Maharashtra State Board Of Technical Education, Mumbai

Teaching And Examination Scheme For Post S.S.C. Diploma Courses

Program Name : Diploma in Electronics & Tele-Communication, Diploma in Electronics, Diploma in Communication Technology, Diploma in Communication Engineering,Diploma in Electronics Engineering

Program Code : EJ/EN/EQ/ET/EX | **With Effect From Academic Year: 2017 - 18**

Duration of Program : 6 Semesters | **Duration : 16 Weeks**

Semester : Sixth | **Scheme - I**

S. N.	Course Title	Course Abbreviation	Course Code	Teaching Scheme			Credit (L+T+P)	Examination Scheme														Grand Total
								Theory							Practical							
								Exam Duration in Hrs.	ESE		PA		Total		ESE		PA		Total			
				L	T	P			Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks		
1	Management	MAN	22509	3	-	-	3	90 Min	70*#	28	30*	00	100	40	--	--	--	--	--	--		100
2	Computer Networking and Data Communication	CND	22634	3	-	2	5	3	70	28	30*	00	100	40	25#	10	25	10	50	20		150
3	Emerging Trends in Electronics	ETE	22636	3	-	-	3	90 Min	70*#	28	30*	00	100	40	--	--	--	--	--	--		100
4	**Elective – II (Select Any One)**																					
	Mechatronics	MEC	22643	3	-	2	5	3	70	28	30*	00	100	40	25@	10	25	10	50	20		150
	Optical Network and Satellite Communication	ONS	22647	3	-	2	5	3	70	28	30*	00	100	40	25@	10	25	10	50	20		150
5	Entrepreneurship Development	EDE	22032	2	-	2	4	--	--	--	--	--	--	--	50@	20	50~	20	100	40		100
6	Capstone Project - Execution & Report Writing	CPE	22060	-	-	4	4	--	--	--	--	--	--	--	50#	20	50~	20	100	40		100
7	VLSI with VHDL	VWV	22062	2	-	2	4	--	--	--	--	--	--	--	25#	10	25	10	50	20		50
			Total	**16**	**-**	**12**	**28**	--	**280**	--	**120**	--	**400**	--	**175**	--	**175**	--	**350**	--		**750**

Student Contact Hours Per Week: **28 Hrs.** Medium of Instruction: **English**

Theory and practical periods of 60 minutes each. Total Marks : **750**

Abbreviations: ESE- End Semester Exam, PA- Progressive Assessment, L - Lectures, T - Tutorial, P - Practical

@ Internal Assessment, # External Assessment, *# On Line Examination, ^ Computer Based Assessment

* Under the theory PA, Out of 30 marks, 10 marks are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the cognitive domain LOs required for the attainment of the COs.

~ For the courses having ONLY Practical Examination, the PA marks. Practical Part - with 60% weightage and Micro-Project Part with 40% weightage

- **If Candidate not securing minimum marks for passing in the "PA" part of practical of any course of any semester then the candidate shall be declared as "Detained" for that semester.**

Program Name : **Diploma in Automobile Engineering / Civil Engineering Group / Electronics Engineering Group / Diploma in Plastic Engineering / Diploma in Production Engineering /Diploma in Fashion & Clothing Technology/ Computer Engineering Group**

Program Code : **AE/CE/CR/CS/ DE/EJ/ET/EN/EX/EQ/IS/IC/IE/PG/PT/DC/ CO/CM/CW/IF**

Semester : **Sixth**

Course Title : **Management**

Course Code : **22509**

1. RATIONALE

An engineer has to work in industry with human capital and machines. Therefore, managerial skills are essential for enhancing their employability and career growth. This course is therefore designed to provide the basic concepts in management principles, safety aspects and Industrial Acts.

2. COMPETENCY

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Use relevant managerial skills for ensuring efficient and effective management.**

3. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

a. Use basic management principles to execute daily activities.
b. Use principles of planning and organising for accomplishment of tasks.
c. Use principles of directing and controlling for implementing the plans.
d. Apply principles of safety management in all activities.
e. Understand various provisions of industrial acts.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme													
				Theory								Practical					
				Paper Hrs.	ESE		PA		Total			ESE		PA		Total	
L	T	P			Max	Min	Max	Min	Max	Min		Max	Min	Max	Min	Max	Min
3	-	-	3	90 Min	70*#	28	30*	00	100	40		--	--	--	--	--	--

(*#) Online Theory Examination.

(*): Under the theory PA, Out of 30 marks, 10 marks are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the cognitive domain TLOs required for the attainment of the Cos.(#): Online examination*

Legends: ***L****-Lecture;* ***T*** *– Tutorial/Teacher Guided Theory Practice;* ***P*** *- Practical;* ***C*** *– Credit,* ***ESE*** *- End Semester Examination;* ***PA*** *- Progressive Assessment*

5. COURSE MAP (with sample COs, PrOs, UOs, ADOs and topics)

This course map illustrates an overview of the flow and linkages of the topics at various levels of outcomes (details in subsequent sections) to be attained by the student by the end of the course, in all domains of learning in terms of the industry/employer identified competency depicted at the centre of this map.

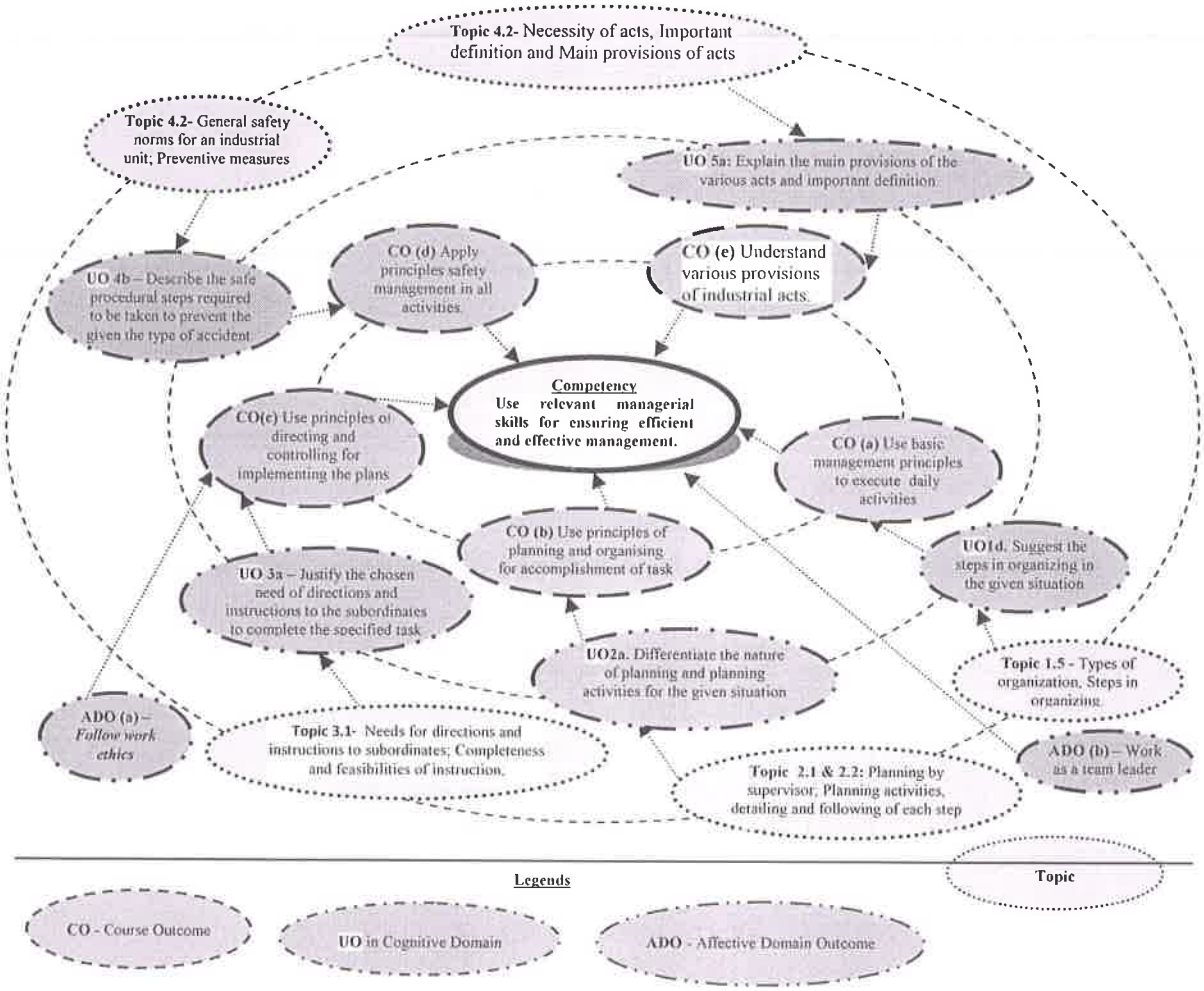


Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

- Not applicable -

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

- Not applicable -

8. UNDERPINNING THEORY COMPONENTS

The following topics are to be taught and assessed in order to develop the sample UOs given below for achieving the COs to attain the identified competency. More UOs could be added.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit – I Introduction to management concepts and managerial skills	1a. Differentiate the concept and principles of management for the given situation. 1b. Explain functions of management for given situation. 1c. Compare the features of the given types of planning 1d. Suggest the steps in organizing in the given situation. 1e. Suggest suitable type of organization for the given example. 1f. Identify the functional areas of management for the given situation 1g. Suggest suitable managerial skills for given situation with justification	1.1 Definitions of management, role and importance of management. 1.2 Management characteristics and principles, levels of management and their functions; management, administration and organization, relation between management and administration. 1.3 Functions of management: planning, organizing, leading/directing, staffing and controlling. 1.4 Types of planning and steps in planning 1.5 Types of organization, Steps in organizing 1.6 Functional areas of management. 1.7 Managerial skills.
Unit – II Planning and organizing at supervisory level	2a. Differentiate the nature of planning and planning activities for the given situation. 2b. Suggest the step wise procedure to complete the given activity in the shop floor. 2c. Prepare materials and manpower budget for the given production activity. 2d. Describe with block diagrams the organization of the physical resources required for the given situation. 2e. Describe the human needs to satisfy the job needs for the specified situation. 2f. List the tasks to be done by the concerned individuals for completing the given activity.	**Planning at supervisory level** 2.1 Planning by supervisor. 2.2 Planning activities, detailing and following of each step. 2.3 Prescribing standard forms for various activities. 2.4 Budgeting for materials and manpower. **Organizing at supervisory level** 2.5 Organizing the physical resources. 2.6 Matching human need with job needs. 2.7 Allotment of tasks to individuals and establishing relationship among persons working in a group
Unit– III Directing and Controlling at supervisory level	3a. Justify the chosen need of directions and instructions to the subordinates to complete the specified task. 3b. Select the feasible set of instructions to complete the given simple task, with justification 3c. Predict the possible mistakes for completing the given simple activity. 3d. Describe the managerial control	**Directing at supervisory level** 3.1 Needs for directions and instructions to subordinates; Completeness and feasibilities of instructions 3.2 Personal counselling advanced predictions of possible mistakes. 3.3 Elaborating decisions, laying disciplinary standards in overall working **Controlling at supervisory level**

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	actions and remedial measures required to be taken for completing the given task successfully.	3.4 Managerial control; Understanding team and link between various departments in respect of process and quality standards; Steps in control process 3.5 Controlling methods; Control over the performance in respect of quality, quantity of production, time and cost. Measuring performance, comparing with standards, correcting unfavorable deviations.
Unit – IV Safety Management	4a. State the general safety norms required to be taken in the given case. 4b. Suggest preventive measures of plant activities in the given situation. 4c. Describe the safe procedural steps required to be taken to prevent the given the type of accident. 4d. Prepare a work permit in to conduct the given maintenance activity. 4e. Explain the causes of the specified type of accident in the given situation. 4f. Prepare the specifications of the firefighting equipment required for the given type of fire.	4.1 Need for safety management measures 4.2 General safety norms for an industrial unit; Preventive measures. 4.3 Definition of accident, types of industrial accident; Causes of accidents; 4.4 Fire hazards; Fire drill. 4.5 Safety procedure 4.6 Work permits.
Unit – V Legislative Acts	5a. Explain the purpose of the act 5b. Explain the main provisions of the various acts and important definition.	5.1 Necessity of acts, Important definition and Main provisions of acts. 5.2 Industrial Acts: a. Indian Factory Act b. Industrial Dispute Act c. Workman Compensation Act d. Minimum Wages Act

***Note**: To attain the COs and competency, above listed UOs need to be undertaken to achieve the 'Application Level' and above of Bloom's 'Cognitive Domain Taxonomy'*

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Introduction to management	12	06	06	04	16

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
	concepts and managerial skills					
II	Planning and organizing at supervisory level	08	04	06	04	14
III	Directing and controlling at supervisory level	08	04	06	04	14
IV	Safety Management	08	04	06	04	14
V	Legislative Acts	12	02	06	04	12
Total		**48**	**20**	**30**	**20**	**70**

Legends: *R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)*
Note*: This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.*

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Write assignments based on the theory taught in classrooms. Assignments consist of ten questions having long answers including charts, symbols, drawing, observations etc.
b. Prepare/Download information about various industrial acts.
c. Visit to any Manufacturing industry and prepare a report consisting of:
   i. Organization structure of the organization/ Dept.
   ii. Safety measures taken in organization.
   iii. Mechanism to handle the disputes.
   iv. Any specific observation you have noticed.
d. Give seminar on relevant topic.
e. Undertake micro-projects.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. ***'L' in item No. 4*** does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
c. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
d. With respect to item No.10, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
e. Guide student(s) in undertaking micro-projects.
f. Demonstrate students thoroughly before they start doing the practice.

g. Encourage students to refer different websites to have deeper understanding of the subject.
h. Observe continuously and monitor the performance of students in Lab.

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project are group-based. However, in the fifth and sixth semesters, it should be preferably be ***individually*** undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than ***16 (sixteen) student engagement hours*** during the course. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

A suggestive list of micro-projects are given here. Similar micro-projects could be added by the concerned faculty:

a. Study of management principles applied to a small scale industry.
b. Study of management principles applied to a medium scale industry.
c. Study of management principles applied to a large scale industry.
d. Prepare case studies of Safety measures followed in different types of organization.
e. Study of measures to be taken for ensuring cyber security.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Management and entrepreneurship	Veerabhadrappa, Havinal	New age international publishers, New Delhi, 2014: ISBN: 978-81-224-2602-1
2	Principles of management	Chaudhry omvir Singh prakash	New Age international publishers, 2012, New Delhi ISBN: 978-81-224-3039-4
3	Industrial Engineering and management	Dr. O. P. Khanna	Dhanpath ray and sons, New Delhi
4	Industrial Engineering and management	Banga and Sharma	Khanna Publication, New Delhi

14. SUGGESTED SOFTWARE/LEARNING WEBSITES

a. https://www.versesolutions.com/
b. https://www.books.google.co.in/books?isbn=817758412X
c. https://www. www.educba.com › Courses › Business › Management

Program Name : **Electronics Engineering Programme Group**

Program Code : **DE/EJ/ET/EN/EX/EQ**

Semester : **Sixth**

Course Title : **Computer Networking and Data Communication**

Course Code : **22634**

1. RATIONALE

Data communication deals with the transmission of digital data through a network. Many applications like Airline Reservations, Railway reservations, e-banking, e-governance, Online Shopping, e-learning can be managed by a single click. Diploma Engineers should be able to select, classify, install, troubleshoot and maintain different industrial data communication networks. This course gives the important concepts and techniques related to data communication and enable students to maintain and troubleshoot computer networks.

2. COMPETENCY

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Maintain computer network systems.**

3. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

a. Maintain wired computer network topologies.
b. Use the relevant network model for the specified data communication system.
c. Maintain relevant transmission medium and modem for data transmission.
d. Analyze error detection/correction and flow control of data in the data network.
e. Configure the network component and assign IP address.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme													
				Theory							Practical						
				Paper Hrs.	ESE		PA		Total		ESE		PA		Total		
L	T	P			Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
3	-	2	5	3	70	28	30*	00	100	40	25#	10	25	10	50	20

(*): Under the theory PA, Out of 30 marks, 10 marks are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the cognitive domain UOs required for the attainment of the COs.

***Legends:** L-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** - Practical; **C** – Credit, **ESE** - End Semester Examination; **PA** - Progressive Assessment*

5. COURSE MAP (with sample COs, PrOs, UOs, ADOs and topics)

This course map illustrates an overview of the flow and linkages of the topics at various levels of outcomes (details in subsequent sections) to be attained by the student by the end of the course, in all domains of learning in terms of the industry/employer identified competency depicted at the centre of this map..

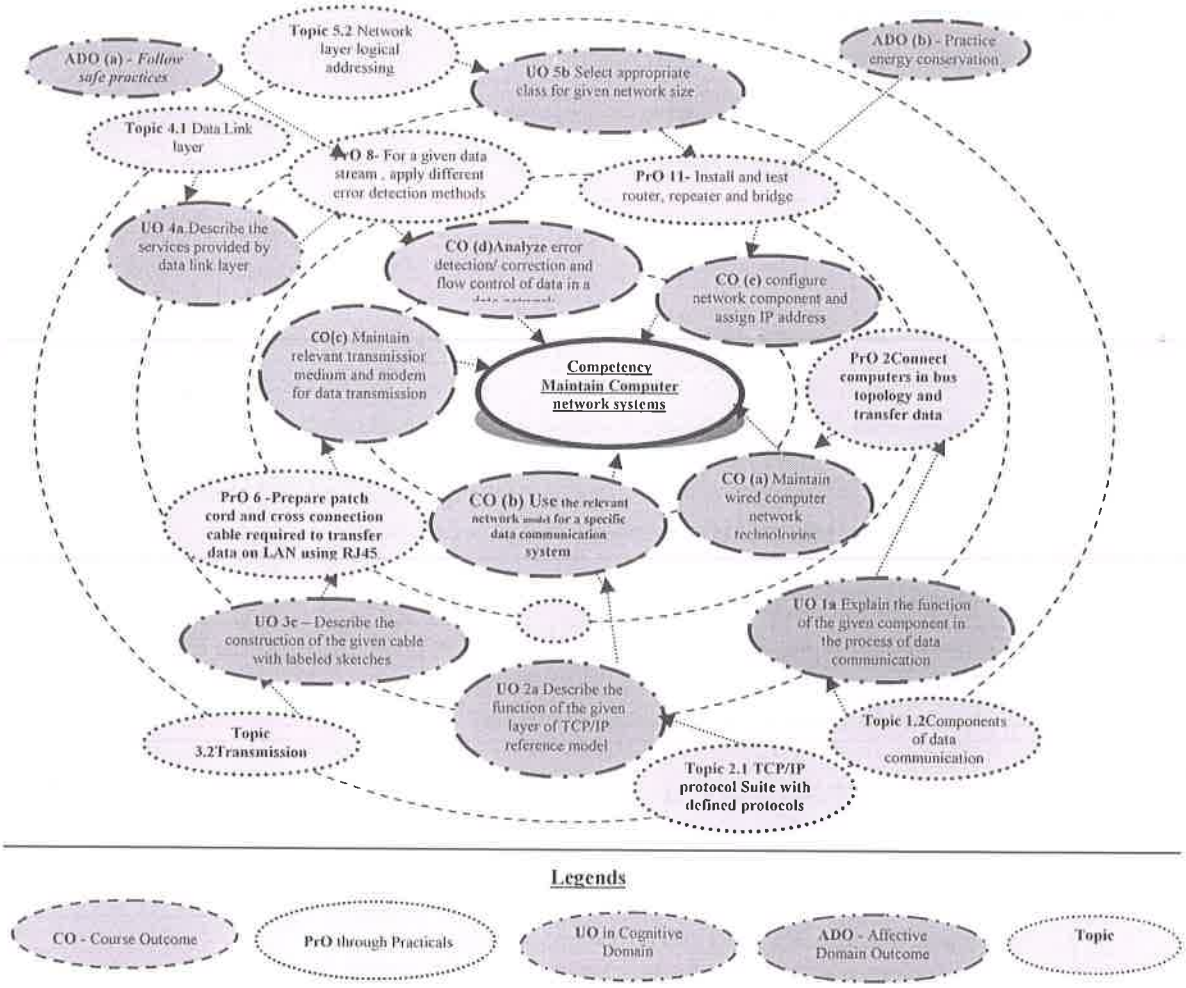


Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

The practicals in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency.

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1	Analyse the type of network topology used in your lab and prepare technical specifications for it.	I	02*
2	Connect computers in bus topology and transfer the data.	I	02
3	Connect computers in star topology and test the performance.	I	02*
4	Install/configure/Test Peer to Peer LAN and sharing of resources.	I	02*
5	Configure Point to Point network in laboratory.	I	02
6	Prepare patch cord and cross connection cables, use to connect the devices on the LAN.	III	02*
7	Using a Hub/ Switch Install a LAN network consisting of 6 computers	III	02
8	Locate the error bit in the given data stream by applying the different error detection methods.	IV	02*
9	Correct the error in a given data stream by applying the different error correction methods.	IV	02
10	Use route command to test the performance of the given network.	V	02

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
11	Install and test Router, Repeater and Bridge	V	02*
12	Assign IP address to the PC connected to the internet.	V	02*
13	Configure/Test Internet connectivity.	V	02*
14	Use FTP protocol to transfer file from one system to another system.	V	02*
15	Install and configure a Firewall for the network security.	V	02
16	Interconnect two PCs using RS232 cable and transfer data as null modem configuration.	V	02
	Total		**32**

Note

i. *A suggestive list of* **PrOs** *is given in the above table. More such PrOs can be added to attain the COs and competency. A judicial mix of minimum 12 or more practical need to be performed, out of which, the practicals marked as '*' are compulsory, so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry.*

ii. *The 'Process' and 'Product' related skills associated with each PrO is to be assessed according to a suggested sample given below:*

S. No.	Performance Indicators	Weightage in %
1	Preparation of experimental setup.	20
2	Setting and operation.	20
3	Safety measures.	10
4	Observation and recording.	10
5	Interpretation of result and conclusion.	20
6	Answer to sample questions.	10
7	Submission of report in time.	10
	Total	**100**

The above PrOs also comprise of the following social skills/attitudes which are Affective Domain Outcomes (ADOs) that are best developed through the laboratory/field based experiences:

a. Follow safety practices.
b. Practice good housekeeping.
c. Demonstrate working as a leader/a team member.
d. Maintain tools and equipment.
e. Follow ethical Practices.

The ADOs are not specific to any one PrO, but are embedded in many PrOs. Hence, the acquisition of the ADOs takes place gradually in the student when s/he undertakes a series of practical experiences over a period of time. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

- 'Valuing Level' in 1st year
- 'Organizing Level' in 2nd year

- 'Characterizing Level' in 3rd year.

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of experiments, as well as aid to procure equipment by authorities concerned.

S. No.	Equipment Name with Broad Specifications	PrO. S. No.
1	Client Machines (Computers with windows / Linux and latest configuration) with Printer: Laser jet	1 to 15
2	Network Tool kit: clamping, crimping tool, network tester, line tester	1 to 15
3	Network Accessories: RJ 45, UTP cable, T connector, Optical Fiber, Coaxial Cable, Modem, various connectors, 1000Mbps NIC.	1 to 15
4	UPS system 6KVA online.	1 to 15
5	Router, Repeater, Bridges: Latest configuration	10,11
6	Computer Hub 8/ 16 node with console port	1 to 15
7	Modem – Latest configuration	13
8	Ethernet Switch 4/8/16/24/32	1 to 15
9	LAN Cable (CAT6, CAT5)	1 to 15
10	Coaxial Cable, UTP Cable, STP Cable, Fiber Optic Cable	1 to 15
11	Firewall with high security and high storage	14,15
12	MS office latest version	1 to 15
13	Antivirus Software (online protection with firewall securities)	1 to 15
14	RS 232 cable and connector	16

8. UNDERPINNING THEORY COMPONENTS

The following topics are to be taught and assessed in order to develop the sample UOs given below for achieving the COs to attain the identified competency. More UOs could be added.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit – I Fundamentals of Data Communication and network topology	1a. Explain the function of the given component in the process of data Communication. 1b. Describe the given data transmission method with its frame format 1c. Explain the given source of noise and its effect 1d. Design computer network considering particular topology. 1e. Classify networks on the basis of the given parameter.	1.1 **Data communication and its characteristics** 1.2 **Components of data communication** Transmitter, Receiver, Medium, Message, Protocol. Standards, Standard organizations. Basic block diagram of data communication system 1.3 **Data Transmission**: Serial, Parallel Synchronous, Asynchronous, Isochronous transmission 1.4 **Transmission characteristics**: Signaling rate, data rate, bit rate, baud rate 1.5 Need of computer networks, Network criteria, advantages of networking 1.6 **Network topologies**: Mesh, Star, Bus, Tree, Ring and Hybrid topologies - Schematic diagram, working, advantages, disadvantages and applications 1.7 **Network Classification: Based on Transmission Technologies:**

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
		Point to-point, Multipoint, Broadcast **Based on physical size(scale)**: PAN, BAN, LAN, MAN, WAN,VPN **Based on Architecture**: Peer to Peer, Client Server, advantages of Client Sever over Peer-to-Peer Model.
Unit– II Network Models	2a. Describe the function of the given layer of TCP/IP Reference model. 2b. Explain the relationship of layers with addresses in TCP/IP. 2c. Differentiate between various addressing schemes in TCP/IP. 2d. Describe the functions of the given layer of OSI Reference model.	2.1 **TCP/IP protocol suite** with define protocols in respective Layers: Physical layer, Data Link Layer, Network Layer, Transport Layer, Application Layer 2.2 **Addressing in TCP/IP**: Physical, logical, Port and specific 2.3 **The ISO-OSI model**: Physical layer, Data Link Layer, Network Layer, Transport Layer, Session Layer, Presentation Layer, Application Layer.
Unit– III Physical layer	3a. Describe the principle of given multiplexing technique. 3b. Select the transmission media for transmitting given signal for the given application. 3c. Describe the construction of the given cable with labeled sketches. 3d. Compare different types of Transmission medium on the basis of given parameter 3e. Explain with sketches the working of the given type of modem 3f. Compare different Multiplexing/Switching techniques on the basis of the given parameters.	3.1 **Multiplexing**: Basic concept, Frequency-Division Multiplexing, Wavelength-Division Multiplexing, Synchronous Time-Division Multiplexing, Statistical Time- Division Multiplexing 3.2 **Transmission medium:** classification based on electromagnetic wave spectrum 3.3 **Guided Media** -Twisted pair (UTP,STP) cable -connector, Coaxial cable - connector, Fiber-optic cable - connector, performance and applications 3.4 **Unguided Media**-Radio waves, microwaves, Infrared and their applications 3.5 **Modems**: classifications : Broadband modem, DSL –ADSL,HDSL,VDSL 3.6 **Switching**: Circuit-switched networks, Packet switched networks –Datagram approach, virtual circuit approach.
Unit– IV Data link layer	4a. Describe the services provided by Data Link Layer. 4b. Describe the technique of the given error control method with examples. 4c. Explain with sketches the given type of flow	4.1 **Data link layer**: Flow and Error control 4.2 **Error control** : Types of errors : single bit and Burst errors Error detection and correction –Hamming code, linear block code, CRC, checksum 4.3 **Flow control**: Framing, Flow and Error control, Noiseless and Noisy Channels – stop-and-wait protocol, Stop and wait

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	control used in the data link layer with justification. 4d. Compare characteristics of given type of Protocol. 4e. Select the appropriate protocol for error free transmission of given data	ARQ protocol 4.4 **Sliding window protocol**: One bit sliding window protocol, Go-Back-N ARQ, Selective Repeat ARQ 4.5 **Point to point Protocol**: service provided by PPP, Frame format PPP and Transition phases of PPP.
Unit– V Network, Transport and Application layer	5a. Justify the function of the given network device. 5b. Select appropriate class for given network size. 5c. Differentiate between class full and class less addressing 5d. Explain the role of NAT in address depletion. 5e. Explain the given type of Routing. 5f. Describe the services provided by transport layer/ network layer/Application layer. 5g. Describe the given type of network security technique.	5.1 **Network devices:** Repeater, Hub, Bridge, Switches , Router, Gateway 5.2 **Network layer Logical addressing**: IPv4 Addresses: address space Notations, classful and classless addressing, Network address translation(NAT), IPv6 addresses, Need for IPv6, Structure and address space 5.3 **Network layer-Multicast Routing Protocols :**Unicast, Multicast and Broadcast routing and applications **Transport Layer**: Process to process delivery, UDP,RTP and SCTP: ports, format, operation and uses 5.4 **Application Layer services**: Concept of DNS, FTP, 5.5 **Network security**: Cryptography: it's Components, Block diagram of symmetric and asymmetric cryptography 5.6 **Security services**: concepts of message and entity security services, Firewall.

Note: To attain the COs and competency, above listed UOs need to be undertaken to achieve the 'Application Level' and above of Bloom's 'Cognitive Domain Taxonomy'

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Fundamentals of Data Communication and network topology	12	02	08	06	16
II	Network Models	08	--	04	08	12
III	Physical layer	08	04	04	06	14
IV	Data link layer	08	-	04	08	12
V	Network, Transport, Application layer	12	02	06	08	16
Total		**48**	**08**	**26**	**36**	**70**

Legends: *R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)*
Note*: This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.*

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Prepare journals based on practical performed in laboratory.
b. Follow the safety precautions.
c. Prepare specifications of a given communication medium.
d. Test the performance of HUB, Switches, router and Servers.
e. Library / Internet survey of computer network and data communication.
f. Prepare power point presentation or animation for understanding different switching networks.
g. Prepare a presentation on TCP/IP reference model and the OSI reference network model
h. Visit to any industry to observe the different networks.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various learning outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. ***'L' in item No. 4*** does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
c. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
d. With respect to item No.10, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***..
e. Video programs/YouTube may be used to teach various topics and sub topics.
f. Demonstrate students thoroughly before they start doing the practice.
g. Encourage students to refer different book and websites to have deeper understanding of the subject.
h. Observe continuously and monitor the performance of students in Lab.
i. Encourage students to use front/rear panel control of electronic instruments.
j. Encourage students to visit nearby electronic instruments repair workshop units or manufacturing industries.
k. Instruct students to safety concern of handling electronic instruments and also to avoid any damage to the electronic instruments.

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student assigned to him/her in the
Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project are group-based. However, in the fifth and sixth semesters, it should be preferably be ***individually*** undertaken to build up the skill and confidence in every student to become problem solver so

that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than ***16 (sixteen) student engagement hours*** during the course. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:

a. A network proposal has to be developed for a bank. The bank has a main office, which is located in London, and has 5 branch offices located at Paris, California, Mumbai ,Dubai and Singapore. The bank has an application server, which is used by its customers across the world for online transactions. All the branches have high speed internet connection. There are approximately 100 users in each of the branch offices and 200 users in the main office.
b. Prepare a proposal to develop a network system that links two branch offices of an organization. The two branches are separated by a distances of 10 Km. Make appropriate assumption while preparing the proposal.
c. Interconnect two PCs using RS232 cable. Write the step by step procedure to transfer a file from one computer to another computer through RS232 link and implement .
d. Prepare a hardware specification required to develop a wireless LAN for a cyber-cafe for 20 users.
e. Develop a Bluetooth network of 5 devices namely laptop, mobile phone, speaker, keyboard, printer (piconet) and transfer files from one device to another. Configure your laptop / mobile as a hot spot for internet access.
f. Prepare a detailed report on application of computer network in a Mall / railway reservation system.
g. Visit a CISCO based laboratory/ any other networking laboratory and prepare a report of the various networking equipments and the networking facility

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Computer Networks.	Tanenbaum, A.S	Pearson Education, New Delhi, India, Fourth Edition, 2011 ISBN : 9788131787571
2	Data Communication and Networking	Forouzan, Behrouz A	McGraw Hill, Education New Delhi, 2015; ISBN 9780072967753
3	Introduction to Data Communications and Networking	Tomasi, W.	Pearson Education, New Delhi, India, 2007 ISBN : 9788131709306
4	Data and Computer Communications	Stallings, W.	Prentice Hall India,10 th Edition, 2013 ISBN : 9780133506488
5	Data Communications and Networks	Godbole, A.S. ; Kahate, A.	Tata McGraw Hill, New Delhi, India, Second Edition, 2011 ISBN (13) : 9780071077705
6	Computer Networks	Kurose, James F. ; Ross, Keith W.	Pearson Education, New Delhi, India, Third Edition, 2011 ISBN : 9788177588781

S. No.	Title of Book	Author	Publication
7	Data Communications and Computer Networks	ISRD Group	Tata McGraw Hill, New Delhi, India, First Edition, 2006 ISBN (13) : 9780070616820

14. SUGGESTED SOFTWARE/LEARNING WEBSITES

a. https://www.youtube.com/watch?v=hAopORgAcbQ
b. nptel.ac.in/courses/106105081/2
c. https://www.ics.uci.edu/~magda/Courses/netsys270/ch1_v1.pp
d. https://www.ics.uci.edu/~magda/Courses/netsys270/ch2_v1.ppt
e. https://www.youtube.com/watch?v=gJ5h4_0mllI
f. https://www.tutorialspoint.com/principles_of_communication/principles_of_communication_multiplexing.htm
g. https://www2.rivier.edu/faculty/vriabov/CS553_ST7_Ch08-Multiplexing.pp
h. https://www.ics.uci.edu/~magda/Courses/netsys270/ch6_1_v1.ppt
i. https://www.ics.uci.edu/~magda/Courses/netsys270/ch7_1_v1.ppt
j. nptel.ac.in/courses/106105082/19
k. nptel.ac.in/courses/106105082/17
l. http://www.nptel.iitm.ac.in/courses
m. nptel.ac.in/courses/106106157/52

Program Name : **Electronics Engineering Programme Group**

Program Code : **DE/EJ/ET/EN/EX/EQ/IE/IS/IC/**

Semester : **Sixth**

Course Title : **Emerging Trends in Electronics**

Course Code : **22636**

1. RATIONALE

Every technological area is developing at an exponential rate. New applications are coming up and it is mandatory for all technologists to be well versed in these developments to survive and provide satisfactory and quality services to the society and industry. This course aims to prepare the diploma graduates to be conversant with such emerging trends. The main areas in which such developments are encompass Smart systems, Digital Factory and Communication. The course gives an introduction of these areas and helps the students to apply emerging trends.

2. COMPETENCY

Aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Use the trending practices in Electronics fields.**

3. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

a) Suggest the relevant computing systems/processor for specific type of application.
b) Suggest the relevant components for the emerging application/s.
c) Suggest different telecom network for given application.
d) Suggest the relevant IoT technologies for Digital Factory.
e) Suggest the different electronic systems for smart world.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme													
				Theory							Practical						
				Paper Hrs.	ESE		PA		Total		ESE		PA		Total		
L	T	P			Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	
3	-	-	3	90 Min	70*#	28	30*	00	100	40	--	--	--	--	--	--	

(*): Under the theory PA, Out of 30 marks, 10 marks are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the cognitive domain UOs required for the attainment of the Cos(#): On Line ESE*

***Legends: L**-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** -Practical; **C** – Credit, **ESE** –End Semester Examination; **PA** - Progressive Assessment **#**-External Assessment*

5. COURSE MAP (with sample COs, UOs, ADOs and topics)

This course map illustrates an overview of the flow and linkages of the topics at various levels of outcomes (details in subsequent sections) to be attained by the student by the end of the course, in all domains of learning in terms of the industry/employer identified competency depicted at the centre of this map.

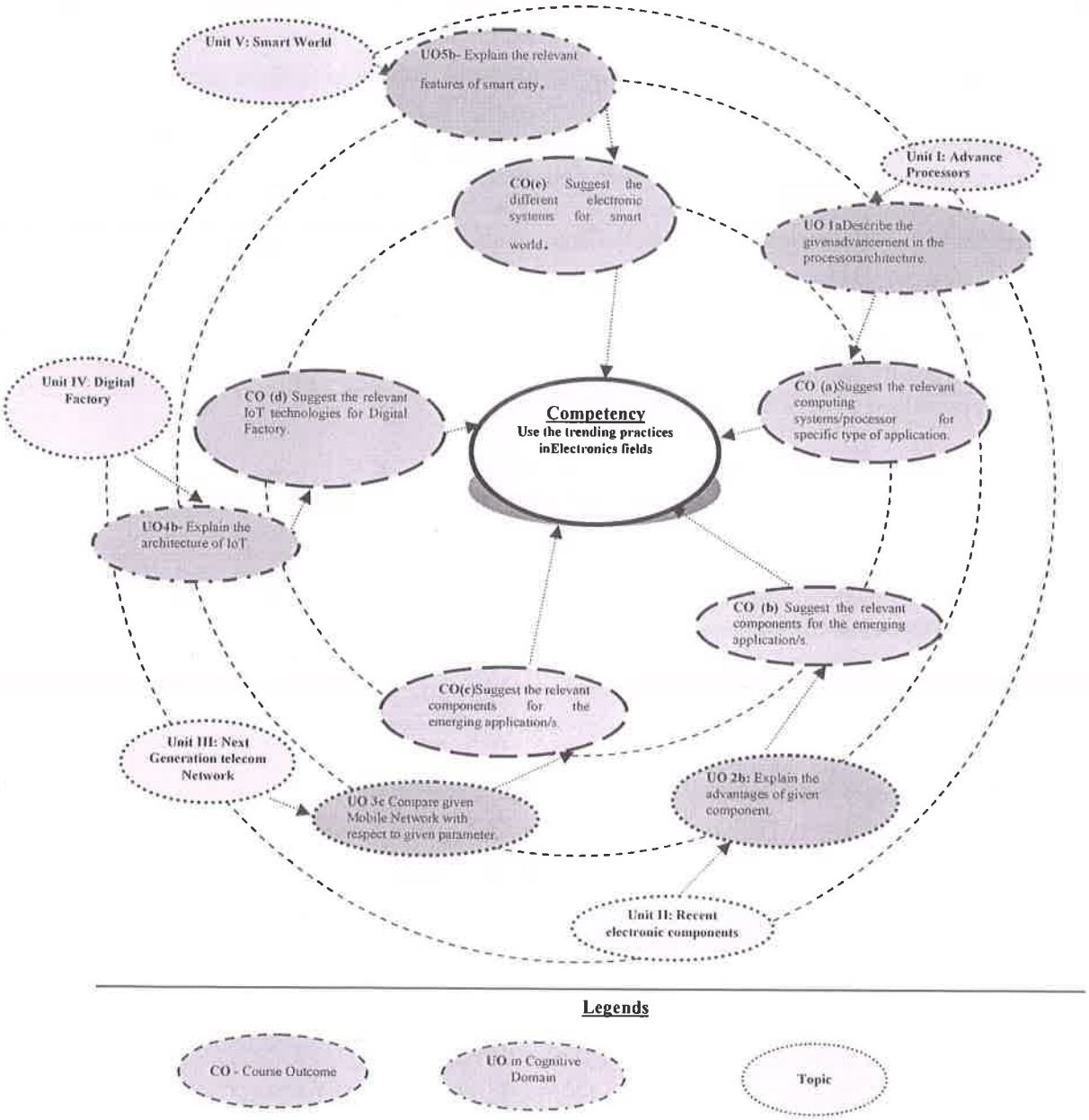


Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES: Not Applicable

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED: Not Applicable

8. UNDERPINNING THEORY COMPONENTS

The following topics are to be taught and assessed in order to develop the sample UOs given below for achieving the COs to attain the identified competency. More UOs could be added.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit– I Advance Processors	1a. Describe the given advancement in the processor architecture. 1b. Describe the given features of Arduino board. 1c. Describe the given function in Arduino IDE. 1d. Describe the given feature of the ARM7 processors. 1e. Compare the given salient features of ARM 7 and ARM 7TDMI processors.	1.1 Advances in processor architecture: RISC, Pipelining and Superscalar concepts, advantages and Applications. 1.2 Arduino: Introduction, Compatible R2/R3 Uno board Features. Atmega 328: Introduction, pin description. 1.3 Arduino IDE: Features, Sketch: C,C++ functions setup(), loop(), pinMode(), digitalWrite(), digitalRead() and delay() 1.4 Arduino Interfacing: LED, Relay, DC motor. 1.5 ARM: Introduction, Features of ARM7 and ARM7TDMI, advantages, applications. Versions of ARM processor only features.
Unit – II Recent Electronic Components	2a. State features of given component. 2b. Explain the advantages of given component. 2c. Explain the concept of SMD and soldering method	2.1 Flexible PCB: Features and Applications 2.2 Battery [Li-ion, nuclear] :Concepts and Applications 2.3 Memristor, Organic LED: Concepts, Features and Applications 2.4 Surface Mount Device: Concepts, advantages, Applications and Reflow soldering method.
Unit– III Next Generation telecom Network	3a. Explain the function of given Network components. 3b. Describe the Spectrum in Telecom sector. 3c. Compare given Mobile Network with respect to given parameter. 3d. Explain the given component used in FTTH. 3e. Explain the Multi Protocol Label Switching in NGN core. 3f. Describe the features of OTN and PON.	3.1 NGN architecture: Features, Functional block diagram, Network components: Media Gateway, Media Gateway Controller, and Application Server. 3.2 NGN Wireless Technology: Telecom network Spectrum: Types [licensed and unlicensed], Mobile Network Evolution (2G to 5G), Comparative features, 3.3 Fiber to the Home (FTTH): Features, Architecture And Components: Optical Line Termination (OLT), Optical Network Unit (ONU). 3.4 NGN Core: Features, Multi Protocol Label Switching (MPLS): Concepts, Features and Advantages.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
		3.5 Next generation transmission system: Optical Transport Network variants: Synchronous Transfer Module STM1, STM4, STM16, STM64 and STM256Features: bit rates and capacity .Passive Optical Network: BPON, Ethernet PON, Gigabit PON features.
Unit– IV Digital Factory	4a. Explain the principle of IoT used in given application. 4b. Explain the architecture of IoT. 4c. Explain the importance of Industrial revolution I4.0.	4.1 Internet of Things IoT: Introduction, principles and features of Cyber Physical system Components [Sensors, Edge-Gateways, Cloud]. 4.2 Architectures [Sensor to cloudvarious data routes: sensor-PLC-SCADA-cloud, sensor-server-cloud, sensor-edge gateway-cloud], Applications in Automotive/ Discrete Manufacturing; Telecom Industry; Agro Industries 4.3 I4.0/IIoT/ Smart Manufacturing: Introduction/ Evolution from I1.0 to I4.0, Applications and benefits of I4.0, Compare I3.0 with I4.0, Architecture of I4.0
Unit– V Smart World	5a. Explain the working principle of given electronic system in smart home. 5b. Explain the relevant features of smart city. 5c. Explain the mechanism of city surveillance in smart city. 5d. Explain the given Network component functions.	5.1 Evolution of smart home. 5.2 Basic requirements and components for Smart Home: Video Monitoring, Security and Alarm, Door control, Heating Ventilation and Air Conditioning control (HVAC), Smart lighting, Smart metering and Web controlling appliances. 5.3 Basic requirements for Smart City: Smart Transportation, Smart Healthcare, Smart waste, Smart physical safety/Security (IP based CCTV, Fire and Gas detection, Fire extinguishers) and Smart education. 5.4 IOT/M2M Network architecture: Conceptual diagram Domains for operation: Application domain, Network domain, M2M device domain. Network components: functions of Sensors, Access devices, Gateways, Access Protocols, Communication Network and Application server.

Note: To attain the COs and competency, above listed UOs need to be undertaken to achieve the 'Application Level' and above of Bloom's 'Cognitive Domain Taxonomy'.

9. SUGGESTED SPECIFICATION TABLE FOR QUESTIONPAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Advance Processors	10	02	06	08	16
II	Recent Electronic Components	08	02	04	04	10
III	Next Generation Telecom Network	12	04	04	08	16
IV	Digital Factory	10	04	06	06	16
V	Smart world	08	02	04	06	12
	Total	**48**	**14**	**24**	**32**	**70**

Legends: *R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)*
Note*: This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.*

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages (one activity by each group), also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Prepare a report on proposed features of Smart city.
b. Prepare a power point presentation on IoT/IIoT applications.
c. Prepare report on visit to nearby telecom exchange/industry.
d. Perform Group discussion on new Electronic Components.
e. Prepare a comparative chart of recent processors.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are suggested strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. ***'L' in item No. 4*** does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
c. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
d. With respect to item No.10, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
e. Guide student(s) in undertaking micro-projects.

f. Show video demonstration on safety precautions.
g. Demonstrate the actions and care to be taken.
h. Arrange a visit to Electronic industry.
i. Arrange expert lecture of industry person.

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the year. In the first two years, the micro-project is group-based. In the third year the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs as applicable. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than ***16 (sixteen) student engagement hours*** during the course. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:

a. Prepare a report on existing automation in an industry and suggest improvements.
b. Prepare a report on Smart City.
c. Build arduino based project for smart home.
d. Build arduino based project for smart city.
e. Prepare a report on Smart city surveillance systems.
f. Prepare report on electronic systems in Disaster Management.
g. Present a power point presentation on upcoming 5G technology.
h. Prepare a report on automatic electronic components assembly machines.
i. Conduct a survey and prepare a report on various EDA tools.
j. Prepare anapplication report on AR VR Technologies.
k. Prepare a report on Artificial Intelligence.
l. Prepare a report on Machine Learning.
m. Prepare report on electronic home security systems.
n. Prepare report on fire and gas detection and deluge systems.
o. Prepare report on ATM security systems.

13. SUGGESTED LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication
1	Sustainable Smart Cities in India: Challenges and Future Perspectives	PoonamSharma, Swati Rajput,	Spinger; ISBN 978-3-319-47145-7
2	The ABC of Fiber Optics Communication	Sudhir Warier	Artech House Boston London ISBN 13: 978-1-63081-414-4
3	IoT Fundamentals: Networking Technologies Protocols and use cases for IoT	David Hanes, Gonzalo Salguein	Cisco Press. ISBN 13: 978-1-58714-456-1

MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION MUMBAI

Sr. No.	Title of Book	Author	Publication
4	The AVR Microcontroller and Embedded Systems using Assembly and C.	MuhammadAli Mazidi	MicroDigitalEd.com ISBN-13:078-0997925968
5	ARM Assembly Language Programming & Architecture	Muhammad Ali Mazidi, Sarmad Naimi	MicroDigitalEd.com ISBN-13: 978-0997925906

14. SUGGESTED SOFTWARE/LEARNING WEBSITES:

Sr No	Theory topic /sub topic	Web site
1	Unit– IAdvance Processors (Advances in processor architecture)	https://slideplayer.com/slide/8290583/
2	Unit– IAdvance Processors (Arduino)	http://www.hobbytronics.co.uk/arduino-uno-r3
3	Unit– I Advance Processors (Arduino)	https://www.arduino.cc/en/Guide/HomePage
4	Unit– Advance Processors(ARM)	http://www.microdigitaled.com
5	Unit– Advance Processors (ARM)	https://en.wikipedia.org/wiki/ARM7
6	Unit – IIRecent Electronic Components (Flexible PCB)	https://en.wikipedia.org/wiki/Flexible_circuit
7	Unit – IIRecent Electronic Components (SMT)	https://www.electronics-notes.com/articles/electronic_components/surface-mount-technology-smd-smt/what-is-smt-primer-tutorial.php
8	Unit– IIINext Generation telecom Network	TRAI official website: www.trai.gov.in
9	Unit– III Next Generation telecom Network	https://www.itu.int/rec/dologin_pub.asp?lang=e&id=T-REC-Y.2012-200609-S!!PDF-E&type=items
10	Unit– IVDigital Factory (IoT)	https://en.wikipedia.org/wiki/Internet_of_things
11	Unit– IVDigital Factory	http://dot.gov.in/sites/default/files/National%20Telecom%20M2M%20Roadmap.pdf
12	Unit– IVDigital Factory	http://www.tec.gov.in/technical-reports/
13	Unit– IVDigital Factory(I4.0/IIoT)	http://i40today.com/
14	Unit– VSmart World	http://tec.gov.in/pdf/M2M/Design%20Planning%20Smart%20Cities%20with%20IoT%20ICT.pdf

Program Name : **Electronics Engineering Programme Group**

Program Code : **DE/EJ/ET/EN/EX/EQ/IE**

Semester : **Sixth**

Course Title : **Mechatronics**

Course Code : **22643**

1. RATIONALE

Mechatronics is a rapidly developing interdisciplinary field of engineering, which comprises the development of various computers integrated electro-mechanical systems. It is an integration of mechanical engineering, electrical & electronics engineering, computer engineering, control and instrumentation engineering. This integration facilitates the production of complex engineering systems with a high level of performance, reliability at affordable price. Due to these aspects, industrial sector is rapidly adopting such integrated systems. To adopt such systems, industries are in need of the diploma engineers to install, operate and maintain these systems.

2. COMPETENCY

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Install, Operate and Maintain various types of mechatronic systems.**

3. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

a) Install and Maintain the sensors and transducers of mechatronics systems.
b) Install and Maintain CNC Machine.
c) Install and Maintain pneumatic components in mechatronic systems.
d) Install and Maintain hydraulic components in mechatronic systems.
e) Install and Maintain different components of robotic systems.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme													
				Theory							Practical						
				Paper Hrs.	ESE		PA		Total		ESE		PA		Total		
L	T	P			Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
3	-	2	5	3	70	28	30*	00	100	40	25@	10	25	10	50	20

(*): Under the theory PA, Out of 30 marks, 10 marks are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the cognitive domain UOs required for the attainment of the COs.

***Legends:** **L**-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** -Practical; **C** – Credit, **ESE** -End Semester Examination; **PA** - Progressive Assessment*

5. COURSE MAP (with sample COs, PrOs, UOs, ADOs and topics)

This course map illustrates an overview of the flow and linkages of the topics at various levels of outcomes (details in subsequent sections) to be attained by the student by the end of the

course, in all domains of learning in terms of the industry/employer identified competency depicted at the centre of this map.

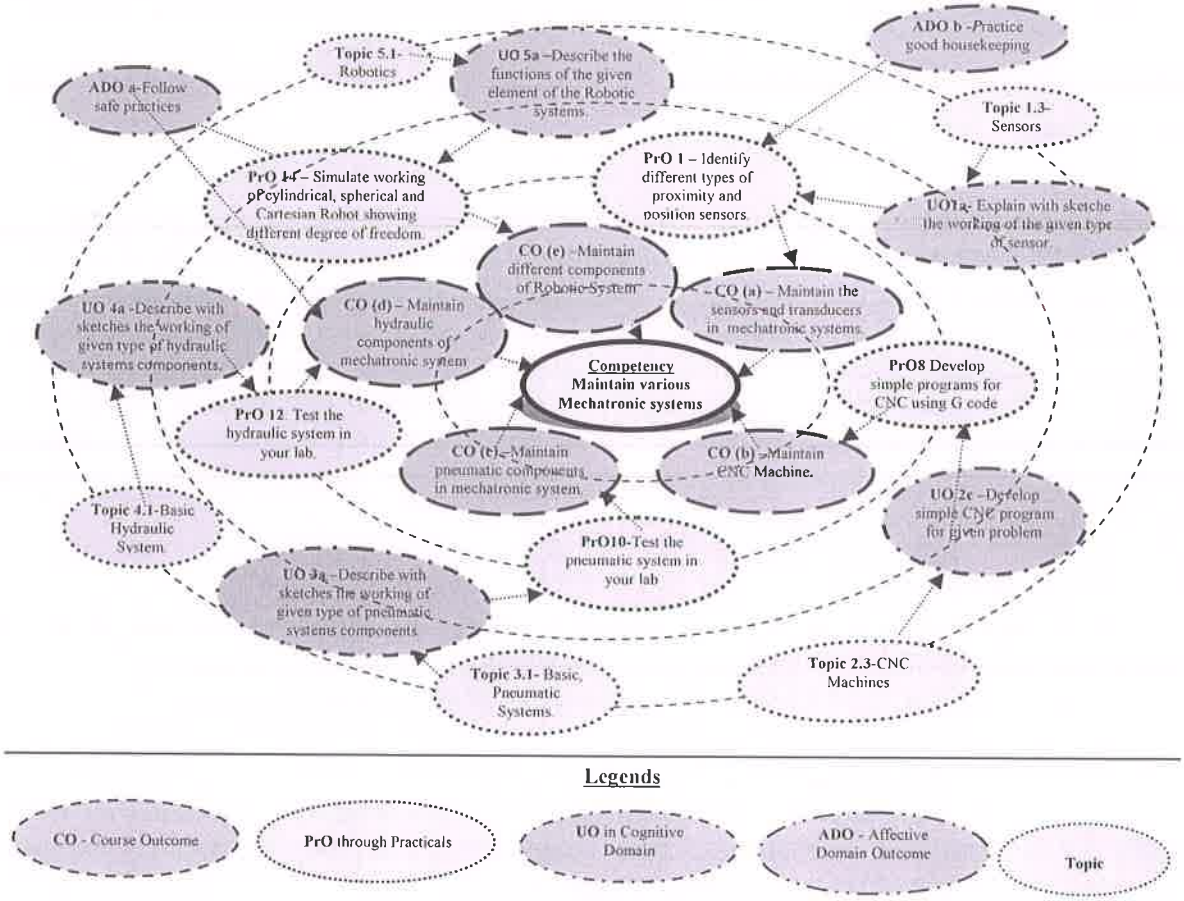


Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

The practicals' in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency:

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1	Identify different types of proximity and position sensors.	I	02
2	Choose the appropriate sensors for the given applications.	I	02*
3	Use relevant transducer for velocity, motion, acceleration and torque sensors for the specified applications.	I	02
4	Measure the speed of the given motor using stroboscope sensor.	I	02*
5	Identify various components of translational mechanical system	II	02
6	Identify various components of rotational mechanical system	II	02
7	Identify various components of electrical system.	II	02*
8	Develop simple programs for CNC using G code and M code.(open source software)	II	02*
9	Troubleshoot pneumatic system of mechatronic systems.	III	02
10	Test the pneumatic system available in your Lab.	III	02*
11	Troubleshoot hydraulic system of mechatronic systems.	IV	02
12	Test the hydraulic system available in your Lab.	IV	02*

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
13	Troubleshootdifferent mechanical actuators of mechatronic systems	IV	02
14	Simulate the working of cylindrical, spherical and Cartesian robot showing different degree of freedoms.	V	02
15	Simulate the working of pick and place robot. (Matlab / simulink software)	V	02*
16	Demonstrate the working of Automated Guide Vehicle (Virtual Lab / Demonstration in Industry/Videos).	V	02
17	Demonstrate the working ofAnti-lock Braking System (ABS)(Virtual Lab / Demonstration in Industry/Videos).	V	02*
	Total		**34**

Note

i. *A suggestive list of PrOs is given in the above table. More such PrOs can be added to attain the COs and competency. A judicial mix of minimum 12 or more practical need to be performed, out of which, the practicals' marked as '*' are compulsory, so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry.*

ii. *The 'Process' and 'Product' related skills associated with each PrO is to be assessed according to a suggested sample given below:*

S.No.	Performance Indicators	Weightage in %
1	Preparation of experimental set up	20
2	Setting and operation	20
3	Safety measures	10
4	Observations and Recording	10
5	Interpretation of result and Conclusion	20
6	Answer to sample questions	10
7	Submission of report in time	10
	Total	**100**

The above PrOs also comprise of the following social skills/attitudes which are Affective Domain Outcomes (ADOs) that are best developed through the laboratory/field based experiences:

a) Follow safety practices.
b) Practice good housekeeping.
c) Practice energy conservation.
d) Work as a leader/a team member.
e) Follow ethical Practices.

The ADOs are not specific to any one PrO, but are embedded in many PrOs. Hence, the acquisition of the ADOs takes place gradually in the student when s/he undertakes a series of practical experiences over a period of time. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

- 'Valuing Level' in 1st year
- 'Organisation Level' in 2nd year

- 'Characterization Level' in 3rd year.

7. MAJOR EQUIPMENT/ INSTRUMENTSREQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of experiments, as well as aid to procure equipment by authorities concerned.

S. No.	Equipment Name with Broad Specifications	PrO. No.
1	Sensors, transducers and signal conditioners demonstration boards.	01, 02 ,03 and 04
2	Small physical models of different types of system (if not available use virtual labs or any other relevant sources).	05 to 07
3	CNC machine.	08
4	Pneumatic system component trainer kit.	09, 10
5	Hydraulic system component trainer kit.	11, 12, 13
6	Small robotics model/proto type/ (or virtual lab).	14, 15
7	AGV and ABS simulation (small physical model or virtual lab)	16, 17

8. UNDERPINNING THEORY COMPONENTS

The following topicsare to betaught and assessed in order to develop the sample UOs given below for achieving the COs to attain the identified competency. More UOs could be added.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit– I Sensors for Mechatronics system.	1a. Describe with sketches the function of the given type(s) of sensors and transducers. 1b. Compare the given types of sensorsbased on given criteria. 1c. Explain with sketches the working of the given type(s) of sensor. 1d. Justify the need for the signal conditioning circuits in the given mechatronics system. 1e. Describe the troubleshooting procedure for the specified problem of the given type of sensor or transducers.	1.1 **Mechatronics system architecture:** Sensors, signal conditioners, PLC/ Embedded controllers, pneumatic, hydraulic and electrical actuators. 1.2 **Introduction to Real Time Mechatronics System:** Block diagram & Functions: Real time mechatronics system(Flexible Manufacturing System: FMS), Computer Integrated Machines: CIM)) 1.3 **Sensors:** Construction, principle of operation and application) i. **Proximity and position Sensors:** Photo electric sensors, Hall Effect sensors, optical encoder, eddy current proximity sensor, inductive sensor, capacitive sensor. ii. **Velocity Sensors:** Electromagnetic transducers, Tacho generators iii. **Motion Sensors:** Stroboscope, pyro electric sensors. iv. **Acceleration sensors:** strain gauge accelerometer, piezoelectric accelerometer, LVDT accelerometer. v. **Pressure sensors:** load cells

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
		vi. **Torque sensors :** Torque measurement using strain gauge, torque measurement using torsion bar (optical method, capacitive method, proximity sensor method, stroboscope method). **1.4 Signal conditioners:** Need of isolators, filters, amplifiers, fluid amplifiers, optical amplifiers and data converters in mechatronics systems.
Unit –II Basic Mechatronics systems.	2a. Describe with sketches the building blocks of the given system model. 2b. Built a model from given system component. 2c. Develop simple CNC programs for given problem. 2d. Describe with sketches general configuration of CNC systems.	2.1 **Basic System Models:** Introduction, mechanical system building blocks – Translational and Rotational system building up a mechanical system model ,Electrical system building blocks - building up a model for an electrical system. **2.2 System Models:** Introduction, rotational-translational systems, electro-mechanical systems – System components & function. (No mathematical modelling) **2.3 CNC Machines:** General configuration of CNC system, advantages of CNC, part programming of CNC machines, G codes and M codes, small application programs, CNC based drilling machine.
Unit-III Pneumatic System	3a. Explain the working of given type of pneumatic system components. 3b. Explain the working principle of given type(s) of pneumatic actuator. 3c. Identify the use of given type(s) of pneumatic component. 3d. Describe the procedure to maintain the given type(s) of pneumatic system component.	3.1 **Basic Pneumatic Systems:** Basic, Pneumatic system circuit, Air compressors, filters and regulators, air treatment, valves 3.2 **Actuators :**Principle of operation of linear actuators (single acting cylinder, double acting cylinder) rotary actuators(rotating vane, gear type) and direction control valves (poppet valve, spool valve) 3.3 **Pneumatic System:** Applications, Advantages and Limitations.
Unit-IV Hydraulic System	4a. Explain the working of given type of hydraulic system components. 4b. Explain the working principle of given type(s) of hydraulic actuator. 4c. Explain with sketches the working	4.1 **Basic Hydraulic systems:** primary components of hydraulic systems: Reservoir, hydraulic pumps, Hydraulic motor, filters and pressure regulation

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	of the given mechanical actuating system. 4d. Identify the use of given type(s) of Hydraulic system components. 4e. Describe the procedure to maintain the given type(s) of Hydraulic system components.	4.2 **Actuators :**Principle of operation of linear actuators (single acting cylinder, double acting cylinder) rotary actuators(rotating vane, rack and pinion type) 4.3 **Mechanical Motion Element:** cams, gear, belt , rack and pinion and bearings (principle of operation and application) 4.4 **Hydraulic System**: Applications, Advantages and Limitation
Unit – V Robotics and Mechatronics Applications	5a. Describe with sketches the functions of the given element of the Robotic systems. 5b. Explain with sketches the given degree of freedom for a robot. 5c. Explain with sketches the working of the given robotics application. 5d. Compare the given types of robot on the basis of degree of freedom, construction, end effectors used and applications. 5e. Describe the procedure to maintain the given robotic system for the specified application.	5.1 **Robotics:** Block diagram and function of each component (sensors, drive system, control system, end effectors), construction and degrees of freedom of cylindrical, spherical and Cartesian robots, applications of robot. 5.2 Microcontroller based antilock brake system. 5.3 Microcontroller based pick and place robot. 5.4 Microcontroller based car park barrier system. 5.5 AGV (Automated Guided Vehicle): Basic concept, block diagram, role of mechatronic in guided vehicle

Note: To attain the COs and competency, above listed UOs need to be undertaken to achieve the 'Application Level' and above of Bloom's 'Cognitive Domain Taxonomy.

9. SUGGESTED SPECIFICATION TABLE FORQUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Sensors for Mechatronics system.	14	06	08	06	20
II	Basic Mechatronics systems.	06	02	04	04	10
III	Pneumatic System	10	04	06	04	14
IV	Hydraulic System	10	04	06	04	14
V	Robotics & Mechatronics Applications	08	04	04	04	12
Total		**48**	**20**	**28**	**22**	**70**

Legends: *R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)*
Note*: This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of UOs. The actual*

distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a) Prepare manuals based on practical performed in laboratory.
b) Give seminar on relevant topic.
c) Library/Internet survey regarding different data books and manuals.
d) Prepare power point presentation on "Mechatronic Systems".
e) Undertake a market survey of different manufacturer of "Mechatronic Systems".

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a) Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b) ***'L' in item No. 4*** does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
c) About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
d) With respect to item No.10, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
e) Guide student(s) in undertaking micro-projects.
f) Use Flash/Animations to explain working of control system.
g) Use open source simulation software modules to perform different applications of pneumatic, hydraulic system.

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project are group-based. However, in the fifth and sixth semesters, it should be preferably be ***individually*** undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than ***16 (sixteen) student engagement hours*** during the course. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:

a) Design a microcontroller based robotarm to pick and place ferrous material from one place to another place (zero to 180 degree).

b) Design a microcontroller based AVCS for speed control and mirror adjustment for car. (Use relevant speed measurement sensor for speed control and simple small dc motor for mirror adjustment)
c) Design a controller based ABS (Use of linear actuator).
d) Design a small model for hydraulic system.
e) Design a small model for pneumatic system.
f) Design a model to demonstrate the use of any one velocity sensor.
g) Demonstrate the use of any one motion sensor using simulation.
h) Demonstrate the use of any one pneumatic actuator using simulation.
i) Demonstrate the use of any one mechanical actuator using simulation.

Note: To implement above micro project actual physical model or simple computer simulation is expected.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Mechatronics - Integrated Mechanical electronic systems.	Ramachandran,K. P.; Vijayaraghavan,G. K.; Balasundaram, M.S.	Wiley-India, New Delhi First edition, 2008 ISBN: 978-81-265-1837-1
2	Mechatronics	Bolton,W.	Pearson Education, New Delhi, 2003,3rd Edition, ISBN: 0131216333
3	Mechatronics	Rajput, R. K.	S. Chand & Co. ltd. New Delhi,1st Edition,, ISBN: 81-219-2859-1
4	Mechatronics	Singh,M. D.; Joshi, J. G.	PHI Learning Private Limited, New Delhi,2006,ISBN: 8120329864

14. SOFTWARE/LEARNING WEBSITES

a) Automation studio (educational version).
b) Autosar (educational version)
c) Mechatronics -www.youtube.com /mechatronics
d) www.nptel.ac.in/downloads/112103174/
e) Basics of Mechatronics - https://www.youtube.com/watch?v=Ro_tFv1iH6g.
f) Simulation of Mechatronics systems -www.youtube.com/watch?v=DbGTwvyT_Co.
g) Understanding control system - www.youtube.com/watch?v=pVAY2zOy0vU.
h) AVCS – Cruise Control - https://www.youtube.com/watch?v=zq1RSDNRh3Q.
i) CNC machine - https://www.youtube.com/watch?v=-Qn-KCU4cWU
j) System variations - www.youtube.com/watch?v=G4OLOjY4MpQ.
k) ABS - www.youtube.com/watch?v=NCkwnm_lsPc.

MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION MUMBAI

Program Name : **Electronics Engineering Programme Group**

Program Code : **DE/EJ/ET/EN/EX/EQ**

Semester : **Sixth**

Course Title : **Optical Network and Satellite Communication**

Course Code : **22647**

1. RATIONALE

Optical communication technology is developing at very fast pace. Cost trends for fiber vs copper, better transmission quality, high data rate, large band width and reduction in fiber maintenance expense are the major reasons for fast adaptation of this mode of communication. Today in different communication scenarios satellite applications plays important role. The knowledge of satellite communication systems and equipment is very essential. This course will facilitate students to apply the basic principles of optical communication system and satellite communication system to maintain different types of applications based on it.

2. COMPETENCY

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Maintain optical communication networks.**
- **Maintain satellite communication systems.**

3. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

a) Interpret the functions of the various blocks of optical fiber communication system.
b) Measure the optical fiber cable parameters.
c) Select relevant architecture of optical networks for the given application.
d) Select uplink and downlink frequencies for various satellite services.
e) Maintain Satellite services.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme												
				Theory							Practical					
L	T	P		Paper Hrs.	ESE		PA		Total		ESE		PA		Total	
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
3	-	2	5	3	70	28	30*	00	100	40	25@	10	25	10	50	20

(*): Under the theory PA, Out of 30 marks, 10 marks are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the cognitive domain UOs required for the attainment of the COs.

***Legends: L**-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** - Practical; **C** – Credit, **ESE** - End Semester Examination; **PA** - Progressive Assessment*

5. COURSE MAP (with sample COs, PrOs, UOs, ADOs and topics)

This course map illustrates an overview of the flow and linkages of the topics at various levels of outcomes (details in subsequent sections) to be attained by the student by the end of the course, in all domains of learning in terms of the industry/employer identified competency depicted at the centre of this map.

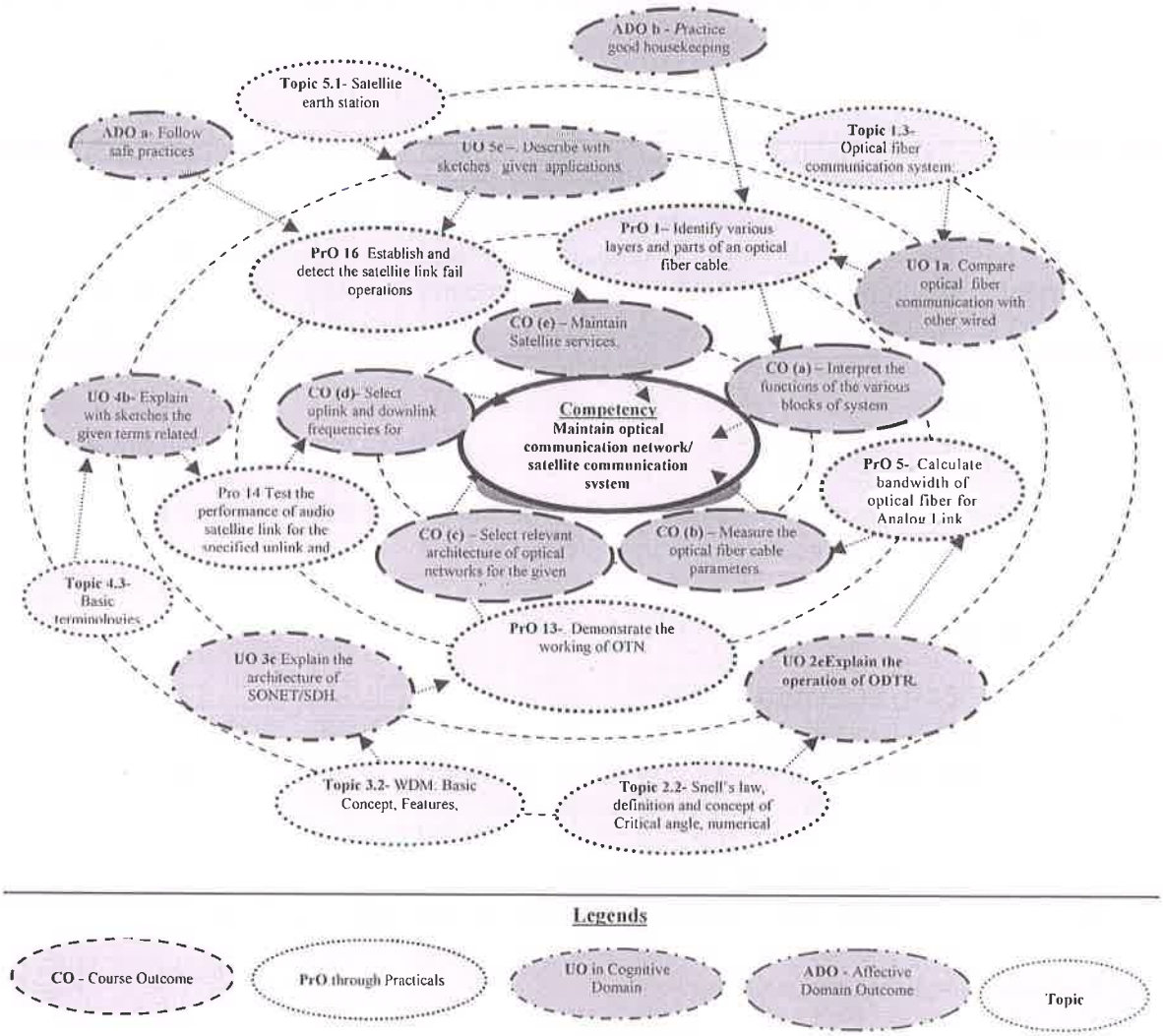


Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

The practicals in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency:

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1	Identify various layers and parts of an optical fiber cable.	I	02*
2	Test the performance of Pulse width modulator and demodulator (PWM) where optical fiber cable is used as transmission media.	I	02*
3	Test the performance of the given photo-diode (Detector) use LED as an optical source.	I	02
4	Test performance of given photo-diode (Detector) use LASER as optical source.	I	02*
5	Calculate bandwidth of optical fiber for Analog Link.	II	02
6	Observe the change in power level of optical fiber due to cleaning	II	02

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
	effects in the fiber.		
7	Calculate Numerical Aperture (NA) and acceptance angle for the given optical fiber cable.	II	02*
8	Connect the given Optic cable with relevant optical connector and test the performance of cable.	II	02
9	Measure attenuation losses for the given length of optical fiber cable.	II	02
10	Measure bending losses of the given optical fiber optic cable.	II	02*
11	Demonstrate attenuation losses for the given length of optical fiber cable with the help of OTDR. (Virtual lab/ Demonstration in industry/videos can be used in case of non-availabity of the splicing machine in the lab)	II	02
12	Join optical fiber cables using Splicing machines. (Virtual lab/ Demonstration in industry/ videos can be used in case of non-availabity of the splicing machine in the lab)	II	02
13	Demonstrate the working of OTN. (Virtual lab/ Demonstration in industry/ videos can be used in case of non-availabity in the lab)	III	02*
14	Test the performance of audio satellite link for the specified uplink and downlink frequency.	IV	02*
15	Develop a program using a relevant simulation tool to calculate the time period of a satellite for the given velocity and altitude based on Kepler's third law.	IV	02
16	Detect the satellite link fail operations and re-establish the link.	V	02
17	Establish a link to transmit and receive three separate signals (audio, video, tone) simultaneously through satellite link.	V	02
		TOTAL	**34**

Note

i. *A suggestive list of PrOs is given in the above table. More such PrOs can be added to attain the COs and competency. A judicial mix of minimum 12 or more practical need to be performed, out of which, the practicals marked as '*' are compulsory, so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry.*

ii. *The 'Process' and 'Product' related skills associated with each PrO is to be assessed according to a suggested sample given below:*

S.No.	Performance Indicators	Weightage in %
a.	Preparation of experimental set up	20
b.	Setting and operation	20
c.	Safety measures	10
d.	Observations and Recording	10
e.	Interpretation of result and Conclusion	20
f.	Answer to sample questions	10
g.	Submission of report in time	10
	Total	**100**

The above PrOs also comprise of the following social skills/ attitudes which are Affective Domain Outcomes (ADOs) that are best developed through the laboratory/field based experiences:

a) Follow safety practices.
b) Practice good housekeeping.
c) Practice energy conservation.
d) Work as a leader/a team member.
a) Follow ethical Practices.

The ADOs are not specific to any one PrO, but are embedded in many PrOs. Hence, the acquisition of the ADOs takes place gradually in the student when s/he undertakes a series of practical experiences over a period of time. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

- 'Valuing Level' in 1st year
- 'Organisation Level' in 2nd year
- 'Characterisation Level' in 3rd year

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of experiments, as well as aid to procure equipment by authorities concerned.

S. No.	Equipment Name with Broad Specifications	PrO. No.
1.	CRO/Digital storage oscilloscope: 60MHz/100MHz/200MHz bandwidth, 500MS/s to 1GS/s real-time sample rate, 50GS/s sample rate for repetitive waveforms, High resolution color LCD display	**2,3,4,5**
2.	DMM: DC, 0-1.5/3Amp, 0-2.5/5 Amp, 0-5/10Amp, 0-150/300V, 0-250/500V, 0-75/150V AC-0-1000V , 0-10A	**2,3,4,5**
3.	Power Supply Type: DC, 0- 30 V, 0 - 3A	**2,3,4,5**
4.	Fiber Optic Trainer kit	**1,2,3,4,5,7**
5.	Fiber optic cable tester	**2,3,4,5**
6.	Optical fiber Power meter	**6,8,9**
7.	Lux meter: Display: 3 1/2 digit 18mm (0.7") /LCD •Ranges: 1 to 50,000 LUX /Over-input: indication of " 1 " /Sampling Time: 0.5 second /Repeatability: ±2% /Temperature Characteristic: ±0.1%/? •Accuracy: ±4%rdg ±0.5%f.s	**3,4,5**
8.	OTDR-Attenuation resolution-0.001 dB, Attenuation measurement linearity 0.05 dB, Distance measurement accuracy ± (0.5 + resolution + 5 × 10-5 × L) m	**8,9,10, 11,12**
9.	PC - Processor - dual core @ 2.4 GHz (i5 or i7 Intel processor or equivalent AMD),RAM - 4 GB, Hard Drive - 320 GB 5400 RPM hard drive,OS- win7/10	**11,12, 13**
10.	Spectrum Analyzer- frequency range- 2.4 to 2.495GHz, Resolution – 26KHz to 3MHz, resolution BW-58.036 to812.500KHz	**14,15,16,17**
11.	Splicing, Cutting and trimming tool of plastic fiber optic cables	**6,12**
12.	Fiber optic cleaning kit .	**6**
13.	Satellite Trainer Kit (ST2272)/ (STC 24): Up linking frequency 2414-	**15,16,17,18**

S. No.	Equipment Name with Broad Specifications	PrO. No.
	/2432/2450/2468 MHz, 4 MHz clock frequency, PIC16F84 - 8 Bit RISC processor based PLL, 16 MHz Bandwidth, FM Modulation of Audio and Video 5/ 5.5/ 8 MHz Audio and Video Modulation, Detachable Dish Antenna, Radiated Power output 25 mW (approx.), 4 downlink frequencies 2414 /2432/2450/2468 MHz	
14.	RF Signal Generator, 9 kHz to 3 GHz, Output Power @1 GHz, -127 dBm to +13 dBm AM, FM, PM Analog I/Q Input Pulse, Frequency Modulation-Maximum Deviation @1 GHz, 20 Hz to 100 kHz	2

8. UNDERPINNING THEORY COMPONENTS

The following topics are to be taught and assessed in order to develop the sample UOs given below for achieving the COs to attain the identified competency. More UOs could be added.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit –I Fundamentals of Fiber Optic Communication	1a.Describe construction and features of Optical fiber. 1b. Compare working of optical fiber for given mode and index profile. 1c. Explain the block diagram of Optical fiber communication system. 1d. Explain the working principle of given optical source and detector.	1.1Optical fiber communication: Advantages, Disadvantages, applications 1.2 Construction of fiber optic cable 1.3 Classification based on modes of propagation of light and index profile. 1.4 optical fiber communication system: Block diagram. 1.5 Optical components: Sources and Detectors
Unit– II Optical Losses	2a. Explain the given terms related to optical theory. 2b. Calculate acceptance angle, critical angle and numerical aperture of the given optical fiber cable. 2c. Explain the step by step procedure of given splicing techniques 2d. Describe the different types of Optical fiber losses. 2e. Explain the operation of ODTR.	2.1 Reflection, refraction, Total internal reflection (TIR), Snell's law, critical angle, numerical aperture, acceptance angle and acceptance cone - (numerical on above concepts) 2.2 Splicing techniques- Fusion splice, V-groove splice and elastic tube splice 2.3 Losses in optical fiber: Absorption loss, scattering loss, dispersion loss, radiation loss, coupling loss. 2.4 OTDR: Working Principle, Block diagram, Specification, Application
Unit-III Optical network.	3a. Describe working principle of the optical network components. 3b. Explain the concept of WDM. 3c. Explain the architecture of SONET/SDH. 3d. Describe the given type of Ethernet standard.	3.1 Optical Network Components Use and Features: Amplifiers, Splitter, Optical Switches, 3.2 WDM: Basic Concept, Features. 3.3 SONET/SDH: Architecture and Hierarchy. 3.4 Ethernet standards of Optical network features: IEEE 802.3j, 802.3y, 802.3z

Unit –IV Overview of Satellite Systems.	4a. Describe with sketches the working principles of the given type of satellite. 4b. Explain with sketches the given terms related to satellite and orbit. 4c. Explain the parameters with respect to the given type of satellite orbit. 4d. Explain Kepler's law of planetary motion with respect to the given criteria.	4.1 Working principle, concepts and basic components of Satellite system : Earth segment, Space segment, active and passive satellite, geostationary and geosynchronous satellites 4.2 Frequency allocations for satellite services, Uplink and downlink frequency, satellite frequency bands 4.3 Basic terminologies used in satellite communication: latitude, longitude, look angle, elevation angle, station keeping, propagation delay time , velocity, look angle and footprint 4.4 Communication Satellite orbits and its types: LEO, MEO, elliptical orbit and GEO, parameters and characteristics of various orbits 4.5 Kepler's law, Apogee and Perigee Heights, Orbit Perturbations, Effects of a non spherical earth, Atmospheric drag, effect of eclipse on satellite motion
Unit-V Satellite segments and Services	5a. Describe with sketches the functions of the given sub-system of the satellite earth station. 5b. Describe the given type of control systems associated with the Satellite. 5c. Describe with sketches given applications	5.1Satellite earth station: Block diagram; Antenna subsystem, LNA, Power subsystem, Telemetry Tracking and Command (TTAC) subsystem, Attitude Control, Spinning satellite stabilization, Momentum wheel stabilization, Station Keeping, Thermal control Transponder: Single, double conversion and regenerative type 5.2 Space link: Equivalent Isotropic Radiated Power(EIRP), Transmission Losses : Free-space transmission loss, Feeder losses, Antenna misalignment losses, Fixed atmospheric and ionosphere losses 5.3 Satellite Applications: GPS: : Global positioning system (GPS) : concept, working principle, transmitter and receiver VSAT: Overview, architecture, working principle, applications

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Fundamentals of Fiber Optic Communication	08	02	04	06	12
II	Optical Losses	12	04	06	06	16
III	Optical network	08	02	06	06	14
IV	Overview of Satellite Systems	08	02	04	06	12
V	Satellite segments and Services	12	02	06	08	16
Total		**48**	**12**	**26**	**32**	**70**

Legends: *R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)*
Note*: This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.*

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a) Visit any industry nearby to your house/college and observe the use of optical devices.
b) List out the specification of various optical devices used in the industries.
c) Undertake Internet survey for various optical fiber cables available in market.
d) Observe various splicing techniques used in industries.
e) Visit any earth station nearby to your house/college and observe the function of different components of satellite system and submit report on it.
f) Write report on various antennas and modulation techniques used for television signal transmission.
g) Visit ISRO website and collect the information related to satellite launching and submit report on it.
h) Collect the information related to Indian satellites program.
i) Prepare report on satellite applications.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a) Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b) ***'L' in item No. 4*** does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
c) About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
d) With respect to item No.10, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
e) Guide student(s) in undertaking micro-projects.

f) Virtual lab or videos can be use in case of non availability of equipment for mentioned experiments.
g) Correlate subtopics with application of instrumentation.
h) Use proper equivalent analogy to explain different optics concepts.
i) Use Flash/Animations to explain the process of light transmission through various types of fiber optic cable
j) Use open source models to explain working of the fiber optic connectors.
k) Use Flash/Animations to explain satellite communication.
l) Use different websites to explain satellite communication systems

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. For all semesters, the micro-project are group-based to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than ***16 (sixteen) student engagement hours*** during the course. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:

a) Using LED as optical source, photodiode as optical detector and plastic fiber cable make prototype optical communication system.
b) Make flow diagram of Fiber to Home (FTH).
c) Test the performance of PWM using copper cable and compare it with result of experiment no 02.
d) Prepared survey report to compare technical specification of different types of optical sources and detectors.
e) Undertake a survey for different types of optical cables, give its specification and application.
f) Undertake a survey of different OTDRs available in market, along with their specifications.
g) Prepared report on splicing techniques used at RailTel, Reliance and BSNL or any other such organization.
h) Monitor an optical networking used for cable service provider (TV and internet) and prepared report.
i) Prepare an Internet based report on the different types of launch vehicles used for satellite launching.
j) Prepare the chart to indicate applications of various satellite frequency bands (L, S, C, X, Ku and Ka band).
k) Prepare a survey report on the different types of antennas used for Satellite communication.
l) Conduct an Internet survey and prepare a detail report on GPS and its applications.
m) Prepare a report on VSAT communication based on visit and Internet survey.
n) Visit a satellite centre/ pool lab having satellite set up and prepare a report on all the components and its functions.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Electronic communications Systems: Fundamentals Through Advanced	Tomasi, Wayne	Pearson Education India, New Delhi **ISBN-13:** 978-8131719534
2	Fiber Optic Communication	Kolimbiris, Harold	Pearson Prentice Hall, New Delhi,2004; ISBN 978-81-317-1588-8
3	The ABCs of Fiber Optic Communication	Warier, Sudhir	ARTECH HOUSE, Canton street Norwood, MA, ISBN 9781630814144
4	Fiber Optic Communication	Kieser, Gerd	Mc Graw Hill Higher Education, New Delhi ,2013, ISBN: 9781259006876,
5	Data Communications and Networking	Forouzan, Behrouz A.	Mc Graw Hill Higher Education, New Delhi, 2013, ISBN: 9781259064753,
6	Optical Fiber Communications Principles and practice	Senior, John M.	Pearson Education Limited, New Delhi, 2010, ISBN: 9788131732663,
7	Satellite Communications	Roddy Dennis	Tata McGraw-Hill, New Delhi, fourth edition ,2017 **ISBN-13:** 978-0070077850
8	Satellite Communication	Katiyar, Sapna	Katson publications, 3rd edition 2013 ISBN-978-93-5014-481-7
9	Satellite communication concepts and applications	Rao Raja K. N.	PHI learning Private limited ,New Delhi , second edition, 2012 ISBN-978-81-203-4725-0
10	Satellite communication systems, techniques and technology	Gerard Maral, Bousquet Michel, Zhili Sun	Wiley publication, New Delhi n 5th Edition,2009 ISBN: 978-0-470-71458-4

14. SOFTWARE/LEARNING WEBSITES

a) Optical wavelength bands: http://www.bbcmag.com/2008issues/june08/BBP_June08_OtoL.pdf
b) For virtual lab :- http://iitg.vlab.co.in/?sub=59&brch=269
c) For virtual lab :- http://vlab.co.in/
d) LED data sheet:-http://www1.futureelectronics.com/doc/EVERLIGHT%C2%A0/334-15__T1C1-4WYA.pdf
e) For fiber cleaning video :https://www.youtube.com/watch?v=MMmRdFs96JY
f) http://www.netes.com.tr/upload_x/dosyalar/93DA75C4C94A4B78E5E09EDBB038F0AA.pdf
g) https://recommendedforyou.xyz/books/g4/25739?q=Satellite%20communication%20lab%20manual
h) http://istc.co.in
i) https://www.isro.gov.in/
j) https://www.nasa.gov/
k) http://www.satcoms.org.uk/satellite/vsat-tutorials.asp?

Program Name : **Diploma in Computer Engineering Group/ Diploma in Mechanical /Chemical Engineering /Diploma in Electronics Engineering Group/ Diploma in Fashion & Clothing**

Program Code : **CO/CM/CW/DC/EJ/ET/EN/EX/EQ/IE/ME/CH**

Semester : **Sixth**

Course Title : **Entrepreneurship Development**

Course Code : **22032**

1. RATIONALE

Globalisation, liberalization and privatization along with revolution in information technology have opened up new opportunities transforming lives of masses. In this context, there is immense opportunity of establishing manufacturing, service, trading, marketing and consultancy enterprises by diploma engineer. Our fast growing economy provides ample scope for diploma engineers to succeed as an entrepreneur. Entrepreneurship requires distinct skill sets which are attempted to be developed through this course. To begin with, this course aims to develop the competency and the related outcomes in order to start small enterprises.

2. COMPETENCY

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Develop project proposals to launch small scale enterprises.**

3. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

a. Identify your entrepreneurial traits.
b. Identify the business opportunities that suits you.
c. Use the support systems to zero down to your business idea.
d. Develop comprehensive business plans.
e. Prepare plans to manage the enterprise effectively.

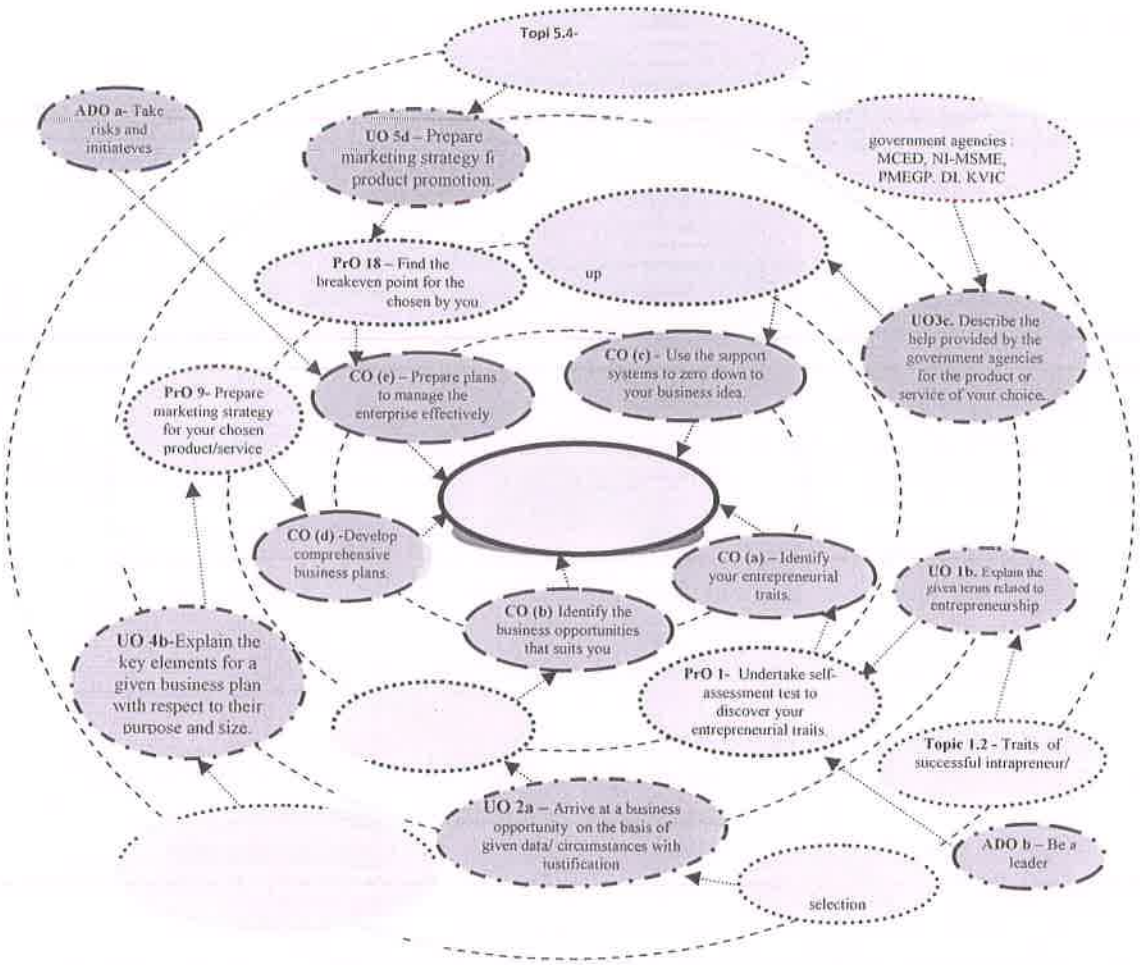
4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme													
				Theory							Practical						
				Paper Hrs.	ESE		PA		Total		ESE		PA		Total		
L	T	P			Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
2	-	2	4	--	--	--	--	--	--	--	50@	20	50~	20	100	40

@ : Internal examination

(~): For the practical only courses, *the PA has two components under practical marks i.e. the assessment of practicals (seen in section 6) has a weightage of 60% (i.e.30 marks) and micro-project assessment (seen in section 11) has a weightage of 40% (i.e.20 marks). This is designed to facilitate attainment of COs holistically, as there is no theory ESE.*

Legends: L*-Lecture;* ***T*** *– Tutorial/Teacher Guided Theory Practice;* ***P*** *– Practical;* ***C*** *– Credit,* ***ESE*** *- End Semester Examination;* ***PA*** *- Progressive Assessment*


Topi 5.4-
ADO a- Take risks and initiateves
UO 5d – Prepare marketing strategy fi product promotion.
government agencies : MCED, NI-MSME, PMEGP. DI. KVIC
PrO 18 – Find the breakeven point for the chosen by you.
up
UO3c. Describe the help provided by the government agencies for the product or service of your choice.
CO (e) – Prepare plans to manage the enterprise effectively.
CO (c) - Use the support systems to zero down to your business idea.
PrO 9- Prepare marketing strategy for your chosen product/service
CO (d) -Develop comprehensive business plans.
CO (a) – Identify your entrepreneurial traits.
UO 1b. Explain the given terms related to entrepreneurship
CO (b) Identify the business opportunities that suits you
UO 4b-Explain the key elements for a given business plan with respect to their purpose and size.
PrO 1- Undertake self-assessment test to discover your entrepreneurial traits.
Topic 1.2 - Traits of successful intrapreneur/
UO 2a – Arrive at a business opportunity on the basis of given data/ circumstances with justification
ADO b – Be a leader
selection

Legends

UO in Cognitive Domain
Topic
ADO - Affective

2. Bags of all types i.e. made of leather, cotton, canvas and jute etc. including kit bags, mail bags, sleeping bags and water-proof bag
3. Bandage cloth
4. Basket cane (Procurement can also be made from State Forest Corpn. and State Handicrafts Corporation)
5. Bath tubs of plastic
6. Battery Charger
7. Belt leather and straps
8. Bolts and Nuts
9. Boot Polish
10. Brooms
11. Domestic Brushes of different types
12. Buckets of all types of plastic
13. Button of all types
14. Chappals and sandals
15. Cleaning Powder
16. Cloth Covers for domestic use
17. Cloth Sponge
18. Coir mattress cushions and matting
19. Cotton Pouches
20. Curtains mosquito
21. Domestic Electric appliances as per BIS Specifications: Toaster Electric, Elect. Iron, Hot Plates, Elect. Mixer, Grinders Room heaters and convectors and ovens
22. Dust Bins of plastic
23. Dusters Cotton all types except the items required in Khadi
24. Electronic door bell
25. Emergency Light (Rechargeable type)
26. Hand drawn carts of all types
27. Hand gloves of all types
28. Hand numbering machine
29. Hand Pump
30. Hand Tools of all types

S. No.	Performance Indicators	Weightage in %
6	Answer the sample questions	10
7	Submission of report in time	10
	Total	**100**

The above PrOs also comprise of the following social skills/attitudes which are Affective Domain Outcomes (ADOs) that are best developed through the laboratory/field based experiences:

a. Follow safe practices
b. Practice good housekeeping
c. Practice energy conservation
d. Demonstrate working as a leader/a team member
e. Maintain tools and equipment
f. Follow ethical practices.

The ADOs are not specific to any one PrO, but are embedded in many PrOs. Hence, the acquisition of the ADOs takes place gradually in the student when s/he undertakes a series of practical experiences over a period of time. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

- 'Valuing Level' in 1st year
- 'Organising Level' in 2nd year
- 'Characterising Level' in 3rd year.

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of experiments, as well as aid to procure equipment by authorities concerned.

S. No.	Equipment Name with Broad Specifications	PrO. No.
1	Seminar Hall equipped with conference table,chairs and multimedia facilities	All
2	Modern desktop Computer with internet connection	All

8. UNDERPINNING THEORY COMPONENTS

The following topics are to be taught and assessed in order to develop the sample UOs given below for achieving the COs to attain the identified competency. More UOs could be added.

Unit	Unit Outcomes (In cognitive domain)	Topics and Sub-topics
Unit – I Entrepreneurship Development - Concept and Scope	1a. Describe the procedure to evaluate your entrepreneurial traits as a career option for the given product to be manufactured or services to be rendered. 1b. Explain the given terms related to Entrepreneurship	1.1 Entrepreneurship as a career 1.2 Traits of successful intrapreneur/ entrepreneur: consistency, creativity, initiative, independent decision making, assertiveness, persuasion, persistence, information seeking, handling business communication, commitment contract, 1.3 sc local and

f. Convert you project work into business.
g. Choose a product and design a unique selling preposition, brand name, logo,

to create opportuniti

e. Use Flash/Animations to explain various maintenances techniquies.
f. Guide student(s) in undertaking micro-projects.
g. Instructors should emphasise more on deductive learning. Students should learn to recognise, create, shape opportunities, and lead teams for providing economic-social value to society.
h. Business simulations should be used to enhance behavioural traits of successful intrapreneurs and entrepreneurs amongst students. Emphasis should be on creating entrepreneurial society rather than only setting up of enterprise.
i. They must be encouraged to surf on net and collect as much information as possible.
j. Each student should complete minimum twenty activities from the suggested list. Minimum possible guidance should be given for the suggested activities.
k. Students should be promoted to use creative ideas, pool their own resources, finish their presentation, communication and team skills.
l. Alumni should be frequently invited for experience sharing, guiding and rewarding students.
m. Display must be arranged for models, collages, business plans and other contributions so that they motivate others.

11. SUGGESTED MICRO-PROJECTS

One Business Plan as a micro-project is planned to be undertaken by a student assigned to him/her in the beginning of the semester. S/he should submit it by the end of the semester to develop the industry oriented COs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation in the middle of the semester and one at the end of the semester before submission of the project proposal incorporating the concepts taught during semester. The total duration of the micro-project should not be less than ***16 (sixteen) student engagement hours*** during the course.

a. Choose any advertisement and analyse its good and bad points.
b. Decide any product and analyse its good and bad features.
c. Select any product and prepare its cost sheet.
d. Choose any product and study its supply chain.
e. Arrange brainstorming sessions for improvement of any product.
f. Study schemes for entrepreneurship promotion of any bank.
g. Visit industrial exhibitions, trade fairs and observe nitty-gritty of business.
h. Open a savings account and build your own capital.
i. Organise industrial visit and suggest modifications for process improvement.

12. SUGGESTED LEARNING RESOURCES

S. No.	Title of Books	Author	Publication
1	The Entrepreneurial Instinct : How Everyone Has the Innate Ability to Start a Successful Small Business	Mehta, Monica	McGraw-Hill Education, New Delhi, 2012, ISBN 978-0-07-179742-9
2	Entrepreneurship	Hisrich, R. D.	McGraw-Hill Education, New Delhi, 2013 ISBN-13: 978-1259001635
3	Part I Readings in Entrepreneurship Education	Sareen, S.B.	Entrepreneurship Development Institute of India (EDI), GOI,

S. No.	Title of Books	Author	Publication
			Ahmedabad, 2016; ISBN: 978-0078029196 ..
4	Reading Material of Entrepreneurship Awareness Camp	Gujral, Raman	Entrepreneurship Development Institute of India (EDI), GOI, 2016 Ahmedabad,
5	Product Design and Manufacturing	Chitale, A K	PHI Learning, New Delhi, 2014; ISBN: 9788120348738
6	Entrepreneurship Development Small Business Entrepreneurship	Charantimath, Poornima	Pearson Education India, New Delhi; ISBN: 9788131762264
7	Entrepreneurship Development: Special edition for MSBTE	CPSC, Manila	Tata Mc-Graw Hill, New Delhi,
8	Entrepreneurship and Small Business Management	Khanka, S.S.	S.Chand and Sons, New Delhi, ISBN: 978-93-5161-094-6
9	Entrepreneurship Development	S, Anil Kumar	New Age International, New Delhi, ISBN: 9788122414349

13. SUGGESTED SOFTWARE/LEARNING WEBSITES

1	MCED Books links	http://www.mced.nic.in/UdyojakSpecial.aspx?linktype=Udyojak
2	MCED Product and Plan Details	http://www.mced.nic.in/allproduct.aspx
3	The National Institute for Entrepreneurship and Small Business Development Publications	http://niesbud.nic.in/Publication.html
4	Courses : The National Institute for Entrepreneurship and Small Business Development	http://niesbud.nic.in/docs/1standardized.pdf
5	Entrepreneur.com	https://www.entrepreneur.com/lists
6	GOVT. SPONSORED SCHEMES	https://www.nabard.org/content1.aspx?id=23andcatid=23andmid=530
7	NABARD - Information Centre	https://www.nabard.org/Tenders.aspx?cid=501andid=24
8	NABARD – What we Do	http://www.nabard.org/content1.aspx?id=8andcatid=8andmid=488
9	Market Review	http://www.businesstoday.in/markets
10	Start Up India	http://www.startupindia.gov.in/pdffile.php?title=Startup%20India%20Action%20Planandtype=Actionandq=Action%20Plan.pdfandcontent_t Actionandsubmenu int=action
11	About - Entrepreneurship Development Institute of India (EDII)	http://www.ediindia.org/institute.html
12	EDII - Centres	http://www.ediindia.org/centres.html
13	EDII - Publications	http://www.ediindia.org/publication.html
14	Business Plans: A Step-by-Step Guide	https://www.entrepreneur.com/article/247574
15	The National Science and Technology Entrepreneurship Development Board (NSTEDB)	http://www.nstedb

16	NSTEDB - Training	http://www.nstedb.com/training/training.htm
17	Tata Exposures	http://www.tatasocial-in.com/project-exposure
18	Ministry Of Micro, Small And Medium EnterpriseS	http://www.dcmsme.gov.in/schemes/TEQUPDetail.htm
19	List of Business Ideas for Small Scale Industry	https://smallb.sidbi.in/%20/thinking-starting-business/big-list-business-ideas-small-business
20	Thinking of Entrepreneurship	https://smallb.sidbi.in/entrepreneurship-stage/thinking-entrepreneurship
21	List of services for Small Scale Industry	http://www.archive.india.gov.in/business/Industry_services/illustrative.php
22	NSIC Schemes and Services	http://www.nsic.co.in/SCHSERV.ASP

MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION MUMBAI

Program Name : **All Branches of Diploma in Engineering and Technology.**

Program Code : **CE/CR/CS/CH/CM/CO/IF/CW/DE/EJ/EN/EQ/ET/EX/IE/ MU/EE/EP/EU/IS/IC/AE/FG/ME/PG/PT/DC/TX/TC**

Semester : **Sixth**

Course Title : **Capstone Project – Execution & Report Writing**

Course Code : **22060**

1. RATIONALE

This course on 'Capstone Project–Execution and Report Writing' is the continuation of the previous semester course on 'Capstone Project–Planning'. So, in this semester, the students are to implement the detailed Capstone Project Plan, which they have prepared in the preceding semester. Therefore, to successfully complete this Capstone Project by the end of this semester, it is necessary to incorporate the suggestions of the guide/examiners of the preceding semester. Hence, it is of utmost importance for the student to again re-capitulate and comprehend the importance, concept and need of the 'Capstone Projects' which are well explained in the 'Capstone Project–Planning' course in the previous semester.

Often, the jobs in the industry, which the diploma holders will come across when they join it and will be in the form of small or large projects. Such projects are generally an integration of the various types of skills which cut across the three major domains of learning i.e. cognitive, psychomotor and affective domain which must have acquired during their journey from first semester to the last semester. Hence, it is essential that students are also given an opportunity to do large projects which require more time compared to the micro-projects in order to develop and integrate the highly essential industry oriented competencies and associated skills in the students. Therefore, in this semester the 'Capstone Project – Execution and Report Writing' will continue to integrate some more additional competencies along with those in the previous semester and hence build up greater confidence to face such situations in the world of work.

2. COMPETENCY

The course should be taught and implemented with the aim to develop the required course outcomes (COs) so that students will acquire following competency needed by the industry:

- **Implement the Capstone Project Plan to solve the identified problem/task faced**

i) Prepare project report after performing due plagiarism check using appropriate tools.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme													
				Theory							Practical						
				Paper Hrs.	ESE		PA		Total		ESE		PA		Total		
L	T	P			Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
-	-	4	4	--	--	--	--	--	--	--	50#	20	50~	20	100	40

Legends: L-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** - Practical; **C** – Credit, **ESE** - End Semester Examination; **PA** - Progressive Assessment

5. Course details

As the implementation of the Capstone project progresses and which has to be submitted at the end of project work, one of the outputs of this course is a detailed ***Project Report*** that is continuously prepared by the student. There will also be regular progressive assessment by the teacher as per the criteria no 7 on the basis of rubrics mentioned in **Appendix –C** and in the formats as shown in **Appendix-B** and also for the end-of-semester examination.

5.1 Guidelines for Capstone Project–Execution and Report Writing

a) The students would like to revise the 'Capstone Project – Plan' based on the feedback received in the fifth semester examination.

b) This revised 'Capstone Project – Plan' would be again approved by the project guide. As soon as the revised plan is approved by the teacher, the student will begin to work according to it and would also continue to maintain a dated ***'Project Diary'*** for the whole semester. This is a sort of a 'weekly diary' indicating all the activities conducted by the student every week in the semester to complete the project. This 'Project Diary' should be got signed by the teacher at regular intervals for progressive assessment. If this is maintained sincerely and truthfully by the student, it will be very helpful in compiling the ***Final Project Report*** at the end of the semester by him/her.

6. Project report

During the final Semester, the student will prepare a 'Project Report' in continuation with the activities conducted in fifth semester under Project Planning having following sub-titles:

Suggested contents of the Project report

- Title page (with name of team members and mentor teacher)
- Certificate (in the Format given in this document as annexure A)
- Acknowledgements (this may need revision at the end of the final semester)
- Abstract (in one paragraph not more than 150 words)
- Content Page

Chapters

1. Chapter–1 Introduction (background of the Industry or User based Problem/Task)
2. Chapter–2 Literature Survey (to finalise and define the Problem Statement)
3. Chapter–3 Scope of the project
4. Chapter–4 Methodology
5. Chapter-5 Details of designs, working and processes

6. Chapter-6 Results and Applications
7. Chapter-7 Conclusions And future scope
8. Appendix (if any)
9. References and Bibliography

Note:

i. The report should contain as many diagrams, figures and charts etc as relevant for the project.
ii. Originality of the report (written in own words) would be given more importance rather than quality of printing and use of glossy paper or multi-colour printing

7. ASSESSMENT OF PROJECT WORK

Project work has two components, first is Progressive Assessment (PA), while another is End Semester Examination (ESE).

7. 1. Progressive Assessment (PA) Guidelines and Criteria

Project guide is supposed to carry out this assessment. It is a continuous process, during which for developing desired qualities in the students, faculty should orally give **informal feedback** to students about their performance and interpersonal behaviour while guiding them on their project work every week. Following criteria should be considered while assessing students informally or formally during different stages of the project work.

The following factors need consideration for both Capstone Project-Planning and Capstone Project-Execution and Report Writing.

a) Students should be assessed during the project work so that students can also get feedback for further improvement.
b) It should be kept in mind that project work is mainly experiential learning and it is not the research work, so emphasis should be on work based learning or learning from experience and development of attitudes and skills as mentioned in course outcomes. So focus of assessment should also be on learning from the process of completing project work rather than on novelty or innovation in the project work.
c) For progressive assessment at the end, students should be asked to give the power point presentation before group of teachers and junior students (so that junior students may also get awareness about the major project work they have to carry out in future)
d) The students would be awarded marks for their efforts (In some cases it may happen that due to some reasons such as unavailability of some material or component or some other resources, students may not be able to complete the project, but they have tried their best, in such cases students would be given appropriate marks if they have done enough efforts.)
e) The students would not be awarded marks if they have completed the project by getting done the work from market or some professionals (taking some help and guidance is different as compared to getting the work or maximum part of the work completed from others on payment basis).
f) Originality of the report (written in own words) would be given more importance.
g) The Project Guide will assure the quality of project done by his group.

Criteria of Marks for PA for Capstone Project -Execution and Report Writing.

S. No.	Criteria	Marks
1	**Project Proposal /Identification**	
2	**Punctuality and overall contribution**	10
3	**Pro ect Diary**	
4	**Execution of Plan during sixth semester**	20
5	**Project Report including documentation**	15
6	**Presentation**	05
	Total	**50**

7.2 END SEMESTER EXAMINATION (ESE)

Evaluation shall be carried out according to following criteria. For each project, students from the concerned group should be asked to make presentation of their project , in front of the external and internal examiners which should be followed by question answer session to ascertain the contribution made by each student.

Criteria of Marks for ESE for Capstone Project -Execution and Report Writing

S. No.	Criteria	Marks
1	Project Proposal	
2	Punctuality and overall contribution	05
3	Project diary	
4	Execution of Plan sixth semester	10
5	Project Report including documentation	10
6	Presentation	10
7	Question and Answer	15
	Total	**50**

8. SPECIAL TEACHING STRETAGIES (If any)

a) Teacher's should not spoon feed the students and let them try on their own at different stages of the project work and even first let them strive hard and only when efforts of students have failed, then teacher should guide them. Guidance should be in initially in the form of clues or hints rather than complete explanation, detailed explanation should be given only when students are not able to work based on clues/hints. The role of teacher should be limited to guide and facilitator

b) Teachers should help students in selecting a topic which is relevant and challenging (but within capacity) for students according to their abilities.

c) ***Teachers should come out of the mindset that there should be compulsorily some innovation and novelty in the project work. Because as discussed earlier, project is mainly opportunity for work based or experiential learning, the aim of which is to develop higher order cognitive skills and attitudes. Project at diploma level is not research or innovation.*** The main thing teachers have to ensure is that students choose a task or problem for their project work which is challenging but according to their capability i.e. a task which they can complete on their g it done from market.

d) Teachers should ensure that students prepare the project plan in as much detail as possible, since this way only they would learn the importance of planning and how to do the detail planning. Teachers should allow students to proceed ahead only when they have detailed plan with them.

e) Teachers should motivate students to maintain project document project diary and project report. They should explain benefits of these activities to students and also train them in these activities, because most of them may be doing this first time.

f) Project Guide should ensure that students submit chapter of report one by one to him/her as per schedule and should check the content of the chapters. The Project guide should monitor that schedule is maintained and report writing is not left till last few weeks. It should not be a problem since first three chapters of the report should have been written in fifth semester itself.

g) Teachers should also encourage students to openly discuss their weaknesses and shortcomings .Teachers should develop confidence in students that admitting mistakes and weaknesses helps in improving them.

h) Teachers should continuously discuss with students about working of group and progress in the project and from this discussion should identify their personal qualities (both strengths and weaknesses) and suggest to them ways for improving those qualities.

i) Internal as well as external examiners should reward students for original work and efforts of students even if they are not fully successful or not able to complete the project in comparison to those students who have taken paid help from others to complete their project.

Appendix–A

CERTIFICATE

This is to certify that Mr./Ms.....

from .....Institute having Enrolment No: .....

has completed project of final year having title .....,.... during the academic year20__-20__. The project completed by individually/ in a group consisting of..... persons under the guidance of the Faculty Guide.

.....

.....

Name & Signature of Guide: .....

Telephone:.....

Appendix–B

PROGRESSIVE ASSESSMENT (PA) OF CAPSTONE PROJECT – EXECUTION AND REPORT WRITING

Evaluation Sheet for Internal Assessment

Name of Student: .....

Name of Programme..... **Semester: Sixth**

Course Title: Capstone Project : Execution and Report Writing **Code:22060.**

Title of the Capstone Project: .....

.....

A. **POs addressed by the Capstone Project** (Mention only those predominant POs)

a) .....

b) .....

c) .....

d) .....

B. **COs addressed by the Capstone Project** (Mention only those predominant POs)

a) .....

b) .....

c) .....

d) .....

C. **OTHER LEARNING OUTCOMES ACHIEVED THROUGH THIS PROJECT**

1. **Unit Outcomes (Cognitive Domain)**

a) .....

b) .....

c) .....

d) .....

2. **Practical Outcomes (in Psychomotor Domain)**

a) .....

b) .....

c) .....

d) .....

3. **Affective Domain Outcomes**

a)

b

c

d

PROGRESSIVE ASSESSMENT (PA) Sheet		
S. No.	**Criteria**	**Marks**
1	Project Proposal /Identification	10
2	Punctuality and overall contribution	
3	Project Diary	
4	Execution of Plan during sixth semester	20
5	Project Report including documentation	15
6	Presentation	05
	Total	**50**

Appendix–B

Suggested Rubric for Capstone Project – Execution and Report Writing

S. No.	Characteristic to be assessed	Poor	Average	Good	Excellent
1	**Problem/Task Identification (Project Title)**	Relate to very few POs Scope of Problem not clear at all	i. Related to some POs ii. Scope of Problem/Task vague	i. Take care of at-least Three POs ii. Scope of Problem/task not very specific	• Take care of more than three POs ii. Scope of problem/task very clear
2	**Literature Survey /Industrial Survey**	Not more than ten sources (primary and secondary), very old reference	At-least 10 relevant sources, at least 5 latest	At –least 15 relevant sources, most latest	About 20 relevant sources, most latest
3	**Project proposal**	Methods are not appropriate, All steps not mentioned, Design of prototype not started (if applicable).	Appropriate plan but not in much detail. Plan B for critical activities not mentioned. Time line is not developed. Design of Prototype is not complete. (if applicable)	Appropriate and detailed plan with Plan B for critical activities mentioned, but clarity is not there in methods, time line is given but not appropriate. Design of prototype is not detailed (if applicable)	Appropriate and detailed plan with Plan B for critical activities mentioned, clarity in methods with time line, Detailed design of prototype (if applicable)
4	**Project Diary**	Entries for most weeks are missing. There is no proper sequence and details are not correct.	Entries for some weeks are missing, details are not appropriate, not signed regularly by the guide.	Entries were made every week but are not in detail. Signed and approved by guide every week	Entries were made every week in detail, signed and approved by guide every week
5	**Final Report Preparation**	Very short, poor quality sketches, Details about methods, material, precaution and conclusions	Detailed, correct and clear description of methods, materials, precautions and	Conclusions. Sufficient Graphic Description.	Very detailed, correct, clear description of methods, materials, precautions and conclusions. Enough tables,

S. No.	Characteristic to be assessed	Poor	Average	Good	Excellent
		omitted, some details are wrong			charts and sketches
6	**Presentation**	Major information is not included, information is not well organized .	Includes major information but not well organized and not presented well	Includes major information and well organized but not presented well	Well organized, includes major information ,well presented
7	**Defense**	Could not reply to considerable number of question.	Replied to considerable number of questions but not very properly	Replied properly to considerable number of question.	Replied to most of the questions properly

Appendix C
Suggestive Project Diary format

Week no:
Activities planned:
Activities Executed:
Reason for delay if any
Corrective measures adopted
Remark and Signature of the Guide

Program Name : **Electronics Engineering Programme Group**

Program Code : **DE/EJ/ET/EN/EX/EQ**

Semester : **Sixth**

Course Title : **VLSI with VHDL**

Course Code : **22062**

1. RATIONALE

In the present scenario of electronics technology, CMOS is a vital important and basic need in the design/development of almost all products in the range from consumer to industrial and telecommunication engineering area. Functional capabilities of this technology leads to advanced Very Large Scale Integration, large density of components, high speed of operation, less area with less power dissipation. Therefore imparting knowledge of VLSI and its tools is need of today. After completion of this course, students will be able to develop applications in the area of digital electronics using VLSI design tools.

2. COMPETENCY

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Maintain VLSI based electronic circuits .**

3. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

a. Develop design flow for the given application using VLSI tools.
b. Interpret CMOS technology circuits with their specifications.
c. Use relevant VHDL model for given application.
d. Debug VHDL program for the given application.
e. Maintain FPGA based circuits

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme													
				Theory							Practical						
L	T	P		Paper Hrs.	ESE		PA		Total		ESE		PA		Total		
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
2	-	2	4	--	--	--	--	--	--	--	25#	10	25~	10	50	20

(*): Under the theory PA, Out of 30 marks, 10 marks are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the cognitive domain UOs required for the attainment of the COs.

***Legends:** **L**-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** - Practical; **C** – Credit, **ESE** - End Semester Examination; **PA** - Progressive Assessment.*

5. COURSE MAP (with sample COs, PrOs, UOs, ADOs and topics)

This course map illustrates an overview of the flow and linkages of the topics at various levels of outcomes (details in subsequent sections) to be attained by the student by the end of the course, in all domains of learning in terms of the industry/employer identified competency depicted at the centre of this map.

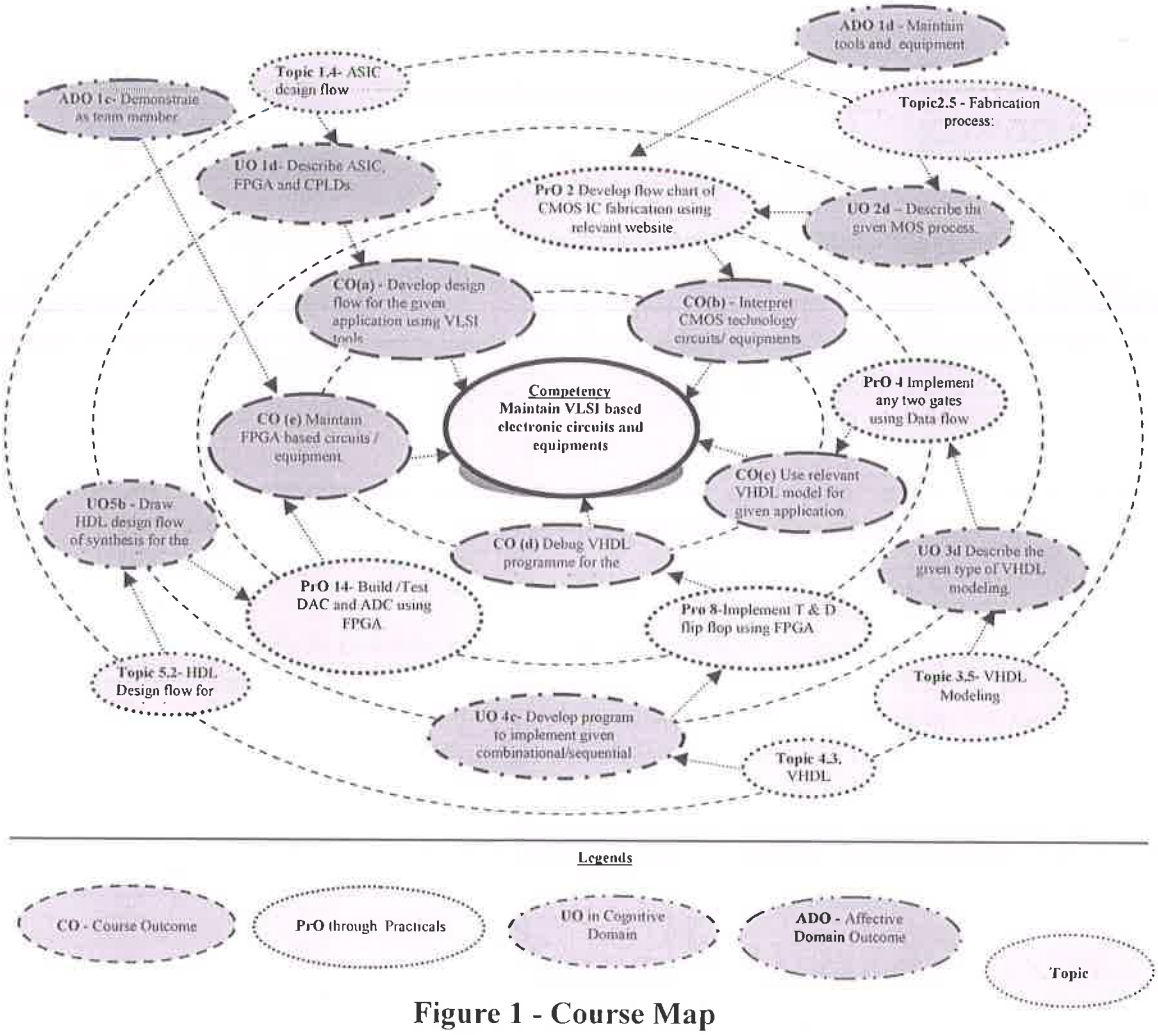


Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

The practicals in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency.

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
1	Identify internal block and pin configuration of FPGA & CPLD using datasheet.	I	02*
2	Develop flow chart of CMOS IC fabrication using relevant website.	II	02*
3	Install EDA tool (VHDL) for VLSI application.	III	02*
4	Implement any two gates using Data flow and Behavioral model.	IV	02*
5	Implement Half /full adder / subtractor using FPGA	IV	02

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
6	Implement 8:1 multiplexer using FPGA	IV	02
7	Implement 1:8 Demultiplexer using FPGA	IV	02
8	Implement T& D-flip-flop using FPGA	IV	02
9	Implement 2:4 Decoder using FPGA	IV	02
10	Implement 8:3 Encoder using FPGA	IV	02
11	Implement up-counter using FPGA	IV	02
12	Implement synchronous counter using FPGA	IV	02
13	Implement binary to gray code converter using FPGA.	IV	02
14	Build /Test DAC using FPGA.	V	02*
15	Implement Stepper motor controller using FPGA.	V	02
16	Implement four Bit ALU or sequence generator using FPGA.	V	02*
	Total		**32**

Note

i. *A suggestive list of **PrOs** is given in the above table. More such PrOs can be added to attain the COs and competency. A judicial mix of minimum 12 or more practical need to be performed, out of which, the practicals marked as '*' are compulsory, so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry.*

ii. *The 'Process' and 'Product' related skills associated with each PrO is to be assessed according to a suggested sample given below:*

S. No.	Performance Indicators	Weightage in %
a.	Preparation of experimental set up	20
b.	Setting and operation	20
c.	Safety measures	10
d.	Observations and Recording	10
e.	Interpretation of result and conclusion	20
f.	Answer to sample questions	10
g.	Submission of report in time	10
	Total	**100**

The above PrOs also comprise of the following social skills/attitudes which are Affective Domain Outcomes (ADOs) that are best developed through the laboratory/field based experiences:

a. Follow safety practices.
b. Practice good housekeeping.
c. Demonstrate working as a leader/a team member.
d. Maintain tools and equipment.
e. Follow ethical practices.

The ADOs are not specific to any one PrO, but are embedded in many PrOs. Hence, the acquisition of the ADOs takes place gradually in the student when s/he undertakes a series of practical experiences over a period of time. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION MUMBAI

- 'Valuing Level' in 1st year
- 'Organizing Level' in 2nd year
- 'Characterizing Level' in 3rd year.

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of experiments, as well as aid to procure equipment by authorities concerned.

S. No.	Equipment Name with Broad Specifications	PrO. S. No.
1	Personal Computer with latest configuration.	All
2	FPGA trainer kit with accessories.	10-15
3	VLSI trainer kit along with peripherals such as switches, keyboard, LEDs, seven segment display.	1-15
4	VLSI trainer kit along with DAC, ADC trainer kit.	1-15
5	VLSI trainer kit along with stepper motor.	1-15
6	JTAG cable, DMM, Bread Board.	1-16
7	Xilinx/Altera or equivalent EDA tool.	13

8. UNDERPINNING THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to develop UOs in cognitive domain for achieving the COs to attain the identified competency.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit – I Advanced Digital Design and ASIC, FPGA, CPLD.	1a. Differentiate between asynchronous and synchronous logic circuit for the given parameters. 1b. Develop the state diagram, state table for the given sequential logic. 1c. Develop model of Moore and Mealy machine of the given Contents. 1d. Describe the given ASIC, FPGA and CPLDs.	1.1 Review of Sequential Logic : Asynchronous and Synchronous, Metastability, Noise margins, Power Fan-out, Skew (Definitions only) 1.2 Moore and Mealy Models, state machine notation, 1.3 Examples on Moore and mealy: counter, sequence detector only 1.4 ASIC design flow 1.5 CPLD - Details of internal block diagram 1.6 FPGA - architecture, details of internal block diagram

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit – II CMOS Technology concepts.	2a. Compare the performance of BJT and CMOS for the given parameters. 2b. Draw the simplified CMOS logic of the given gates. 2c. Explain CMOS inverter characteristics with relevant sketch. 2d. Describe the given MOS fabrication process.	2.1 Introduction of BJT and CMOS parameters 2.2 Basic gates using CMOS Inverter, NOR, NAND, MOS transistor switches, transmission gates, CMOS inverter characteristics. 2.3 Complex logic using CMOS 2.4 Estimation of resistance and capacitance layout. 2.5 Fabrication process: Overview of wafer processing, Oxidation, epitaxy, deposition, Ion–Implementation and diffusion, silicon gate process. 2.6 Basics of NMOS, PMOS and CMOS: nwell, pwell, twin tub process.
Unit– III Introduction to VHDL	3a. Describe Hardware description language, its components and programming syntax. 3b. Describe the given VHDL flow elements. 3c. Describe the use of given data type declaration in VHDL. 3d. Describe the given type of VHDL modeling.	3.1 Introduction to HDL: History of VHDL, Pro's and Con's of VHDL 3.2 VHDL Flow elements:-Entity, Architecture, configuration, package, library only definitions. 3.3 Data Types, operators, operations. 3.4 Signal, constant and variables (syntax and use). 3.5 VHDL Modeling: - Data flow, Behavioral, Structural.
Unit– IV VHDL Programming .	4a. Develop program using concurrent statements for the given application in VHDL. 4b. Develop program using sequential statements for the given application in VHDL. 4c. Develop program to implement the given combinational /sequential logic circuit using VHDL. 4d. Describe the test bench for the given application in VHDL.	4.1 Concurrent constructs (when, with). 4.2 Sequential Constructs (process, if, case, loop, assert, wait) 4.3 VHDL program to implement Flip Flop, Counter, shift register, MUX, DEMUX, ENCODER, DECODER, MOORE, MEALY machines . 4.4 Test bench and its applications.
Unit– V HDL Simulation and Synthesis.	5a. Describe VHDL simulation for the given application. 5b. Draw HDL design flow of synthesis for the given application. 5c. Describe use of efficient coding styles, optimizing expression, sharing of complex operator.	5.1 Event scheduling, sensitivity list, zero modeling, simulation cycle, comparison of software and hardware description language, delta delay. 5.2 HDL Design flow for synthesis 5.3 Efficient Coding Styles, Optimizing arithmetic expression, sharing of complex operator.

***Note**: To attain the COs and competency, above listed UOs need to be undertaken to achieve the 'Application Level' and above of Bloom's 'Cognitive Domain Taxonomy'.*

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Introduction to Advanced Digital Design Specific & and ASIC, FPGA, CPLD.	06	Not Applicable as no theory paper			
II	Introduction to CMOS Technology	04				
III	Introduction to VHDL	08				
IV	VHDL Programming.	08				
V	HDL Simulation and Synthesis.	06				
	Total	**32**				

***Legends:** R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)*
***Note**: This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.*

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Prepare the survey report on the VLSI based applications.
b. Compare technical specifications and applications of various types of memory, CPLDs, FPGA and Prepare report.
c. Refer basic requirement of PC configuration to install VLSI EDA tool.
d. Give seminar on any course relevant topic.
e. Conduct library / internet survey regarding different data sheet and manuals related CPLD, FPGA.
f. Prepare power point presentation on VLSI and their applications.
g. Undertake a market survey of companies profile related to VLSI and prepare report.
h. Search for video / animations / power point presentation on internet for complex topic related to the course and make a presentation.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various learning outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. ***'L' in item No. 4*** does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.

c. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
d. With respect to item No.10, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
e. Guide student(s) in undertaking micro-projects.
f. PPTs/Animations may be used to explain the construction and working of electronic circuits.
g. Guide students for using data sheets / manuals.

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student assigned to him/her in the beginning of the semester. S/he ought to submit it by the end of the semester to develop the industry oriented COs. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than ***16 (sixteen) student engagement hours*** during the course.

In the first four semesters, the micro-project could be group-based. However, in higher semesters, it should be individually undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. A suggestive list is given here. Similar micro-projects could be added by the concerned faculty:

a. Prepare report of CMOS fabrication process.
b. Market Survey related to CMOS IC's and prepare report.
c. Develop four bit addition/subtraction.
d. Develop square wave generator of Frequency = 1Hz/ 100Hz.
e. A shopkeeper requires an alarm system when a customer enters into the shop through exits door. Develop a VLSI based system.
f. An indication for any maloperation in the given application is to be indicated by blinking of LEDs. Build a VLSI based system for the same.

Note: *Use FPGA kit and general purpose PCB for making micro projects*

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	VHDL Basics to programming	Gaganpreet Kaur	Pearson Education India, 2011 ISBN 10: 8131732118 ISBN 13: 9788131732113
2	Digital Logic: Application and design	John M. Yarbrough	C.L Engineering, ISBN 10: 0314066756 ISBN 13: 978 0314066756

S. No.	Title of Book	Author	Publication
3	An engineering approach to digital design	Willian I. Fletcher	Prentice- Hall of India ISBN-13: 978-0132776998 ISBN-10: 0132776995
4	Principles of CMOS VLSI Design: A system perspective	Neil H. E. Weste Kamran Eshraghian	Pearson Education ISBN 10: 0201082225 / ISBN 13: 9780201082227
5	VHDL programming by example	Douglas Perry	Tata Mcgraw-hill; 4 edition (2002) ISBN-10: 0070499446 ISBN-13: 978-0070499447
6	Introduction to VLSI Design	Eugene D. Fabricus	McGraw Hill ISBN-13: 978-0070199484 ISBN-10: 0070199485
7	VLSI design and EDA tools	Sarkar & Sarkar	Scitech Publications (India) Pvt Ltd (December , 2013) ISBN-10: 8183714978 ISBN-13: 978-8183714976
8	Xilinx Manual	Xilinx	www.xilinx.com

14. SUGGESTED SOFTWARE/LEARNING WEBSITES

a. http://rti.etf.bg.ac.rs/rti/ri5rvl/tutorial/TUTORIAL/HTML/HOMEPG.HTM
b. http://iiith.vlab.co.in/?sub=21&brch=66&sim=531&cnt=1&lan=en-IN
c. http://www.vlsiencyclopedia.com/2012/12/loop-statement.html
d. https://books.google.co.in/books?id=RjdYEY8dJvwC&pg=SA3-PA47&lpg=SA3-PA47&dq=vlsi+next+statement&source=bl&ots=oS8dg9uQL6&sig=KHqaQMIgQ5CWkpC_c8Yfew_7h20&hl=en&sa=X&ved=0ahUKEwjx_5LQk5bLAhVRSo4KHcoGDDMQ6AEIPjAH#v=onepage&q=vlsi%20next%20statement&f=false
e. http://only-vlsi.blogspot.in/2007/12/vlsi-design-flow.html
f. http://www.vhdl.renerta.com/source/vhd00014.htm
g. http://www.csee.umbc.edu/portal/help/VHDL/summary.html
h. http://vlab.co.in/ba_labs_all.php?id=1