

## Department of Electronics and Communication Engineering

Detailed distribution of total 160 credits across 1<sup>st</sup> semester to 8<sup>th</sup> semester

AY: 2024-25

Sem.	BSC	ESC/ETC	HSSM	AEC	PCC	PEC	OEC	Proj.	Int.	Mand.	Total
I	08	09	02	01							20
II	08	09	02	01							20
III		03	01	01	15						20
IV	03	03	01	01	12						20
V			03	03	09	03		02		02 (ES)	22
VI				01	09	03	03	02			18
VII					12	03	03	06			24
VIII						03	03		10		16
Tot.	19	24	09	08	57	12	09	10	10	02	160

**Basaveshwar Engineering College, Bagalkote**  
**B.E. in Electronics and Communication Engineering**  
**Scheme of Teaching and Examinations**  
**AY: 2024-25**

**I SEMESTER (Physics Cycle)**

Sl. No.	Course and Course Code		Course Title	Teaching / Paper setting Dept.	Teaching hrs./week				Examination				Credits
					Lecture	Tutorial	Practical/ Drawing	Self-Study Component	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	ASC (IC)	BMAE101C	Mathematics-I	Maths Dept.	3	0	2	0	3	50	50	100	4
2	ASC (IC)	BPHE102C	Physics for Electrical Sciences	Physics Dept.	3	0	2	0	3	50	50	100	4
3	ESC	BECA103C	Basic Electronics	Dept.	3	0	0	0	3	50	50	100	3
4	ESC-I	BCSA104N	Engineering Science Course-I	Dept.	2/3	0/0	2/0	0	3	50	50	100	3
5	ETC-I	BECB105B	Emerging Technology Course-I	Dept.	3	0	0	0	3	50	50	100	3
7	HSMC	BHSA106C	Communicative English	HSS Dept.	1	0	0	0	1	50	50	100	1
8	HSMC	BHSA107C	Indian Constitution	HSS Dept.	1	0	0	0	1	50	50	100	1
9	AEC	BHSA108C	Scientific Foundations of Health	Dept.	1	0	0	0	1	50	50	100	1
<b>Total</b>					17	0	6	0	18	<b>400</b>	<b>400</b>	<b>800</b>	<b>20</b>
Sl. No.	Emerging Technology Course-I ETC-I				Engineering Science Course-I ESC-I				Engineering Science Course ESC				
1.	Introduction to Embedded System- BECB105B/ BECB205B				Introduction to C Programming - BCSA104N/ BCSA204N				Basic Electronics- BECA103C/ BECA203C				
2.	Smart Materials and Systems- BMEA105B/ BMEA205B				Introduction to Electronics & Communication- BECA104N/ BECA204N								
3.	Introduction to Nano Technology- BECA105B/ BECA205B												
4.	Introduction to Sustainable Engineering- BMEB105B/ BMEB205B												
5.	Introduction to Internet of Things (IOT)- BISA105B/ BISA205B												

Note: Department is offering Subject: Introduction to Electronics & Communication (22UEC114N/214N) to other department students

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**AY: 2024-25**

**II SEMESTER (Chemistry Cycle)**

Sl. No.	Course and Course Code		Course Title	Teaching / Paper setting Dept.	Teaching hrs./week				Examination				Credits
					Lecture	Tutorial	Practical / Drawing	Self-Study Component	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	ASC (IC)	BMAE201C	Mathematics-II	Maths Dept.	3	0	2	0	3	50	50	100	4
2	ASC (IC)	BCHE202C	Applied Chemistry for EEE Stream	Chemistry Dept.	3	0	2	0	3	50	50	100	4
3	ESC	BMEB203C	Computer Aided Engineering & Drawing	Civil / Mechanical Dept.	2	0	2	0	3	50	50	100	3
4	ESC-II		Engineering Science Course-II	EEE Dept.	3	0	0	0	3	50	50	100	3
5	PLC-II		Programming Language Course-II	Dept.	2	0	2	0	3	50	50	100	3
6	AEC		Professional Writing Skills in English	HSS Dept.	1	0	0	0	1	50	50	100	1
7	HSM C		Sanskritika Kannada	HSS Dept.	1	0	0	0	1	50	50	100	1
8			Balake Kannada										
9	SDC		Innovation and Design Thinking	Dept.	1	0	0	0	1	50	50	100	1
<b>Total</b>					16	0	8	0	24	<b>400</b>	<b>400</b>	<b>800</b>	<b>20</b>

Sl. No.	Programming Language Course-II PLC-II	Engineering Science Course-II ESC-II	Engineering Science Course ESC
1.	Introduction to C++ Programming- BCSD105D/ BCSD205D	Introduction to Electrical Engineering- BEEA104N/ BEEA204N	CAED- BMEB103C/ BMEB203C
2.	Introduction to Python Programming- BCSB105D/ BCSB205D	Introduction to Electronics & Communication- BECA104N/ BECA204N	
3.	Basics of JAVA programming- BCSC105D/ BCSC205D		

**Basaveshwar Engineering College, Bagalkote**  
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III SEMESTER													
Sl. No	Course	Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	SDA	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	PCC		AV Mathematics-III for EC Engineering	MATHEMATICS	3	0	0		03	50	50	100	3
2	IPCC		Digital System Design using Verilog	ECE DEPT.	3	0	2		03	50	50	100	4
3	IPCC		Electronic Principles and Circuits	ECE DEPT.	3	0	2		03	50	50	100	4
4	PCC		Network Analysis	ECE DEPT.	3	0	0		03	50	50	100	3
5	PCCL		Analog and Digital Systems Design Lab	ECE DEPT.	0	0	2		03	50	50	100	1
6	ESC		ESC/ETC/PLC	ECE DEPT.	3	0	0		03	50	50	100	3
7	UHV		Social Connect and Responsibility	HSS DEPT.	0	0	2		01	100	---	100	1
8	AEC/ SEC		Ability Enhancement Course/Skill Enhancement Course- III	ECE DEPT.	If the course is a Theory				01	50	50	100	1
					1	0	0						
					If a course is a laboratory				02				
					0	0	2						
9	MC		Yoga	NSS COORDINATOR	0	0	2		25	---	25	0	
			National Service Scheme (NSS)	MUSIC TEACHER									
			Physical Education (PE) (Sports and Athletics)	PHYSICAL EDUCATION DIRECTOR									
			Music	YOGA TEACHER									
<b>Total</b>					<b>15/16</b>	<b>0</b>	<b>12</b>		<b>22</b>	<b>550</b>	<b>350</b>	<b>900</b>	<b>20</b>

Sl. No.	Ability Enhancement Course (AEC)	Subject Code	Engineering Science Course (ESC)	Subject Code	Skill Enhancement Course (SEC)	Subject Code
1.	C++ Basics		Electronic Devices		MATLAB Programming	
2.	IOT for Smart Infrastructure		Computer Organization and Architecture		LABVIEW programming	
3.			Sensors and Instrumentation			
4.			Applied Numerical Methods for EC Engineers			

**PCC:** Professional Core Course, **PCCL:** Professional Core Course laboratory, **UHV:** Universal Human Value Course, **MC:** Mandatory Course(Non-credit), **AEC:** Ability Enhancement Course, **SEC:** Skill Enhancement Course, **L:**Lecture, **T:**Tutorial, **P:**Practical **S=SDA:**Skill Development Activity, **CIE:** Continuous Internal Evaluation, **SXX:**

IV SEMESTER													
Sl. No	Course and Course Code		Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	PCC		Electromagnetic Theory	ECE DEPT.	3	0	0	0	03	50	50	100	3
2	IPCC		Principles of Communication Systems	ECE DEPT.	3	0	2	0	03	50	50	100	4
3	IPCC		Control Systems	ECE DEPT.	3	0	2	0	03	50	50	100	4
4	PCCL		Communication Lab	ECE DEPT.	0	0	2	0	03	50	50	100	1
5	ESC		ESC/ETC/PLC	ECE DEPT.	3	0	0	0	03	50	50	100	3
6	AEC/ SEC		Ability Enhancement Course/Skill Enhancement Course- IV	ECE DEPT.	If the course is Theory				01	50	50	100	1
					1	0	0	0					
					If the course is a lab				02				
					0	0	2	0					
7	BSC		Biology For Engineers	ECE DEPT.	3	0	0	0	03	50	50	100	3
8	UHV		Universal human values course	ECE DEPT.	1	0	0	0	01	50	50	100	1
9	MC		Yoga	YOGA TEACHER									
			National Service Scheme (NSS)	NSS COORDINATOR									
			Physical Education (PE) (Sports and Athletics)	PHYSICAL EDUCATION DIRECTOR	0	0	2			25	---	25	0
			Music	MUSIC TEACHER									
<b>Total</b>					<b>16/17</b>	<b>0</b>	<b>10</b>		<b>22</b>	<b>500</b>	<b>400</b>	<b>900</b>	<b>20</b>

**PCC:** Professional Core Course, **PCCL:** Professional Core Course laboratory, **UHV:** Universal Human Value Course, **MC:** Mandatory Course(Non-credit), **AEC:** Ability Enhancement Course, **SEC:** Skill Enhancement Course, **L:**Lecture, **T:**Tutorial, **P:**Practical **S=SDA:**Skill Development Activity, **CIE:** Continuous Internal Evaluation, **SXX:**

Sl. No.	Ability Enhancement Course AEC	Subject Code	Engineering Science Course ESC	Subject Code	Skill Enhancement Course (SEC)	Subject Code
1.	Octave Programming		Data Structures using C		Data Structures Lab using C	
2.	Programmable Logic Controllers		Microcontrollers		Microcontroller Lab	
3.			Industrial Electronics			
4.			Operating Systems			

V SEMESTER													
Sl. No	Course and Course Code		Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours/Week				Examination			Credits	
					Theory Lecture	Tutorial	Practical/Drawing	SDA	Duration in hours	CIE Marks	SEE Marks		Total Marks
					L	T	P	S					
1	HSMS		Technological Innovation and Management Entrepreneurship	ECE DEPT.	3	0	0	0	03	50	50	100	3
2	IPCC		Digital Signal Processing	ECE DEPT.	3	0	2	0	03	50	50	100	4
3	PCC		Digital Communication	ECE DEPT.	4	0	0	0	03	50	50	100	4
4	PCCL		Digital Communication Lab	ECE DEPT.	0	0	2	0	03	50	50	100	1
5	PEC		Professional Elective Course	ECE DEPT.	3	0	0	0	03	50	50	100	3
6	PROJ		Mini Project	ECE DEPT.	0	0	4	0	03	100	--	100	2
7	AEC		<b>Research Methodology and IPR</b>	ECE DEPT.	2	2	0	0	02	50	50	100	3
8	MC		Environmental Studies	ANY DEPARTMENT	2	0	0	0	02	50	50	100	2
9	MC		Yoga	YOGA TEACHER	0	0	2			25	---	25	0
			National Service Scheme (NSS)	NSS COORDINATOR									
			Physical Education (PE) (Sports and Athletics)	PHYSICAL EDUCATION DIRECTOR									
			Music	MUSIC TEACHER									
10	AC		Qualitative Aptitude and Soft Skills	TPC	2	0	0	0	2	100	--	100	0
<b>Total</b>					<b>19</b>	<b>2</b>	<b>10</b>	<b>0</b>	<b>24</b>	<b>650</b>	<b>350</b>	<b>1000</b>	<b>22</b>
<b>Professional Elective Course</b>													
1.	Intelligent Systems and Machine Learning Algorithms												
2.	Digital Switching and Finite Automata Theory												
3.	Data Structure using C++												
4.	Satellite and Optical Communication												
<b>PCC:</b> Professional Core Course, <b>PCCL:</b> Professional Core Course laboratory, <b>UHV:</b> Universal Human Value Course, <b>MC:</b> Mandatory Course(Non-credit), <b>AEC:</b> Ability Enhancement Course, <b>SEC:</b> Skill Enhancement Course, <b>L:</b> Lecture, <b>T:</b> Tutorial, <b>P:</b> Practical <b>S=SDA:</b> Skill Development Activity, <b>CIE:</b> Continuous Internal Evaluation, <b>SXX:</b> , <b>AC:</b> Audit Course													

## VI SEMESTER

Sl.No	Course and Course Code		Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours/Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/Drawing	SDA	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	IPCC		Embedded System Design	ECE DEPT	3	0	2	0	03	50	50	100	4
2	PCC		VLSI Design and Testing	ECE DEPT	4	0	0	0	03	50	50	100	4
3	PEC		Professional Elective Course	ECE DEPT	3	0	0	0	03	50	50	100	3
4	OEC		Open Elective Course	RESPECTIVE DEPT	3	0	0	0	03	50	50	100	3
5	PROJ		Major Project Phase I	ECE DEPT	0	0	4	0	03	100	--	100	2
6	PCCL		VLSI Design and Testing Lab	ECE DEPT	0	0	2	0	03	50	50	100	1
7	AEC		Indian Knowledge System	ECE DEPT	If the course is offered as a Theory				01	50	50	100	1
					1	0	0	0					
					If course is offered as a practical								
					0	0	2	0					
8	MC		Yoga	YOGA TEACHER	0	0	2			25	---	25	0
			National Service Scheme (NSS)	NSS COORDINATOR									
			Physical Education (PE) (Sports and Athletics)	PHYSICAL EDUCATION DIRECTOR									
			Music	MUSIC TEACHER									
<b>Total</b>					<b>14/13</b>	<b>0</b>	<b>12/10</b>	<b>0</b>	<b>19</b>	<b>500</b>	<b>300</b>	<b>800</b>	<b>18</b>

Sl. No.	Professional Elective Course (PEC)	Subject Code	Open Elective Course (OE)	Subject Code
1.	Multimedia Communication		Digital System Design using Verilog	
2.	Digital Image Processing		Electronic Communication Systems	
3.	Computer and Data Security		Consumer Electronics	
4.	FPGA System Design using Verilog		Basic VLSI Design	

VII SEMESTER (Swappable VII and VIII SEMESTER)													
Sl.No	Course and Course Code		Course Title	Teaching Department(TD) and Question Paper Setting Board(PSB)	Teaching Hours/Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/Drawing	SDA	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	IPCC		Microwave Engineering and Antenna Theory	ECE DEPT	3	0	2	0	03	50	50	100	4
2	IPCC		Computer Networks and Protocols	ECE DEPT	3	0	2	0	03	50	50	100	4
3	PCC		Wireless Communication Systems	ECE DEPT	4	0	0	0	03	50	50	100	4
4	PEC		<b>Professional Elective Course</b>	RESPTIVE DEPT	3	0	0	0	03	50	50	100	3
5	OEC		<b>Open Elective Course</b>	ECE DEPT	3	0	0	0	03	50	50	100	3
6	PROJ		<b>Major Project Phase-II</b>	ECE DEPT	0	0	12	0	03	100	100	200	6
					16	0	16	0	18	350	350	700	24

Sl. No.	Professional Elective Course (PEC)	Subject Code	Open Elective Course (OE)	Subject Code
1.	Application Specific Integrated Circuit		E-waste Management	
2.	Automotive Electronics		Embedded System Applications	
3.	Cyber Security		Automotive Electronics	
4.	Radar Communication		Sensors and Actuators	
<b>L:</b> Lecture, <b>T:</b> Tutorial, <b>P:</b> Practical <b>S=SDA:</b> SkillDevelopmentActivity, <b>CIE:</b> ContinuousInternalEvaluation, <b>SEE:</b> SemesterEndEvaluation. <b>TD-</b> TeachingDepartment, <b>PSB:</b> PaperSettingdepartment, <b>OEC:</b> OpenElectiveCourse, <b>PEC:</b> ProfessionalElectiveCourse. <b>PROJ:</b> Projectwork, <b>INT:</b> IndustryInternship/ResearchInternship/RuralInternship				



**VIII SEMESTER (Swappable VII and VIII SEMESTER)**

Sl.No	Course and Course Code		Course Title	Teaching Department(TD) and Question Paper Setting Board(PSB)	Teaching Hours/Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/Drawing	SDA	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	PEC		Professional Elective (Online Courses) MOOCS		3	0	0	0	03	50	50	100	3
2	OEC		Open Elective (Online Courses) MOOCS		3	0	0	0	01	50	50	100	3
3	INT		Internship (Industry/Research) (14-20weeks)		0	0	12	0	03	100	100	200	10
			<b>Total</b>		6	0	12	0	07	<b>200</b>	<b>200</b>	<b>400</b>	<b>16</b>
<b>Professional Elective Course</b>													
	BOS Recommended Course				BOS Recommended Course								
	BOS Recommended Course				BOS Recommended Course								
<b>Open Elective Courses</b>													
	BOS Recommended Course				BOS Recommended Course								
	BOS Recommended Course				BOS Recommended Course								
<p><b>L:</b>Lecture,<b>T:</b>Tutorial,<b>P:</b>Practical<b>S=SDA:</b>SkillDevelopmentActivity,<b>CIE:</b>ContinuousInternalEvaluation,<b>SEE:</b>SemesterEndEvaluation.<b>TD-</b>TeachingDepartment,<b>PSB:</b> PaperSettingdepartment,<b>OEC:</b>OpenElectiveCourse,<b>PEC:</b>ProfessionalElectiveCourse.<b>PROJ:</b>Projectwork,<b>INT:</b>IndustryInternship/ResearchInternship/RuralInternship</p>													

Course Title:	<b>Basic Electronics (For ECE and Allied Branches)</b>		
Course Code:		CIE Marks	50
Course Type (Theory/Practical/Integrated )	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	3:0:0:0	Exam Hours	03
Total Hours of Pedagogy	40 hours	Credits	03
<b>Course objectives:</b> Students will be taught			
<ol style="list-style-type: none"> <li>1. Operation of Semiconductor diode, Zener diode and Special purpose diodes and their applications.</li> <li>2. Biasing circuits for transistor (BJT) as an amplifier.</li> <li>3. Study of linear Op-amps and its applications.</li> <li>4. Logic circuits and their optimization.</li> <li>5. Principles of Transducers and Communication.</li> </ol>			
<b>Teaching-Learning Process</b>			
These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes and make Teaching –Learning more effective			
<ol style="list-style-type: none"> <li>1. Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.</li> <li>2. Show Video/animation films to explain the functioning of various analog and digital circuits.</li> <li>3. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.</li> <li>4. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.</li> <li>5. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1 (8 Hours)</b>			
<b>Semiconductor Diodes:</b> Introduction, PN Junction diode, Characteristics and Parameters, Diode Approximations, DC Load Line analysis (Text 1: 2.1,2.2,2.3,2.4)			
<b>Diode Applications:</b> Introduction, Half Wave Rectification, Full Wave Rectification, Full Wave Rectifier Power Supply: Capacitor Filter Circuit, RC $\pi$ Filter (includes numerical) (Text 1: 3.1,3.2,3.4,3.5)			
<b>Zener Diodes:</b> Junction Breakdown, Circuit Symbol and Package, Characteristics and Parameters, Equivalent Circuit, Zener Diode Voltage Regulator. (Text 1: 2.9, 3.7)			
<b>Module-2(8 Hours)</b>			
<b>Bipolar Junction Transistors:</b> Introduction BJT Voltages & Currents, BJT Amplification, Common Base Characteristics, Common Emitter Characteristics, Common Collector Characteristics, BJT Biasing: Introduction, DC Load line and Bias point (Text 1: 4.2, 4.3, 4.5, 4.6, 5.1)			
<b>Field Effect Transistor:</b> Junction Field Effect Transistor, JFET Characteristics, MOSFETs: Enhancement MOSFETs, Depletion Enhancement MOSFETs (Text 1: 9.1,9.2,9.5)			
<b>Module-3(8 Hours)</b>			
<b>Operational Amplifiers:</b> Introduction, The Operational Amplifier, Block Diagram Representation of Typical Op-Amp, Schematic Symbol, Op-Amp parameters - Gain, input resistance, Output resistance, CMRR, Slew rate, Bandwidth, input offset voltage, Input bias Current and Input offset Current, The Ideal Op-Amp, Equivalent Circuit of Op-Amp, Open Loop Op-Amp configurations, Differential Amplifier, Inverting & Non Inverting Amplifier			
<b>Op-Amp Applications:</b> Inverting Configuration, Non-Inverting Configuration, Differential Configuration, Voltage Follower, Integrator, Differentiator (Text 2: 1.1, 1.2, 1.3, 1.5, 2.2, 2.3, 2.4, 2.6, 6.5.1, 6.5.2, 6.5.3, 6.12, 6.13).			
<b>Module-4(8 Hours)</b>			
<b>Boolean Algebra and Logic Circuits:</b> Binary numbers, Number Base Conversion, octal & Hexa Decimal Numbers, Complements, Basic definitions, Axiomatic Definition of Boolean Algebra, Basic Theorems and Properties of Boolean Algebra, Boolean Functions, Canonical and Standard Forms, Other Logic Operations, Digital Logic Gates (Text 3: 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7)			
<b>Combinational logic:</b> Introduction, Design procedure, Adders- Half adder, Full adder (Text 3: 4.1, 4.2, 4.3)			
<b>Module-5(8 Hours)</b>			

**Introduction to Transducers:** Introduction, Resistive Transducers, Inductive Transducers, Capacitive Transducers, Thermal transducers, Optoelectronic transducer, and Piezoelectric transducers (Text 4: Chapter 18: 18.1, 18.2, 18.3, 18.4, 18.5)

**Communications:** Introduction to communication, Communication System, Modulation (Text book 5: 1.1, 1.2, 1.3)

**Course outcome (Course Skill Set)**

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

**CO1:**Develop the basic knowledge on construction, operation and characteristics of semiconductor devices.(Level: C3)

**CO2:**Apply the acquired knowledge to construct small scale circuits consisting of semiconductor devices (Level: C3)

**CO3:**Develop competence knowledge to construct basic digital circuit by make use of basic gate and its function.(Level: C3)

**CO4:** Construct the conceptual blocks for basic communication system. (Level: C3)

**CO5:** Apply the knowledge of various transducers principle in sensor system. (Level: C3)

**A. CO v/s PO Mapping Table**

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	-	2	2						
CO2	3	2	3	-	2	1						
CO3	3	2	3	-	3				1			
CO4	2	1	1	-	2	1			1			1
CO5	2	1	1	-	2	1			1			1

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). The minimum passing mark for the SEE is 35% of the maximum marks (18 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation(CIE):**

Three Tests each of 20 Marks;

- 1<sup>st</sup>, 2<sup>nd</sup>, and 3<sup>rd</sup> tests shall be conducted after completion of the syllabus of 30-35%,70-75%, and 90-100% of the course/s respectively.
- Assignments/Seminar/quiz/group discussion /field survey & report presentation/ course project/Skill development activities, suitably planned to attain the COs and POs for a total of40 Marks.  
If the nature of the courses requires assignments/Seminars/Quizzes/group discussion two evaluation components shall be conducted. If course project/field survey/skill developmentactivities etc then the evaluation method shall be one.

Total CIE marks (out of 100 marks) shall be scaled down to 50 marks

**Semester End Examination(SEE):**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (duration 03 hours)

- The question paper shall be set for 100 marks. The medium of the question paper shall be English). The duration of SEE is 03 hours.
- The question paper will have 10 questions. Two questions per module. Each question is set for 20 marks. The students have to answer 5 full questions, selecting one full question from each module. The student has to answer for 100 marks and **marks scored out of 100 shall be proportionally reduced to 50 marks.**
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

**Suggested Learning Resources:****Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)**

1. Electronic Devices and Circuits, David A Bell, 5<sup>th</sup> Edition, Oxford, 2016
2. Op-amps and Linear Integrated Circuits, Ramakanth A Gayakwad, Pearson Education, 4<sup>th</sup> Edition
3. Digital Logic and Computer Design, M. Morris Mano, PHI Learning, 2008 ISBN-978-81-203-0417-8
4. Electronic Instrumentation and Measurements (3rd Edition) – David A. Bell, Oxford University Press,2013
5. Electronic Communication Systems, George Kennedy, 4<sup>th</sup> Edition, TMH

**Web links and Video Lectures (e-Resources):**

- <https://nptel.ac.in/courses/122106025>
- <https://nptel.ac.in/courses/108105132>
- <https://nptel.ac.in/courses/117104072>

Course Title:	<b>Introduction to Electronics &amp; Communication</b>		
Course Code:		CIE Marks	50
Course Type (Theory/Practical/Integrated )	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	3:0:0:0	Exam Hours	03
Total Hours of Pedagogy	40 hours	Credits	03
<b>Course objectives</b>			
<ol style="list-style-type: none"> <li>1. To prepare students with fundamental knowledge/ overview in the field of Electronics and Communication Engineering.</li> <li>2. To equip students with a basic foundation in electronic engineering required for comprehending the operation and application of electronic circuits, logic design, embedded systems, and communication systems.</li> <li>3. Professionalism &amp; Learning Environment: To inculcate in first-year engineering students an ethical and professional attitude by providing an academic environment inclusive of effective communication, teamwork, ability to relate engineering issues to a broader social context, and life-long learning needed for a successful professional career.</li> </ol>			
<b>Teaching-Learning Process</b>			
<p>These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes and make Teaching – Learning more effective</p> <ol style="list-style-type: none"> <li>1. Lecturer method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.</li> <li>2. Arrange visits to nearby PSUs such as BHEL, BEL, ISRO, etc., and small-scale hardware Industries to give brief information about the electronics manufacturing industry.</li> <li>3. Show Video/animation films to explain the functioning of various analog and digital circuits.</li> <li>4. Encourage collaborative (Group) Learning in the class</li> <li>5. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking</li> <li>6. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.</li> <li>7. Topics will be introduced in multiple representations.</li> <li>8. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.</li> <li>9. Discuss how every concept can be applied to the real world - and when that's possible, it Helps improve the students' understanding.</li> </ol>			
<b>Module-1 ( 8 hours )</b>			
<p><b>Power Supplies</b> – Block diagram, Half-wave rectifier, Full-wave rectifiers and filters, Voltage regulators, Output resistance and voltage regulation, Voltage multipliers.</p> <p><b>Amplifiers</b> – Types of amplifiers, Gain, Input and output resistance, Frequency response, Bandwidth, Phase shift, Negative feedback, multi-stage amplifiers (Text 1)</p>			
<b>Module-2(8 hours )</b>			
<p><b>Oscillators</b> – Barkhausen criterion, sinusoidal and non-sinusoidal oscillators, Ladder network oscillator, Wein bridge oscillator, Multivibrators, Single-stage astable oscillator, Crystal controlled oscillators (Only Concepts, working, and waveforms. No mathematical derivations)</p> <p><b>Operational amplifiers</b> -Operational amplifier parameters, Operational amplifier characteristics, Operational amplifier configurations, Operational amplifier circuits. Text 1)</p>			
<b>Module-3 ( 8 hours)</b>			

**Boolean Algebra and Logic Circuits:** Binary numbers, Number Base Conversion, octal & HexaDecimal Numbers, Complements, Basic definitions, Axiomatic Definition of Boolean Algebra, Basic Theorems and Properties of Boolean Algebra, Boolean Functions, Canonical and Standard Forms, Other Logic Operations, Digital Logic Gates (Text 2: 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7) **Combinational logic:** Introduction, Design procedure, Adders- Half adder, Full adder (Text 2:4.1, 4.2, 4.3)

**Module-4 ( 8 hours)**

**Embedded Systems** – Definition, Embedded systems vs general computing systems, Classification of Embedded Systems, Major application areas of Embedded Systems, Elements of an Embedded System, Core of the Embedded System, Microprocessor vs Microcontroller, RISC vs CISC **Sensors and Interfacing** – Instrumentation and control systems, Transducers, Sensors, Actuators, LED, 7-Segment LED Display. (Text 3)

**Module-5 ( 8 hours)**

**Analog Communication Schemes** – Modern communication system scheme, Information source, and input transducer, Transmitter, Channel or Medium – Hardwired and Soft wired, Noise, Receiver, Multiplexing, Types of communication systems. Types of modulation (only concepts) – AM, FM, Concept of Radio wave propagation (Ground, space, sky)

**Digital Modulation Schemes:** Advantages of digital communication over analog communication, ASK, FSK, PSK, Radio signal transmission Multiple access techniques. (Text 4)

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). The minimum passing mark for the SEE is 35% of the maximum marks (18 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation (CIE):**

Three Tests each of 20 Marks;

- 1<sup>st</sup>, 2<sup>nd</sup>, and 3<sup>rd</sup> tests shall be conducted after completion of the syllabus of 30-35%, 70-75%, and 90-100% of the course/s respectively.
- Assignments/Seminar/quiz/group discussion /field survey & report presentation/ course project/Skill development activities, suitably planned to attain the COs and POs for a total of 40 Marks.  
If the nature of the courses requires assignments/Seminars/Quizzes/group discussion two evaluation components shall be conducted. If course project/field survey/skill development activities etc then the evaluation method shall be one.

Total CIE marks (out of 100 marks) shall be scaled down to 50 marks

**Semester End Examination(SEE):**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (duration 03 hours)

- The question paper shall be set for 100 marks. The medium of the question paper shall be English. The duration of SEE is 03 hours.
- The question paper will have 10 questions. Two questions per module. Each question is set for 20 marks. The students have to answer 5 full questions, selecting one full question from each module. The student has to answer for 100 marks and **marks scored out of 100 shall be proportionally reduced to 50 marks.**
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

Suggested Learning Resources:

Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)

1. Mike Tooley, 'Electronic Circuits, Fundamentals & Applications', 4th Edition, Elsevier, 2015. DOI <https://doi.org/10.4324/9781315737980>. eBook ISBN 9781315737980

2. Digital Logic and Computer Design, M. Morris Mano, PHI Learning, 2008 ISBN-978-81-203-0417-84.
3. K V Shibu, 'Introduction to Embedded Systems', 2nd Edition, McGraw Hill Education (India), Private Limited, 2016
4. S L Kakani and Priyanka Punglia, 'Communication Systems', New Age International Publisher, 2017.

Course Outcomes	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1. Differentiate and analyze the applications of electronic devices and circuits.	3	3	2	-	2	2	-	1	1	-	-	-	3	-	-
2. Analyze the operation of oscillators, op amps and its applications.	3	2	3	-	2	1	-	1	1	-	-	-	3	-	-
3. Analyze different number systems and logic circuits built with basic gates.	3	2	3	-	3	-	-	1	1	-	-	-	3	-	-
4. Decide type of transducer, sensor and modulation for a given application.	3	1	1	-	2	1	-	1	1	-	-	-	3	-	-
5. Describe communication system and modulation techniques for a given application.	3	2	2	-	2	1	-	1	1	-	-	-	3		
<b>Course Contribution to POs and PSOs</b>	<b>3</b>	<b>2</b>	<b>2.2</b>	<b>-</b>	<b>2.2</b>	<b>1</b>	<b>-</b>	<b>1</b>	<b>1</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>3</b>	<b>-</b>	<b>-</b>

<b>Course Title:</b>	<b>INTRODUCTION TO EMBEDDED SYSTEMS</b>			
Course Code:			CIE Marks	50
Course Type (Theory/Practical /Integrated )		Theory	SEE Marks	50
			Total Marks	100
Teaching Hours/Week (L:T:P: S)	3:0:0:0		Exam Hours	03
Total Hours of Pedagogy	40 hours		Credits	03
<b>Course objectives:</b> To teach students				
<ul style="list-style-type: none"> <li>• Introductory topics of Embedded System design</li> <li>• Characteristics &amp; attributes of Embedded System</li> <li>• Introduction of Embedded System Software and Hardware development</li> <li>• RTOS based Embedded system design</li> </ul>				
<b>Teaching-Learning Process</b>				
These are sample Strategies, which teacher can use to accelerate the attainment of the various courseoutcomes and make Teaching –Learning more effective				
<ol style="list-style-type: none"> <li>1. Lecturer method (L) does not mean only the traditional lecture method, but a different type ofteaching method may be adopted to develop the outcomes.</li> <li>2. Show Video/animation films to explain the functioning of various analog and digital circuits.</li> <li>3. Adopt Problem Based Learning (PBL), which fosters students’ Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather thansimply recall it.</li> <li>4. Show the different ways to solve the same problem and encourage the students to come upwith their own creative ways to solve them.</li> <li>5. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>				
<b>Module-1 (8 Hours)</b>				
<b>Introduction:</b> Embedded Systems and general purpose computer systems, history, classifications, applications and purpose of embedded systems <b>Chapter 1 – Text 1</b>				
<b>Core of Embedded Systems :</b> Microprocessors and microcontrollers, RISC and CISC controllers, Big endian and Little endian processors, Application specific ICs, Programmable logic devices, COTS, sensors and actuators: Light Emi ng Diode (LED) and 7-Segment LED Display, communication interface: Inter Integrated Circuit ( I2C) Bus, Serial Peripheral Interface ( SPI) Bus, Universal Asynchronous Receiver Transmitter ( UART) and RS-232 C and RS-485, embedded firmware, other system components : Oscillator Unit and Watchdog Timer, PCB and passive components <b>Chapter 2 – Text 1</b>				
<b>Module-2(8 Hours)</b>				
<b>Characteristics and quality attributes of embedded systems:</b> Characteristics, Operational and nonoperational quality attributes, application specific embedded system - washing machine, domainspecific – automotive <b>Chapter 3 &amp; 4 – Text 1</b>				
<b>Module-3(8 Hours)</b>				
<b>Hardware Software Co design and Program Modelling :</b> Fundamental issues in Hardware Software Co-design, Computational models in Embedded System Design <b>Chapter 7 – Text 1: 7.1, 7.2</b> <b>Embedded Hardware Design and Development:</b> Analog Electronic Components, Digital Electronic Components, VLSI & Integrated Circuit Design, Electronic Design Automation Tools <b>Chapter 8 – Text 1: 8.1, 8.2, 8.3, 8.4</b>				
<b>Module-4(8 Hours)</b>				
<b>Embedded Firmware Design and Development:</b> Embedded Firmware Design Approaches,Embedded Firmware Development Languages <b>Chapter 9 – Text 1: 9.1, 9.2</b>				
<b>Embedded System Development Environments:</b> Types of files generated on cross compilation (only explanation – programming codes need not be dealt), disassemble/decompiler, Simulators, Emulators and Debugging <b>Chapter 13 – Text 1: 13.2, 13.3,13.4</b>				
<b>Module-5(8 Hours)</b>				



**Real-time Operating System(RTOS) based Embedded System Design:**

Operating System basics, Types of Operating Systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling **Chapter 10 – Text 1: 10.1 to 10.5**

**Course outcome (Course Skill Set)**

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

CO1	Explain characteristics of Embedded System design
CO2	Acquire knowledge about basic concepts of circuit emulators, debugging and RTOS
CO3	Analyse embedded system software and hardware requirements
CO4	Develop programming skills in embedded systems for various applications.
CO5	Design basic embedded system for real time applications

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). The minimum passing mark for the SEE is 35% of the maximum marks (18 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation(CIE):**

Three Tests each of 20 Marks;

- 1<sup>st</sup>, 2<sup>nd</sup>, and 3<sup>rd</sup> tests shall be conducted after completion of the syllabus of 30-35%, 70-75%, and 90-100% of the course/s respectively.
- Assignments/Seminar/quiz/group discussion /field survey & report presentation/ course project/Skill development activities, suitably planned to attain the COs and POs for a total of 40Marks. If the nature of the courses requires assignments/Seminars/Quizzes/group discussion two evaluation components shall be conducted. If course project/field survey/skill development activities etc then the evaluation method shall be one.

Total CIE marks (out of 100 marks) shall be scaled down to 50 marks

**Semester End Examination (SEE):**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

- The question paper shall be set for 100 marks. The medium of the question paper shall be English). The duration of SEE is 03 hours.
- The question paper will have 10 questions. Two questions per module. Each question is set for 20 marks. The students have to answer 5 full questions, selecting one full question from each module. The student has to answer for 100 marks and **marks scored out of 100 shall be proportionally reduced to 50 marks.**

There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

**Suggested Learning Resources:****Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)**

1. Shibu K V, "Introduction to Embedded Systems", Second Edition, McGraw Hill Education

**Web links and Video Lectures (e-Resources):**

NPTL Lectures: <https://nptel.ac.in/courses/108102045> Embedded Systems, IIT Delhi, Prof. Santanu Chaudhary

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- To design a simple Embedded System like simple remote

To demonstrate simple microcontroller based experiments like LED interfacing, LCD interfacing, DAC etc

<b>Course Outcomes:</b>	
CO1:	Explain characteristics of Embedded System design
CO2:	Acquire knowledge about basic concepts of circuit emulators, debugging and RTOS
CO3:	Analyse embedded system software and hardware requirements
CO4:	Develop programming skills in embedded systems for various applications.
CO5:	Design basic embedded system for real time applications

### **CO and PO Mapping**

<b>Course Outcomes</b>	<b>Programme Outcomes</b>											
	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>	<b>11</b>	<b>12</b>
CO1	3	1	1		1	1	1	1	1	1		1
CO2	3	2	2		1	1	1	1	1	2		1
CO3	3	2	2		1	2	1	1	2	1		2
CO4	3	2	1		2	1	1	1	1	1		1
CO5	3	2	2		1	2	1	1	1	1		1

Course Title:	Introduction to Nano Technology		
Course Code:		CIE Marks	50
Course Type (Theory/Practical/Integrated )	ETC (Integrated)	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	02:00:02:00	Exam Hours	03
Total Hours of Pedagogy	40 hours	Credits	03
Teaching Department	NT/Chem/Phys/Any Engg. Branch	QP setting	NT/Chem/Phys

### Course objectives

- To provide a comprehensive overview of synthesis and characterization of nanoparticles, nanocomposites and hierarchical materials with nanoscale features.
- To provide the engineering students with necessary background for understanding various nanomaterials characterization techniques
- To develop an understanding of the basis of the choice of material for device applications
- To give an insight into complete systems where nanotechnology can be used to improve our everyday life

### Teaching-Learning Process

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes and make Teaching –Learning more effective

1. Chalk and Talk
2. Powerpoint presentation
3. Video Lecturing
4. E-sources
5. Self learning

### Module-1 (07 hours of pedagogy)

#### Introduction to Nanomaterials

Nanotechnology, Frontier of future-an overview, Length Scales, Variation of physical properties from bulk to thin films to nanomaterials, Confinement of electron in 0D, 1D, 2D and 3D systems, Surface to Volume Ratio, Synthesis of Nanomaterials: Bottom-Up approach: Chemical Routes for Synthesis of nanomaterials-Sol-gel, Precipitation, Solution Combustion synthesis, Hydrothermal, SILAR, Chemical Bath Deposition. Top-Down approach- Ball milling technique, Sputtering, Laser Ablation

### Module-2 (07 hours of pedagogy)

#### Characterization of Nanomaterials

Basic principles and instrumentations of Electron Microscopy –Transmission Electron Microscope, Scanning Electron Microscope, Scanning Probes- Scanning Tunneling microscope, Atomic Force Microscope –different imaging modes, comparison of SEM and TEM, AFM and STM, AFM and SEM.

Basic principles of working of X-ray diffraction, derivation of Debye-Scherrer equation, numericals on Debye Scherrer equation, Optical Spectroscopy- Instrumentation and application of IR, UV/VIS (Band gap measurement)

### Module-3(07 hours of pedagogy)

#### Carbon Based Materials

Introduction, Synthesis, Properties (electrical, Electronic and Mechanical), and Applications of Graphene, SWCNT, MWCNT, Fullerenes and other Carbon Materials: Carbon nanocomposites, nanofibres, nanodiscs, nanodiamonds.

### Module-4(07 hours of pedagogy)

**Nanotechnology in Energy storage and conversion**

Solar cells: First generation, Second generation and third generation solar cells: Construction and working of Dye sensitized and Quantum dot sensitized solar cells.

Batteries: Nanotechnology in Lithium ion battery- working, Requirements of anodic and cathodic materials, classification based on ion storage mechanisms, limitations of graphite anodes, Advances in Cathodic materials, Anodic materials, Separators

Fuel Cells: Introduction, construction, working of fuel cells and nanotechnology in hydrogen storage and proton exchange membranes

**Self study for lifelong learning:**

Super capacitors: Introduction, construction and working of supercapacitor

**Module-5 (07 hours of pedagogy)****Applications of Nanotechnology**

Nanotech Applications and Recent Breakthroughs: Introduction, Significant Impact of Nanotechnology and Nanomaterial, Medicine and Healthcare Applications, Biological and Biochemical Applications (Nano biotechnology), Electronic Applications (Nano electronics), Computing Applications (Nano computers), Chemical Applications (Nano chemistry), Optical Applications (Nano photonics), Agriculture and Food Applications, Recent Major Breakthroughs in Nanotechnology.

**Self study for lifelong learning:**

Nano coatings (Photocatalysts) and super hydrophobic coatings (Lotus effect)

**Course outcome (Course Skill Set)**

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

CO1	Demonstrate the synthesis of nanoparticles by various techniques. [L2]
CO2	Explain working of basic instruments used in characterization of nanoparticles. [L2]
CO3	Discuss the application of nanotechnology to mechanical and civil domains [L2]
CO4	Classify the nanomaterials based on the dimensions. [L3]
CO5	Assess the suitability of nanomaterials for various device applications. [L4]

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). The minimum passing mark for the SEE is 35% of the maximum marks (18 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/

course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation(CIE):**

Three Tests each of 20 Marks;

- 1<sup>st</sup>, 2<sup>nd</sup>, and 3<sup>rd</sup> tests shall be conducted after completion of the syllabus of 30-35%,70-75%, and 90-100% of the course/s respectively.

- Assignments/Seminar/quiz/group discussion /field survey & report presentation/ course project/Skill development activities, suitably planned to attain the COs and POs for a total of 40 Marks.

If the nature of the courses requires assignments/Seminars/Quizzes/group discussion two evaluation components shall be conducted. If course project/field survey/skill development activities etc then the evaluation method shall be one.

Total CIE marks (out of 100 marks) shall be scaled down to 50 marks

### **Semester End Examination (SEE):**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject **(duration 03 hours)**

- The question paper shall be set for 100 marks. The medium of the question paper shall be English). The duration of SEE is 03 hours.
- The question paper will have 10 questions. Two questions per module. Each question is set for 20 marks. The students have to answer 5 full questions, selecting one full question from each module. The student has to answer for 100 marks and **marks scored out of 100 shall be proportionally reduced to 50 marks.**
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

### **Suggested Learning Resources:**

#### **Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)**

1. Nano Materials – A.K. Bandyopadhyay/ New Age Publishers
2. Nanocrystals: Synthesis, Properties and Applications – C.N.R. Rao, P. John Thomas and G. U. Kulkarni, Springer Series in Materials Science
3. Nano Essentials- T. Pradeep/TMH
4. Peter J. F. Harris, Carbon nanotube science: synthesis, properties, and applications. Cambridge University Press, 2011
5. M.A. Shah, K.A. Shah, “Nanotechnology: The Science of Small”, Wiley India, ISBN 13: 9788126538683

#### **Reference Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)**

1. Introduction to Nanotechnology, C. P. Poole and F. J. Owens, Wiley, 2003
2. Understanding Nanotechnology, Scientific American 2002
3. Nanotechnology, M. Ratner and D. Ratner, Prentice Hall 2003
4. Nanotechnology, M. Wildon, K. Kannagara, G. Smith, M. Simmons and B. Raguse, CRC Press Boca Raton 2002
5. Recent reviews on Li-ion batteries, solar cells and fuel cells

#### **Web links and Video Lectures (e-Resources):**

- <https://nptel.ac.in/courses/118104008>
- <https://www.digimat.in/nptel/courses/video/118104008/L16.html>
- <https://archive.nptel.ac.in/courses/113/106/113106099/>
- <https://nptel.ac.in/courses/112107283>
- [https://onlinecourses.nptel.ac.in/noc22\\_me131/preview](https://onlinecourses.nptel.ac.in/noc22_me131/preview)

**Practical Based learning (Any 5 experiments x 2 hours = 10 practical hours)**

- Preparation of silver nanoparticles and characterization of particle size by optical spectroscopy
- Preparation of ZnO nanoparticles by combustion technique
- Preparation of Al<sub>2</sub>O<sub>3</sub> nanoparticles by precipitation method
- Preparation of Silica nanoparticles by sol-gel method
- Preparation of metal oxide nanoparticles by hydrothermal method
- Determination of thermal conductivity of nanofluids using a thermal analyser
- Preparation of thin films by SILAR method
- Determination of Band gap of given material using Tauc plot

**COs and POs Mapping (Individual teacher has to fill up)**

COs	POs											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	3	3	2						2	1		
CO2	3	3	2									
CO3	3	3										
CO4	3	3							2	1		2
CO5	3	3							2	1		2

Level 3-

**Highly Mapped, Level 2-Moderately Mapped, Level 1-Low Mapped, Level 0- Not Mapped**