Paneerselvam ,”Research Methodology”, PHI Learning Private Limited, Eight Printing 2010.
3	Leedy P. D and Ormrod J. E., Practical research: Planning and Design, 7 <sup>th</sup> edition. 2001.
4	Subbarau N R, Handbook of Intellectual property law and practice, S Viswanathan Printers and Publishing Private Limited, 1998.
5	Stuart Melville and Wayne Goddard, “Research methodology: an introduction for science & engineering students”
6	Ranjit Kumar, 2nd Edition, “Research Methodology: A Step by Step Guide for beginners”
7	Robert P. Merges, Peter S. Menell, Mark A. Lemley, “Intellectual Property in New Technological Age”, 2016.
8	T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand, 2008

**8. e-links:**

1	<p><b>Research articles</b></p> <p><a href="http://sci-hub.la/">http://sci-hub.la/</a>  <a href="http://sci-hub.hk/">http://sci-hub.hk/</a>  <a href="http://tree.sci-hub.la/">http://tree.sci-hub.la/</a>  <a href="http://sci-hub.tw/">http://sci-hub.tw/</a>  <a href="http://sci-hub.name/">http://sci-hub.name/</a>  <a href="http://sci-hub.tv/">http://sci-hub.tv/</a>  <a href="http://80.82.77.84/">http://80.82.77.84/</a>  <a href="http://80.8277.83/">http://80.8277.83/</a>  <a href="http://gen.lib.rus.ec/scimag/index.php">http://gen.lib.rus.ec/scimag/index.php</a>  <a href="http://libgen.io/scimag/index.php">http://libgen.io/scimag/index.php</a>  <a href="http://sci-hub.la/">http://sci-hub.la/</a>  <a href="http://twin.sci-hub.la/">http://twin.sci-hub.la/</a>  <a href="http://cyber.sci-hub.la/">http://cyber.sci-hub.la/</a>  <a href="http://tree.sci-hub.la/">http://tree.sci-hub.la/</a>  <a href="http://tree.sci-hub.tv/">http://tree.sci-hub.tv/</a>  <a href="http://tree.sci-hub.hk/">http://tree.sci-hub.hk/</a>  <a href="https://iranpaper.ir/">https://iranpaper.ir/</a>  <a href="https://www.researchgate.net/">https://www.researchgate.net/</a>  <a href="https://scholar.google.com">https://scholar.google.com</a></p> <p><b>Books</b></p> <p><a href="http://libgen.io">http://libgen.io</a>  <a href="http://gen.lib.rus.ec/">http://gen.lib.rus.ec/</a>  <a href="https://libgen.pw/">https://libgen.pw/</a>  <a href="https://b-ok.org/">https://b-ok.org/</a>  <a href="http://en.bookfi.net/">http://en.bookfi.net/</a>  <a href="https://www.scribd.com/">https://www.scribd.com/</a>  <a href="https://www.avaxhome.co/">https://www.avaxhome.co/</a>  <a href="https://www.ebook3000.com/">https://www.ebook3000.com/</a>  <a href="http://www.freebookspot.es/">http://www.freebookspot.es/</a></p> <p><b>Journals</b></p>
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	<p><a href="http://www.ourglocal.com/journal/">http://www.ourglocal.com/journal/</a>  <a href="http://journalseek.net/">http://journalseek.net/</a>  <a href="https://www.scimagojr.com/">https://www.scimagojr.com/</a>  <a href="http://isindexing.com/isi/journals.php">http://isindexing.com/isi/journals.php</a>            Research &amp; research process: <a href="https://dokumen.tips/documents/the-research-process-a-quick-glance.html">https://dokumen.tips/documents/the-research-process-a-quick-glance.html</a>            Types of research and their difference <a href="https://youtu.be/a-XtVF7Bofg">https://youtu.be/a-XtVF7Bofg</a></p>
2	<p>Research problem and research question <a href="https://youtu.be/71-GucBaM8U">https://youtu.be/71-GucBaM8U</a>            How to conduct literature review for your research (a computer science example)?  <a href="https://youtu.be/OjfdgtYaL-o">https://youtu.be/OjfdgtYaL-o</a>            How to do a literature review using Google scholar <a href="https://youtu.be/Hn8wkikDaKE">https://youtu.be/Hn8wkikDaKE</a>            How to write a literature review? <a href="https://www.youtube.com/watch?v=zIYC6zG265E">https://www.youtube.com/watch?v=zIYC6zG265E</a>            Bibliography  <a href="https://youtu.be/PX8lwiTRC9o">https://youtu.be/PX8lwiTRC9o</a>  <a href="https://youtu.be/jgIg30VuLBE">https://youtu.be/jgIg30VuLBE</a>  <b>Citation tools:</b> Citation machine – <a href="http://www.citationmachine.net/">http://www.citationmachine.net/</a>            (citation, h-index, i10-index, Scopus indexed journal, IEEE, Sci-Hub.)</p>
3	<p>Research problem, question vs hypothesis  <a href="https://youtu.be/NIw8RXXSriBY">https://youtu.be/NIw8RXXSriBY</a>  <a href="https://youtu.be/NIw8RXXSriBY">https://youtu.be/NIw8RXXSriBY</a>            Introduction to statistics <a href="https://latrobe.libguides.com/math/statistics">https://latrobe.libguides.com/math/statistics</a>            Descriptive and inferential statistics  <a href="https://medium.com/@seema.singh/statistics-descriptive-and-inferential-63661eb13bb5">https://medium.com/@seema.singh/statistics-descriptive-and-inferential-63661eb13bb5</a>  <a href="https://youtu.be/edEXEyvG4Wk">https://youtu.be/edEXEyvG4Wk</a>  <a href="https://calculator-online.net/anova-calculator/">https://calculator-online.net/anova-calculator/</a>            Hypothesis <a href="https://youtu.be/ZzeXCKd5a18">https://youtu.be/ZzeXCKd5a18</a>            Variables <a href="https://youtu.be/_VdOB4JJE_8">https://youtu.be/_VdOB4JJE_8</a>            Types of scales of measurement <a href="https://youtu.be/KMFcBoSg6Ak">https://youtu.be/KMFcBoSg6Ak</a>            Research design: <a href="https://youtu.be/ZNo-M11dPZ8">https://youtu.be/ZNo-M11dPZ8</a>            Data collection methods <a href="https://youtu.be/Coe0N2xb8kk">https://youtu.be/Coe0N2xb8kk</a>,  <a href="https://www.slideshare.net/priyansakthi/methods-of-data-collection-16037781">https://www.slideshare.net/priyansakthi/methods-of-data-collection-16037781</a>            Primary and secondary sources of Data collection and its limitations  <a href="https://www.civilengineeringterms.com/research-methodology/primary-secondary-sources-data-collection/">https://www.civilengineeringterms.com/research-methodology/primary-secondary-sources-data-collection/</a>  <a href="https://www.qualtrics.com/au/experience-management/research/anova/">https://www.qualtrics.com/au/experience-management/research/anova/</a></p>
4	<p>Case study  <a href="https://youtu.be/ectS1ote8uA">https://youtu.be/ectS1ote8uA</a>  <a href="https://universalteacher.com/1/definition-of-research-design/">https://universalteacher.com/1/definition-of-research-design/</a>  <a href="https://youtu.be/SwRIhMstINg">https://youtu.be/SwRIhMstINg</a>  <a href="https://youtu.be/ZNo-M11dPZ8">https://youtu.be/ZNo-M11dPZ8</a>            Research proposal  <a href="https://web.pdx.edu/~dbls/proposals.html">https://web.pdx.edu/~dbls/proposals.html</a>  <a href="https://youtu.be/YNkws0x0W0o">https://youtu.be/YNkws0x0W0o</a>  <a href="https://youtu.be/166FXhGd9T4">https://youtu.be/166FXhGd9T4</a>            Example of research proposal <a href="https://youtu.be/jkjk5GEA4UE">https://youtu.be/jkjk5GEA4UE</a></p>
5	<p>Plagiarism <a href="http://www.youtube.com/watch?v=EF5eFeJMplA">http://www.youtube.com/watch?v=EF5eFeJMplA</a>  <b>plagiarism detection</b>  <a href="http://turnitin.com/">http://turnitin.com/</a>  <a href="http://www.ithenticate.com/">http://www.ithenticate.com/</a>            Research report  <a href="https://youtu.be/bvrqAgFBMBY">https://youtu.be/bvrqAgFBMBY</a>  <a href="https://youtu.be/cNOpKXB5Y4k">https://youtu.be/cNOpKXB5Y4k</a></p>

Intellectual Property Rights & Research ethics <a href="https://youtu.be/eWOOVlwkrEc">https://youtu.be/eWOOVlwkrEc</a>
<b>Article editing</b>
<a href="https://www.mendeley.com/">https://www.mendeley.com/</a>
<a href="https://www.typeset.io/">https://www.typeset.io/</a>
<a href="http://endnote.com/">http://endnote.com/</a>
<b>English corrections</b>
<a href="https://www.grammarly.com/">https://www.grammarly.com/</a>

### 9. SEE Scheme of Evaluation

Pathway: Science and Research		Sem: V
Course: Research Methods		Marks: 100
Course code: 20RM53T		Duration: 3hrs
Answer any <b>FIVE</b> full questions, choosing <b>ONE</b> full question from each <b>SECTION</b> . Each full question carries 20 marks.		
SECTION – A		
1	a) Distinguish between research methods and research methodology?	6
	b) Discuss the steps of research process?	8
	c) List the types of research.	6
2	a) Distinguish between the Qualitative Research & Quantitative Research	6
	b) Discuss the concept and source of literature review	8
	c) Write the guidelines for preparing bibliography.	6
SECTION – B		
3	a) What is research problem? Elaborate the points to be observed while defining a research problem.	7
	b) What is hypothesis? Interpret different types of hypotheses.	7
	c) Explain four types of measurement scales.	6
4	a) Elaborate on common errors committed by researchers in selecting the research problem.	6
	b) What is a variable & a concept? Interpret different types of variable.	6
	c) Explain the errors in hypothesis testing.	8
SECTION – C		
5	a) Differentiate primary and secondary data.	6
	b) What is population, census and sample. Describe the types of sample.	6
	c) What is ANOVA? What is the difference between one-way and two-way ANOVA tests?	8
6	a) List the differences between collection of data through questionnaires and schedules.	7
	b) What is Chi-square test? Explain its significance in statistical analysis.	7
	c) Differentiate between descriptive statistical analysis and inferential statistical analysis.	6
SECTION – D		

7	a) What is a research proposal? List the elements of research proposal.	9
	b) What is research design? List the different types of research designs.	6
	c) Write short note on Ground Theory.	5
8	a) List the difference between Correlation and Regression.	7
	b) Explain the different types of research designs.	7
	c) Write the differences between ethnography and case study and give examples of each.	6
<b>SECTION – E</b>		
9	a) What is ethics in research? Why it is important?	5
	b) What is IP? List the importance of IPRs.	6
	c) Explain the different components of a research report.	9
10	a) What is plagiarism? How plagiarism can be detected using online tools?	6
	b) Write short notes on the following: (a) Patents (b) Trade Marks (c) Copyright	6
	c) What is oral presentation? Explain the merits and demerits of oral presentation?	8
<b>Total Marks</b>		<b>100</b>

**Note : Research paper to be document in standard format**



**Government of Karnataka**  
**DEPARTMENT OF COLLEGIATE AND TECHNICAL EDUCATION**

<b>Pathway</b>	Science and Research	<b>Semester</b>	V
<b>Course Code</b>	20TW54P	<b>Type of Course</b>	Pathway
<b>Course Name</b>	Technical writing	<b>Contact Hours</b>	8 hours/week 104 hours/semester
<b>Teaching Scheme</b>	L:T:P :: 3:1:4	<b>Credits</b>	6
<b>CIE Marks</b>	60	<b>SEE Marks</b>	40

### 1. Rationale

This course focuses on preparing students to write technically as well as to design effective technical documents for both written and digital media. Also emphasise the nature of a writing process and the importance of knowing your audience and writing specifically to meet their needs. All of these aim at assisting students to improve their writing skills. Major topics covered include reports, proposals, report components & design for technical reports.

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

<b>CO-01</b>	Explain the basic technical writing concepts & writing process by selecting appropriate writing style to a specific audience.
<b>CO-02</b>	Apply & adapt flexible writing process strategies for both technical and workplace writing tasks.
<b>CO-03</b>	Draft effective technical documents with clarity and conciseness like reports, user manuals, proposals, etc.
<b>CO-04</b>	Identify design elements needed for documents & produce it both collaboratively and independently.
<b>CO-05</b>	Write, create and publish technical information using appropriate tools across various communication channels.

## 3. Course Content

Week	CO	PO	Lecture (Knowledge Criteria)	Tutorial (Activity Criteria)	Practice (Performance Criteria)
			3 hours/week	1 hour/week	4 hours/week (2 hours/batch twice in a week)
1	1	5,7	<b>Communication (revise)</b> Introduction, communication process, types of communication, written communication, examples of written communication. <b>Technical writing</b> What is technical writing? & who writes technical documents? Importance of technical writing in the field of engineering, Characteristics of technical writing, Technical writing and academic writing, Taxonomy of technical writing (Different kinds of document engineers write in various contexts and with different purposes and audiences.)	Refer table1	<ul style="list-style-type: none"> <li>Visit the government office, industry, R &amp; D department &amp; collect some of the technical reports, manuals, etc., relevant to individual disciplines. (Specify the kind of reports to be collected)</li> <li>Students shall be sharing their experience on the search process and will discuss the reports, magazines etc., collected by them.</li> </ul>
2	1	5,7	<b>Technical writing basics</b> Structuring the writing, Know your audience, i) types of audiences ii) audience analysis Choosing the right words, Planning documents purpose, References.		<ul style="list-style-type: none"> <li>Visit the websites of two competing organisations, determine the audience each site targets (Example: urban company, Byjus, Myntra, amazon, flipkart etc).</li> <li>Take any one of the technical reports collected by students (during practice session 1). Ask them to explain the purpose of the report and the way the reporter used technical writing characteristics to achieve the purpose. (ref. activity 2)</li> </ul>
3	1	5,7	<b>Writing process</b> A process for technical writing Planning/ brainstorming (concept mapping) Drafting & revising Editing & publishing Writing tools Ethics in writing, codes of ethics, Copyrights, Permission & Plagiarism, Detection tools		<ul style="list-style-type: none"> <li>Write a short essay (on any given topic**).</li> <li>Write a brainstorming concept map for a proposal to create a new project/ research topic / new department (or on any given topic**).</li> </ul> Activity 3 discussion



4	2	5,7	<p><b>Scientific writing</b> Introduction Research papers</p> <ul style="list-style-type: none"> <li>● Survey on the field</li> <li>● Based on survey data</li> <li>● Based on experimentation</li> </ul> <p><b>Reviews</b> Writing good reviews for various types of publications</p> <ul style="list-style-type: none"> <li>● Journals and conference paper reviews</li> <li>● Book reviews</li> </ul>	<ul style="list-style-type: none"> <li>● In a small group, identify an issue at your institute. <ul style="list-style-type: none"> <li>a. Develop a survey to collect facts and opinions about the issue.</li> <li>b. Establish your audience and administer the survey in person.</li> <li>c. Tabulate the survey results.</li> </ul> </li> <li>● Select a scholarly paper of interest to you (use Google Scholar) and write a review. Keep your review around 300 words in length.</li> </ul>
5	2	5,7	<p><b>Business communications</b> E-mail –based on business communications Transmittal letter (Cover letters) General business letter format Text messages Memoranda (Memos) Meeting, agendas and minutes Press releases</p>	<ul style="list-style-type: none"> <li>● Prepare a (fictitious) agenda for the meeting organized by the sports or cultural committee of your institution.</li> <li>● Write a set of minutes for the meetings (any held in the institute for students)</li> </ul>
6	3	5,7	<p><b>Technical reports</b> Technical procedures Progress reports &amp; its format Manuals, types of manuals Facilities descriptions Strategic plans</p>	<ul style="list-style-type: none"> <li>● Write a step-by-step procedure for a topic given** (For Ex: instructions for assembling, processing, or organizing things or constructing a simple model etc.)</li> <li>● Write an instruction manual for any of your choices.</li> </ul>
7	3	5,7	<p>Problem reports/Bug reports Periodic reports Safety analysis report and warning in a set of instruction etc. Test reports Laboratory report Project report</p>	<ul style="list-style-type: none"> <li>● Write a problem report for some unfortunate happenstance in which you were involved.</li> <li>● Find different safety warnings and instructions. Write in your words a set of warning instructions for a topic of your choice.</li> </ul>
8	3, 4	5,7	<p><b>Proposal</b> Proposal, Types of proposal, grant and planning proposal, request for proposal. <b>Writing collaboratively</b> What is collaborative writing? Collaborative writing process Advantages and Disadvantages of collaboration Organising collaborative projects.</p>	<ul style="list-style-type: none"> <li>● Draft a research proposal for chosen research topic. (This can be done by writing collaboratively)</li> </ul>
9	4	5,7	<p><b>Technical Reports: Components &amp; Design</b></p>	<ul style="list-style-type: none"> <li>● Report formatting in word:</li> </ul>

			<b>1) Report Components</b> Cover letter Cover page Abstract and executive summary Table of contents List of figures and tables Introduction Conclusions <b>2) Design and Graphics Layout and Design</b> Headers & Footers Headings Lists		a) Introduction to report components b) Define styles to paragraph & headings, bulleted list in a paragraph. c) Headers & Footers, title page with cover image, Styling lists & captions. d) Auto generate Table of contents, creating a list of figures & tables.
10	4	5,7	<b>Graphics</b> Drawings Flowcharts Global graphics Graphs Tables Mathematical equations (Microsoft Equation editor, MathType, LaTeX)		<ul style="list-style-type: none"> <li>● Create a simple Gantt chart in excel.</li> <li>● Practice to type paragraph &amp; mathematical equations using any one of the software tool.</li> </ul>
11	5	5,7	<b>Writing for Media</b> Types of media Types of media writing – newspapers, column writing, review of literature, editorial etc. <b>Writing for E-media</b> E-mail - Rules of E-mails The signature line E-newsletters Blog Social networks (Facebook, LinkedIn, snapchat, twitter etc) E-magazines E-readers Online courses FAQ Discussion forums (online)		<ul style="list-style-type: none"> <li>● Write an e-mail to a manufacturer of some technical product that you recently purchased describing any problems you had in setting up the product. If you had no such problems, describe the ease with which you set up the product.</li> <li>● Write a FAQ on a topic of your choice. Choose from your college, your major or any topic with which you are familiar.</li> </ul>
12	5	5,7	<b>Technical writing software tools</b> Publishing tools Graphics tools Help tools Web tools (Microsoft Word, Macromedia RoboHelp, Adobe FrameMaker, Sang IT, Ms Visio, PowerPoint, and photoshop.)		<ul style="list-style-type: none"> <li>● Explore any one technical writing software tool. (submit a report on tool learnt)</li> </ul>
13	5	5,7	<b>Publishing</b>		

		What kind of work can be published? Why to publish? Freelance writing Writing technical books The review process <ul style="list-style-type: none"> <li>● Administrative rejection</li> <li>● Review flow</li> <li>● Review of books</li> </ul> Rejection letters, responding to rejection letters Online publishing		<ul style="list-style-type: none"> <li>● Explore the procedure/format for publishing an e-book. (document the procedure for publishing an e-book)</li> </ul>
<b>Total in hours</b>		<b>39</b>	<b>13</b>	<b>52</b>

**Note 1:** \*\*Lecturer shall provide the related topic to students wherever required.

**Note 2:** Students should document all the above practice and submit it at the end.

**Table 1:** Suggestive activities for tutorials (the list is only shared as an example and not inclusive of all possible activities for that course. Students and faculty are encouraged to choose activities that are relevant to the topic and the availability of such resources at their institution)

1	Conduct an Internet search for the keywords technical writing. Write a summary of your findings.
2	Search for several issues of your favourite magazine. Look at the table of contents and go through the articles and advertisements. After considering the following questions, write a few paragraphs analysing one magazine for audience and purpose. <ol style="list-style-type: none"> <li>a. What is the purpose of the magazine? Who is the intended audience?</li> <li>b. What are four things the editors of the magazine have done to accommodate their readers’ needs and wants? In other words, how have the editors appealed to their readers?</li> <li>c. Do you like the way the magazine has tried to appeal to its readers? Why do you believe the appeal is or is not successful?</li> <li>d. What suggestions do you have for improving the appeal of the magazine?</li> </ol>
3	Interview a writer in your area (a reporter, technical writer, or local novelist) about his or her writing process. Does the writer come up with topics, or does someone else provide them? Summarize the writer’s process and share your findings with the class. If possible, bring to class something the writer has written or invite the writer to class to talk about the writing process.
4	Identify a company where you might like to work and gather information that would help you apply for a job there. For instance, learn about products, services, and activities. Research the way the company is organized, its business philosophy, and its niche in the marketplace. Write a report that would be helpful to other students who might be interested in seeking employment there.
5	Prepare a press release for your institution with which you are affiliated to announce an upcoming event, an accomplishment, or other newsworthy information.
6	Write a progress report (Ex: for any ongoing project)
7	Identify a local government agency whose work involves proposals. For example, your town or city government’s Public Works Department might publish RFPs (requests for proposals) or RFBs (requests for bids) seeking proposals or bids for pending construction projects. Or the Health Department might issue RFPs to select the best contractor. Ask for copies of RFPs and, if possible, interview the writer(s).

8	Interview employees in your area, asking how often they work collaboratively, what kinds of projects they complete collaboratively, and how they organize tasks.
9	From technical books, try to explain figure in words using as few words as possible. How many words did it take?
10	For a technical discipline of your choice, identify a relevant: Blog Newsletter Magazine Journal Conference Make a note if you cannot find any of these.
11	Design a brochure that includes everything about your institute.
12	Read or listen to the international news for one week. Pick an issue and write a statement of the problem. Brainstorm at least two solutions and list the positives and negatives of the solutions.

#### 4. CIE and SEE Assessment Methodologies

Sl. No	Assessment	Test Week	Duration In minutes	Max marks	Conversion
1.	CIE-1 Skill Test 1	3	120	20	60
2.	CIE-2 Skill Test 2	7	120	20	
3	CIE-3 Skill Test 3	13	120	20	
<b>Total CIE Marks</b>					60
Semester End Examination (Practice)		180		100	40
<b>Total Marks</b>					<b>100</b>

#### Reference: CIE -1 Skill Test 1

<b>Activity: Essay Writing</b>						
Discuss on how technical communication and writing would become helpful in your future career.						
Evaluation Parameters	5	4	3	2	1	Student Score
<b>Original Ideas</b>	<b>Interesting content with a fresh perspective</b>	Communicates information well	Basic information is conveyed	Ideas are below the expected level	No thought given to the content	5
<b>Word Choice</b>	Sophisticated use of nouns and verbs make the essay very informative	Nouns and verbs make essay informative	Nouns and verbs are moderately used	<b>Needs more nouns and verbs</b>	Little or no use of nouns and verbs	2

<b>Sentence Structure</b>	Sentence structure enhances meaning; flows throughout	Sentence structure is evident; sentences mostly flow	<b>Sentence structure is limited; sentences need to flow</b>	Sentence structure is inappropriate; sentences need to flow	No sense of sentence structure or flow	3
<b>Mechanics</b>	No errors	<b>Few (if any) errors</b>	Few errors	Several errors	Numerous errors	4
<b>Total</b>						<b>14/20</b>

**Note:** Reduce to 10 Marks

### 5. Scheme of Valuation for CIE Skill test

Sl. No	Assessment	Marks
1.	Portfolio Evaluation of activities conducted up to the schedule of the skill test	10
2.	Assessment of any one activity through qualitative assessment (Rubrics)	10
<b>Total</b>		<b>20</b>

### 6. Rubrics for Assessment of Activity (Qualitative Assessment) (10 Marks)

Sl. No.	Dimension	Beginner	Intermediate	Good	Advanced	Expert	Students Score
		2	4	6	8	10	
1		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	
2		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	
3		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	
4		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	
Average/Total Marks							

**Note:** Dimension and Descriptor shall be defined by the respective course coordinator as per the activities

### 7. SEE Scheme of Evaluation:

Sl. No.	Assessment	Evidence	Marks	Conversion
1	Portfolio Evaluation- Scientific writing & Business communications	Report	10	
2	Portfolio Evaluation- Technical reports	Report	10	
3	Portfolio Evaluation- Proposal	Report	10	

4	Portfolio Evaluation- Writing for e-media	Report	10	40 Marks
5	Portfolio Evaluation- Technical writing using software tools & Publishing	Report	10	
6	Any one activity - By qualitative assessment (Rubrics).	BTE Answer scripts	50	
<b>Total</b>			<b>100</b>	

**8. Reference:**

Sl. No.	Description
1	Technical Writing : A Practical Guide for Engineers and Scientists by Phillip A. Laplante
2	Engineer's Guide to technical writing – Kenneth G. Budinski
3	A Guide to writing as an engineer, 4 <sup>th</sup> Edition – by David Beer, David McMurrey, WILEY
4	Technical writing 101 by Alan S. Pringle, Sarah S. O'Keefe – for technical writer tools
5	Technical Writing for Success, 4 <sup>th</sup> Edition - By Darlene Smith-Worthington, Sue Jefferson

**9. E-links:**

1	Writing common engineering documents <a href="https://learning.oreilly.com/library/view/a-guide-to/9781118300275/10_chapter05.html#chap5-sec032">https://learning.oreilly.com/library/view/a-guide-to/9781118300275/10_chapter05.html#chap5-sec032</a>
2	Formatting tables and figures in your research <a href="https://youtu.be/axjUhr6Ssz8">https://youtu.be/axjUhr6Ssz8</a> APA tables in word <a href="https://youtu.be/Xt_2ohUL9BI">https://youtu.be/Xt_2ohUL9BI</a> part -2 Auto-generate list of figures and list of tables <a href="https://youtu.be/eOujr6iLPts">https://youtu.be/eOujr6iLPts</a> Report writing part 1-Report in single file and auto-generate table of contents <a href="https://youtu.be/JNSrlwC7Hwk">https://youtu.be/JNSrlwC7Hwk</a> Report writing – headings and table of contents <a href="https://youtu.be/VFMPLcC7h0I">https://youtu.be/VFMPLcC7h0I</a> Report writing – images, captions & table of figures in word <a href="https://youtu.be/jv1h4QhP-aU">https://youtu.be/jv1h4QhP-aU</a> Report writing – citations and bibliography <a href="https://youtu.be/4dywz6dIQM">https://youtu.be/4dywz6dIQM</a> report writing – cover pages <a href="https://youtu.be/Xfi0AaQ-8HY">https://youtu.be/Xfi0AaQ-8HY</a> software tools for creating engineering documentation <a href="https://youtu.be/uPitFGqjyPU">https://youtu.be/uPitFGqjyPU</a> How to adjust margins <a href="https://youtu.be/Q-tg3nnnr0">https://youtu.be/Q-tg3nnnr0</a> Inserting and Formatting Tables <a href="https://youtu.be/0FCruReZTgk">https://youtu.be/0FCruReZTgk</a> Line & Character spacing   Microsoft Word Tutorials <a href="https://youtu.be/GwuLe07-pfU">https://youtu.be/GwuLe07-pfU</a> Professional report formatting in word <a href="https://youtu.be/4n6Le0-1i2o">https://youtu.be/4n6Le0-1i2o</a>
3	Progress Report: <a href="https://pressbooks.bccampus.ca/technicalwriting/chapter/progressreports/">https://pressbooks.bccampus.ca/technicalwriting/chapter/progressreports/</a> Technical writing Examples <a href="https://instrktiv.com/en/technical-writing-examples/#hoofdstuk_44">https://instrktiv.com/en/technical-writing-examples/#hoofdstuk_44</a>
4	Types of media <a href="https://whatagraph.com/blog/articles/different-types-of-media">https://whatagraph.com/blog/articles/different-types-of-media</a> Writing for social media <a href="https://styleguide.mailchimp.com/writing-for-social-media/">https://styleguide.mailchimp.com/writing-for-social-media/</a> Types of media writing <a href="https://blog.copify.com/post/different-types-of-media-writing">https://blog.copify.com/post/different-types-of-media-writing</a>