Maharashtra State Board of Technical Education, Mumbai

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

Program Name : Diploma in Medical Electronics

Program Code : MU **With Effect From Academic Year: 2017 - 18**

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

Semester : Fifth **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	Rehabilitation Engineering	REN	22545	3	2	-	5	3	70	28	30*	00	100	40	--	--	--	--	--	--	100
2	Therapeutic Equipment	TEQ	22546	3	2	2	7	3	70	28	30*	00	100	40	25#	10	25	10	50	20	150
3	Medical Imaging Equipment	MIE	22547	3	-	2	5	3	70	28	30*	00	100	40	25@	10	25	10	50	20	150
4	Intensive Care Equipment	ICE	22548	3	-	2	5	3	70	28	30*	00	100	40	25#	10	25	10	50	20	150
5	Energy and Biomedical Waste Management	EBW	22549	3	-	2	5	3	70	28	30*	00	100	40	25@	10	25	10	50	20	150
6	Enterprenureship Development	EDE	22032	2	-	2	4	--	--	--	--	--	--	--	50@	20	50~	20	100	40	100
			Total	**17**	**4**	**10**	**31**	--	**350**	--	**150**	--	**500**	--	**150**	--	**150**	--	**300**	--	**800**

Student Contact Hours Per Week: **31 Hrs.** Medium of Instruction: **English**

Theory and practical periods of 60 minutes each. Total Marks : **800**

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.**
- **Evalution of Industrial Training and its reports is to done after completion of Industrial Training. Credits of Industrial Training will not affect the framing of time table.**

Program Name : **Diploma in Information Technology/ Automobile Engineering / Digital Electronics / Medical Electronics / Plastic Engineering / Production Engineering / Fashion & Clothing Engineering / Electrical Engineering Group/ Instrumentation/ Instrumentation & Control**

Program Code : **IF/AE/DE/MU/IS/IC/PS/PG/PT/DC/EE/EP/EU**

Semester : **Fifth**

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						
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	--	--	--	--	--	--	--	50@	20	50~	20	100	40	

(\$):*Online Examination;* ***(~)****:PA has two components under practical marks i.e. the assessment of practicals (seen in section 6) has a weightage of 60% (i.e.15 marks) and micro-project assessment (seen in section 12) and the remaining has a weightage 40% (i.e.10*

marks) will be 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* **$:** Online examination.

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.

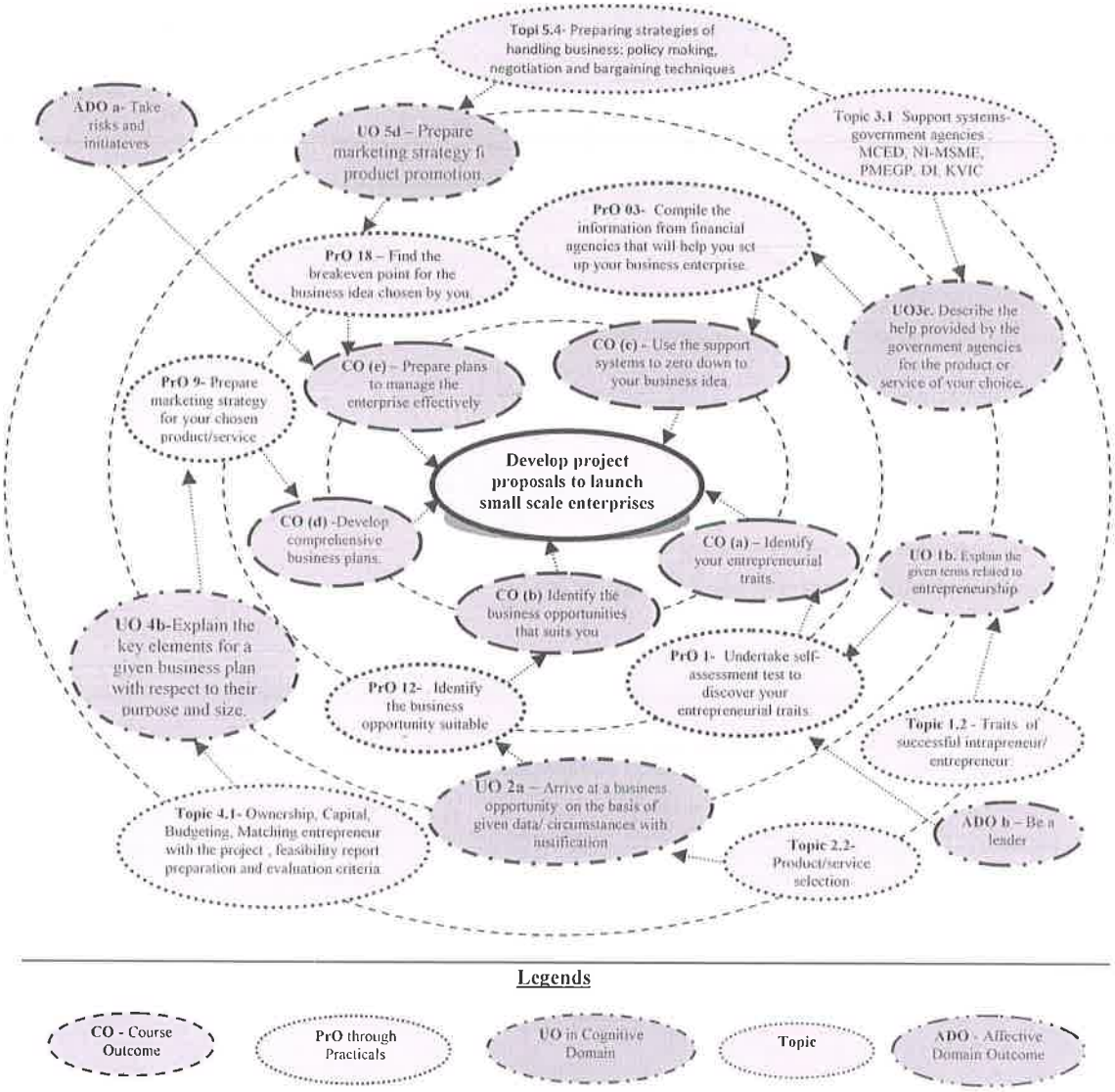

Figure 1 - Course Map

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	Submit a profile summary(about500words) of a successful entrepreneur indicating milestone achievements.	I	02*
2	Undertake SWOT analysis to arrive at your business idea of a product/service.	I	02
3	Generate business ideas(product/service) for intrapreneurial and entrepreneurial opportunities through brainstorming.	II	02*
4	Undertake self-assessment test to discover your entrepreneurial traits.	II	02
5	Identify the business opportunity suitable for you.	II	02
6	Arrange an exhibition cum sale of products prepared out of waste.	II	02
7	Survey industries of your stream, grade them according to the level of scale of production, investment, turnover, pollution to prepare a report on it.	II	02
8	Visit a bank/financial institution to enquire about various funding schemes for small scale enterprise.	III	02
9	Collect loan application forms of nationalise banks/other financial institutions.	III	02
10	Compile the information from financial agencies that will help you set up your business enterprise.	III	02*
11	Compile the information from the government agencies that will help you set up your business enterprise.	III	02
12	Prepare Technological feasibility report of a chosen product/service.	III	02
13	Prepare financial feasibility report of a chosen product/service.	III	02
14	Craft a vision statement and enabling mission statements for your chosen enterprise.	III	02
15	Prepare a set of short term,medium and long term goals for starting a chosen small scale enterprise	III	02
16	Prepare marketing strategy for your chosen product/service.	IV	02*
17	Compile information about various insurance schemes covering different risk factors.	IV	02
18	Organize a funfair of your class and write a report of profit/loss	V	02
19	Find the breakeven point for the business idea chosen by you.	V	02
20	Arrange a discussion session with your institute's pass out students who are successful entrepreneurs.	V	02
21	Prepare a business plan for your chosen small scale enterprise	V	02*
	Total		**42**

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:

Sample Products that can be manufactured under SME

1. Badges cloth embroidered and metals
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
31. Handles wooden and bamboo (Procurement can also be made from State Forest Corpn. and State Handicrafts Corporation)
32. Haver Sacks
33. Honey
34. Invalid wheeled chairs.
35. Iron (dhobi)
36. Lamp holders
37. Letter Boxes
38. Nail Cutters
39. Oil Stoves (Wick stoves only)
40. Paper conversion products, paper bags, envelops, Ice-cream cup, paper cup and saucers and paper Plates
41. Pickles, Chutney and Pappads
42. Pouches for various purposes

43. Safe meat and milk
44. Safety matches
45. Safety Pins (and other similar products like paper pins, staples pins etc.)
46. Shoe laces
47. Sign Boards painted
48. Soap Liquid
49. Spectacle frames
50. Steel Chair
51. Umbrellas
52. Utensils all types

Sample Services that can be offered under SME

1. Marketing Consultancy
2. Industrial Consultancy
3. Equipment Rental & Leasing
4. Typing Centres
5. Photocopying Centres (Zeroxing)
6. Industrial photography
7. Industrial R & D Labs.
8. Industrial Testing Labs.
9. Desk Top publishing
10. Advertising Agencies
11. Internet Browsing/Setting up of Cyber Cafes
12. Auto Repair, services and garages
13. Documentary Films on themes like Family Planning, Social forestry, energy conservation and commercial advertising
14. Laboratories engaged in testing of raw materials, finished products
15. 'Servicing Industry' Undertakings engaged in maintenance, repair, testing or electronic/electrical equipment/ instruments i.e. measuring/control instruments servicing of all types of vehicles and machinery of any description including televisions, tape recorders, VCRs, Radios, Transformers, Motors, Watches.
16. Laundry and Dry Cleaning
17. X-Ray Clinic
18. Tailoring
19. Servicing of agriculture farm equipment e.g. Tractor, Pump, Rig, Boring Machines.
20. Weigh Bridge
21. Photographic Lab
22. Blue printing and enlargement of drawing/designs facilities
23. ISD/STD Booths
24. Teleprinter/Fax Services
25. Sub-contracting Exchanges (SCXs) established by Industry Associations.
26. Coloured or Black and White Studios equipped with processing laboratory.
27. Ropeways in hilly areas.
28. Installation and operation of Cable TV Network:
29. Operating EPABX under franchises
30. Beauty Parlours
31. Creches.

S. No.	Performance Indicators	Weightage in %
1	Leadership skills	20

S. No.	Performance Indicators	Weightage in %
2	Team work	20
3	Lateral/creative thinking	10
4	Observations and recording	10
5	Self learning	20
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.	1.1 Entrepreneurship as a career 1.2 Traits of successful intrapreneur/ entrepreneur: consistency, creativity, initiative, independent decision making, assertiveness, persuasion, persistence, information seeking.

Unit	Unit Outcomes (In cognitive domain)	Topics and Sub-topics
	1b. Explain the given terms related to Entrepreneurship 1c. Describe the salient features of the resources required for starting the specified enterprise. 1d. Identify the characteristics for a given type of enterprise.	handling business communication, commitment to work contract, calculated risk taking. 1.3 Entrepreneurship : scope in local and global market. 1.4 Intrapreneur and entrepreneur 1.5 Types of enterprises and their features : manufacturing, service and trading. 1.6 Steps in setting up of a business.
Unit – II Entrepreneurial Opportunities and selection process	2a. Arrive at a business opportunity on the basis of given data/circumstances with justification. 2b. Describe the scheme(s) offered by the government for starting the specified enterprise. 2c. Suggest a suitable place for setting up the specified enterprise on the basis of given data/circumstances with justification. 2d. Suggest the steps for the selection process of an enterprise for the specified product or service with justification. 2e. Describe the market study procedure of the specified enterprise.	2.1 Product/Service selection: Process, core competence, product/service life cycle, new product/ service development process, mortality curve, creativity and innovation in product/ service modification / development. 2.2 Process selection: Technology life cycle, forms and cost of transformation, factors affecting process selection, location for an industry, material handling. 2.3 Market study procedures: questionnaire design, sampling, market survey, data analysis 2.4 Getting information from concerned stakeholders such as Maharashtra Centre for Entrepreneurship Development[MCED], National Institute for Micro, Small and Medium Enterprises [NI-MSME], Prime Minister Employment Generation Program [PMEGP], Directorate of Industries[DI], Khadi Village Instries Commission[KVIC]
Unit – III Support Systems	3a. Describe the support system required for the specified enterprise. 3b. Describe the help provided by the government agencies for the specified product/service. 3c. Describe the help provided by the non-governmental agencies for the specified product/service. 3d. Compute the breakeven	3.1 Categorisation of MSME, ancillary industries 3.2 Support systems- government agencies: MCED, NI-MSME, PMEGP,DI, KVIC 3.3 Support agencies for entrepreneurship guidance, training, registration, technical consultation, technology transfer and quality control, marketing and finance. 3.4 Breakeven point, return on investment and return on sales.

Unit	Unit Outcomes (In cognitive domain)	Topics and Sub-topics
	point for the specified business enterprise, stating the assumptions made.	
UNIT IV Business Plan Preparation	4a. Justify the importance of the business plan for the given product/service. 4b. Explain the key elements for the given business plan with respect to their purpose/size 4c. Prepare the budget for the given venture. 4d. Prepare the details of the given component of the given startup business plan.	4.1 Sources of Product for Business : Feasibility study 4.2 Ownership, Capital, Budgeting, Matching entrepreneur with the project , feasibility report preparation and evaluation criteria 4.3 Business plan preparation
Unit –V Managing Enterprise	5a. Justify the USP of the given product/ service from marketing point of view. 5b. Formulate a business policy for the given product/service. 5c. Choose the relevant negotiation techniques for the given product/ service with justification. 5d. Identify the risks that you may encounter for the given type of business/enterprise with justification. 5e. Describe the role of the incubation centre for the given product/service.	5.1 Unique Selling Proposition [U.S.P.]: Identification, developing a marketing plan. 5.2 Preparing strategies of handling business: policy making, negotiation and bargaining techniques. 5.3 Risk Management: Planning for calculated risk taking, initiation with low cost projects, integrated futuristic planning, angel investors, venture capitalist. 5.4 Incubation centres: Role and procedure.

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

9. SSUGGESTED 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. Develop two products from household waste (attach photographs).
b. Download product development and innovative films from internet.
c. Prepare a collage for 'Traits of successful entrepreneurs'.
d. Invite entrepreneurs, industry officials, bankers for interaction.
e. Identify your hobbies and interests and convert them into business idea.
f. Convert you project work into business.

g. Choose a product and design a unique selling preposition, brand name, logo, advertisement (print, radio, television), jingle, packing, packaging, label for it.
h. Develop your own website. Share your strengths and weakness on it. Declare your time bound goals and monitor them on the website.
i. Choose any advertisement and analyse its good and bad points.
j. Decide any product and analyse its good and bad features.
k. Select any product and prepare its cost sheet.
l. Choose any product and study its supply chain.
m. Arrange brainstorming sessions for improvement of any product.
n. Study schemes for entrepreneurship promotion of any bank.
o. Visit industrial exhibitions, trade fairs and observe nitty-gritty of business.
p. Open a savings account and build your own capital.
q. Organise industrial visit and suggest modifications for process improvement.
r. Interview at least four entrepreneurs or businessman and identify Charms of entrepreneurship and Traits of successful entrepreneurs.
s. Analyse case studies of any two successful entrepreneurs.
t. Perform a survey and identify local resources available for setting up of an enterprise.
u. Engage in marketing of products.
v. Carry out a demand supply gap analysis for a particular product.
w. Organise a prototype development competition.
x. Arrange fairs, events in the institute and try for sponsorships.
y. Select any performance criteria and continuously compete with yourself.
z. On any performance criteria continuously compete with others.
aa. Foresee your dream and make a long term plan for its accomplishment.
bb. Dream for something unique and make a write-up.
cc. Read articles, books on creativity.
dd. Using morphological analysis technique, reduce cost or increase quality of a product.
ee. Conduct a market survey for a project. Collect data on machinery specifications, price, output/hr, power consumption, manpower requirement, wages, raw material requirement, specification, price, competitor's product price, features, dealer commissions, marketing mix.
ff. Prepare a business plan and organize a business plan competition.
gg. Select a social cause, set objectives, plan and work for its accomplishment.
hh. Videograph as many as possible from the above and upload on your website, YouTube, facebook.

10. 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/UOs 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. 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.

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, 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	Khanka, S.S.	S.Chand and Sons, New Delhi;

S. No.	Title of Books	Author	Publication
	Business Management		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_type=Actionandsubmenupoint=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.com/index.htm
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

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 : **Fifth**

Course Title : **Capstone Project – Planning**

Course Code : **22058**

1. RATIONALE

To develop "learning to learn" skill in the students so that they continue to acquire on their own new knowledge and skills from different 'on the job experiences' during their career in industry. An educational 'project' just does that and may be defined as ***'a purposeful student activity, planned, designed and performed by a student or group of students to solve/ complete the identified problem/task, which require students to integrate the various skills acquired over a period to accomplish higher level cognitive and affective domain outcomes and sometimes the psychomotor domain outcomes as well'***. Projects mainly serve this purpose of developing learning-to-learn skills with an aim to develop the following attributes in the students:

a) Initiative, confidence and ability to tackle new problems
b) Spirit of enquiry
c) Creativity and innovativeness
d) Planning and decision making skills
e) Ability to work in a team and to lead a team
f) Ability of self directed learning which is required for lifelong learning
g) Persistence (habit of not giving up quickly and trying different solutions in case of momentary failures, till success is achieved)
h) Resourcefulness
i) Habit of keeping proper records of events and to present a formal comprehensive report of their work.
(Rational should not contain attributes and these attributes are repeated in CO s therefore may be eliminated)

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:

- **Plan innovative/creative solutions independently and/or collaboratively to integrate various competencies acquired during the semesters to solve/complete the identified problems/task/shortcomings faced by industry/user related to the concerned occupation.**

3. COURSE OUTCOMES (COs)

The following could be some of the major course outcomes depending upon the nature of the projects undertaken. However, in case of some projects few of the following course outcomes may not be applicable.

a) Write the problem/task specification in existing systems related to the occupation.
b) Select, collect and use required information/knowledge to solve the problem/complete the task.
c) Logically choose relevant possible solution(s).
d) Consider the ethical issues related to the project (if there are any).
e) Assess the impact of the project on society (if there is any).

f) Prepare 'project proposals' with action plan.
g) Communicate effectively and confidently as a member and leader of team.

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	--	--	--	--	--	--	--	25@	10	25	10	50	20	

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

5. Capstones Project

One of the dictionary meaning is the 'crown' or the stone placed on top of the building structure like 'kalash on top of Temples and Mosques' or 'Cross on top of churches'. Capstone projects are culminating experiences in which students synthesize the competencies acquired over whole programme. In some cases they also integrate cross-disciplinary knowledge. Thus Capstone projects prepare students for entry into a career and can be described as a 'rite of passage' or 'minimal threshold' through which participants change their status from student to graduate. A capstone project therefore should serve as a synthesis — reflection and integration— to bridge the real-world preparatory experience to real life. Thus capstone project should have emphasis on integration, experiential learning, and real-world problem solving and hence these projects are very important for students. To develop the highly essential industry oriented skills and competencies in the students, the capstone projects are offered in the last two semesters to serve for following purposes:

a) Integrate the competencies acquired by the students in the previous and current semesters.
b) Provide opportunities for interdisciplinary work in tackling problems likely to be faced by them in industry which are exciting and challenging.

6. Capstone Project Planning

Students are supposed to find out a suitable project and prepare a detailed plan in fifth semester so that it can be executed smoothly in sixth semester. The main characteristic of any project whether small or big is that it requires simultaneous application of various types of skills in the different domains of learning. In the process of arriving at a particular solution, the student must be required to make a number of decisions after scrutiny of the information s/he has accumulated from experiments, analysis, survey and other sources.

The projects will have a detailed project proposal, which must be executed or implemented within the time allocated, simultaneously maintaining a project diary periodically monitored by the teacher. A detailed project report is to be prepared as project progresses, which has to be submitted after the project is over. Project diary will be assessed by teacher

During the guidance and supervision of the project work, teachers' should ensure that students acquire following ***learning outcomes*** (depending upon the nature of the project work some of these learning outcomes may not be applicable):

a) Identify the problems in the area related to their programme.
b) Identify the information suggesting the cause of the problem and possible solutions.
c) Assess the feasibility of different solutions and the financial implications.
d) Collect relevant data from different sources (books/internet/market/suppliers/experts etc. through surveys/interviews).

e) Prepare required drawings and detailed plan for execution of the work.
f) Prepare seminar presentations to present findings/features of the project.

During the guidance and supervision of the project work, teachers' should ensure that the given rubrics are observed

If students are able to acquire these *learning outcomes*, then they would be able to acquire the COs as discussed in section 3.

7. Scopes of Projects

Scope of the project work should be decided based on following criteria:

a) **Relation to diploma programme curriculum:**
b) **Abilities possessed by the group of students:**
c) **Resources Available:**
d) **Suggested Type of Capstone Projects**

In general, the projects that the students can take up could be of the following types;

i. Design projects
ii. Prototype (design, make, test and evaluate).
iii. Field works: This could include surveys, using equipment, charting data and information from visual observation and prepare a case study.
iv. Fabrication of some equipment/machine etc.
v. Construction of some structure.
vi. Application development using hardware/software.

The best practice is that teacher should guide students about the above factors to be considered for choosing the project and based on these factors students should do the ground work and identify the possible projects and teachers should work as only facilitator and Guide in final selection of the project title and its scope.

8. GUIDELINES FOR UNDERTAKING A PROJECT

The selection of the *Capstone Project title* must have emphasis to attain with respect to CO's , PO's and PSO's of the programme. The students will then work on the identified problem/task through a rigorous process of understanding and analyzing the problem, conducting a literature search, deriving and discussing under the supervision of project guide. The project team will prepare the **Project Proposal** with the following sub-titles:

a) Rationale (one page)
b) Introduction
c) Literature Survey
d) Problem Definition
e) Proposed Methodology of solving Identified problem
f) Resources and consumables required.
g) Action Plan (sequential list of activities with probable dates of completion)

Project Idea shall be approved by the teacher and HOD. The student will begin to maintain a dated Project Diary comprising of 15-20 pages for the whole semester. This diary should be assessed by teacher timely.

Suggested Project Activities to be performed in Semester V (Project Planning)

a) Finalization of project team and allocation of project guide
b) Identify project domain /area
c) Submission of Project Proposals/ Project Ideas by the project team
d) Finalization of Project Idea by project guide and HOD
e) Weekly interaction of project team and project guide
f) Project team should perform activities as mentioned in criteria no 8 and record in project diary (appendix D)
g) Before the end of semester V, Project team should prepare and submit Project Planning Report as mentioned in criteria no 9.

h) Project team should prepare and submit detailed schedule of Project Execution and Report writing of Semester VI in consultation with project guide.

9. Project Planning Report

At the end of fifth Semester, the student will prepare a Semester V ,**Project Planning Report** with the following sub-titles:

- Certificate (in the Format given in this document as annexure A)
- Acknowledgements
- Abstract (in one paragraph not more than 150 words)
- Content Page
- Chapter-1 Introduction and background of the Industry or User based Problem
- Chapter-2 Literature Survey for Problem Identification and Specification,
- Chapter-3 Proposed Detailed Methodology of solving the identified problem with action plan
- References and Bibliography

Note: The report should contain relevant diagrams and figures, charts.

10. ASSESSMENT OF CAPSTONE PROJECT – PLANNING

Like other courses, assessment of Project work also has two components, first is progressive assessment, while another is end of the term assessment. The faculty will undertake the progressive assessment to develop the COs in the students. They can give oral informal feedback about their performance and their interpersonal behaviour while guiding them on their project work every week. There will also be regular progressive assessment by the teacher as per the criteria no 12 and 13 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.

11. PROGRESSIVE ASSESSMENT (PA) GUIDELINES AND CRITERIA

The assessment of the students in the fifth semester Progressive Assessment (PA) for 25 marks is to be done based on following criteria.

S. No.	Criteria	Marks
1	**Problem Identification/Project Title**	**10**
2	**Industrial Survey and Literature Review**	
3	**Punctuality and overall contribution**	
4	**Project Diary**	
5	**Report writing including documentation.**	**10**
6	**Presentation**	**05**
	Total	**25**

12 END-SEMESTER-EXAMINATION (ESE) ASSESSENT CRITERIA

The assessment of the students in the fifth semester end-semester-examination (ESE) for 25 marks is to be done based on following criteria. This assessment shall be done by the HOD/Senior Faculty in the presence of Project guide.

S. No.	Criteria	Marks
1	**Report writing including documentation.**	**10**
2	**Presentation**	**15**
	Total	**25**

Annexure- A
CERTIFICATE

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

from (institute)..... having Enrolment No: .....

has completed ***Project Planning Report*** having title .....

Individually/ in a group consisting of..... Candidates under the guidance of the Faculty Guide.

Name & Signature of Guide.....

.Name & Signature of HOD: .....

Appendix–B
Evaluation Sheet (ESE)

for

Capstone Project Planning

Name of Student: .....Enrollment No.....

Name of Program..... **Semester:** .....

Course Title and Code:.....

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**	**Max Marks**	**Marks Obtained**
1	**Problem Identification/Project Title**	**10**	
2	**Industrial Survey and Literature Review**		
3	**Punctuality and overall contribution**		
4	**Project Diary**		
5	**Report writing including documentation.**	**10**	
6	**Presentation**	**05**	
	Total	**25**	

Name and Signature of Project Guide:

Appendix–C

SUGGESTED RUBRIC FOR ASSESSMENT OF CAPSTONE PROJECT

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	i. 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)

S. No.	Characteristic to be assessed	Poor	Average	Good	Excellent
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 omitted, some details are wrong	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, 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	**Question and Answer session**	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 D
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 : **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 : **Fifth**

Course Title : **Capstone Project – Planning**

Course Code : **22058**

1. RATIONALE

To develop "learning to learn" skill in the students so that they continue to acquire on their own new knowledge and skills from different 'on the job experiences' during their career in industry. An educational 'project' just does that and may be defined as ***'a purposeful student activity, planned, designed and performed by a student or group of students to solve/ complete the identified problem/task, which require students to integrate the various skills acquired over a period to accomplish higher level cognitive and affective domain outcomes and sometimes the psychomotor domain outcomes as well'***. Projects mainly serve this purpose of developing learning-to-learn skills with an aim to develop the following attributes in the students:

a) Initiative, confidence and ability to tackle new problems
b) Spirit of enquiry
c) Creativity and innovativeness
d) Planning and decision making skills
e) Ability to work in a team and to lead a team
f) Ability of self directed learning which is required for lifelong learning
g) Persistence (habit of not giving up quickly and trying different solutions in case of momentary failures, till success is achieved)
h) Resourcefulness
i) Habit of keeping proper records of events and to present a formal comprehensive report of their work.
(Rational should not contain attributes and these attributes are repeated in CO s therefore may be eliminated)

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:

- **Plan innovative/creative solutions independently and/or collaboratively to integrate various competencies acquired during the semesters to solve/complete the identified problems/task/shortcomings faced by industry/user related to the concerned occupation.**

3. COURSE OUTCOMES (COs)

The following could be some of the major course outcomes depending upon the nature of the projects undertaken. However, in case of some projects few of the following course outcomes may not be applicable.

a) Write the problem/task specification in existing systems related to the occupation.
b) Select, collect and use required information/knowledge to solve the problem/complete the task.
c) Logically choose relevant possible solution(s).
d) Consider the ethical issues related to the project (if there are any).
e) Assess the impact of the project on society (if there is any).

f) Prepare 'project proposals' with action plan.
g) Communicate effectively and confidently as a member and leader of team.

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	--	--	--	--	--	--	--	25@	10	25	10	50	20	

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

5. Capstones Project

One of the dictionary meaning is the 'crown' or the stone placed on top of the building structure like 'kalash on top of Temples and Mosques' or 'Cross on top of churches'. Capstone projects are culminating experiences in which students synthesize the competencies acquired over whole programme. In some cases they also integrate cross-disciplinary knowledge. Thus Capstone projects prepare students for entry into a career and can be described as a 'rite of passage' or 'minimal threshold' through which participants change their status from student to graduate. A capstone project therefore should serve as a synthesis — reflection and integration— to bridge the real-world preparatory experience to real life. Thus capstone project should have emphasis on integration, experiential learning, and real-world problem solving and hence these projects are very important for students. To develop the highly essential industry oriented skills and competencies in the students, the capstone projects are offered in the last two semesters to serve for following purposes:

a) Integrate the competencies acquired by the students in the previous and current semesters.
b) Provide opportunities for interdisciplinary work in tackling problems likely to be faced by them in industry which are exciting and challenging.

6. Capstone Project Planning

Students are supposed to find out a suitable project and prepare a detailed plan in fifth semester so that it can be executed smoothly in sixth semester. The main characteristic of any project whether small or big is that it requires simultaneous application of various types of skills in the different domains of learning. In the process of arriving at a particular solution, the student must be required to make a number of decisions after scrutiny of the information s/he has accumulated from experiments, analysis, survey and other sources.

The projects will have a detailed project proposal, which must be executed or implemented within the time allocated, simultaneously maintaining a project diary periodically monitored by the teacher. A detailed project report is to be prepared as project progresses, which has to be submitted after the project is over. Project diary will be assessed by teacher

During the guidance and supervision of the project work, teachers' should ensure that students acquire following ***learning outcomes*** (depending upon the nature of the project work some of these learning outcomes may not be applicable):

a) Identify the problems in the area related to their programme.
b) Identify the information suggesting the cause of the problem and possible solutions.
c) Assess the feasibility of different solutions and the financial implications.
d) Collect relevant data from different sources (books/internet/market/suppliers/experts etc. through surveys/interviews).

e) Prepare required drawings and detailed plan for execution of the work.
f) Prepare seminar presentations to present findings/features of the project.

During the guidance and supervision of the project work, teachers' should ensure that the given rubrics are observed

If students are able to acquire these *learning outcomes*, then they would be able to acquire the COs as discussed in section 3.

7. Scopes of Projects

Scope of the project work should be decided based on following criteria:

a) **Relation to diploma programme curriculum:**
b) **Abilities possessed by the group of students:**
c) **Resources Available:**
d) **Suggested Type of Capstone Projects**

In general, the projects that the students can take up could be of the following types;

i. Design projects
ii. Prototype (design, make, test and evaluate).
iii. Field works: This could include surveys, using equipment, charting data and information from visual observation and prepare a case study.
iv. Fabrication of some equipment/machine etc.
v. Construction of some structure.
vi. Application development using hardware/software.

The best practice is that teacher should guide students about the above factors to be considered for choosing the project and based on these factors students should do the ground work and identify the possible projects and teachers should work as only facilitator and Guide in final selection of the project title and its scope.

8. GUIDELINES FOR UNDERTAKING A PROJECT

The selection of the *Capstone Project title* must have emphasis to attain with respect to CO's , PO's and PSO's of the programme. The students will then work on the identified problem/task through a rigorous process of understanding and analyzing the problem, conducting a literature search, deriving and discussing under the supervision of project guide. The project team will prepare the **Project Proposal** with the following sub-titles:

a) Rationale (one page)
b) Introduction
c) Literature Survey
d) Problem Definition
e) Proposed Methodology of solving Identified problem
f) Resources and consumables required.
g) Action Plan (sequential list of activities with probable dates of completion)

Project Idea shall be approved by the teacher and HOD. The student will begin to maintain a dated Project Diary comprising of 15-20 pages for the whole semester. This diary should be assessed by teacher timely.

Suggested Project Activities to be performed in Semester V (Project Planning)

a) Finalization of project team and allocation of project guide
b) Identify project domain /area
c) Submission of Project Proposals/ Project Ideas by the project team
d) Finalization of Project Idea by project guide and HOD
e) Weekly interaction of project team and project guide
f) Project team should perform activities as mentioned in criteria no 8 and record in project diary (appendix D)
g) Before the end of semester V, Project team should prepare and submit Project Planning Report as mentioned in criteria no 9.

h) Project team should prepare and submit detailed schedule of Project Execution and Report writing of Semester VI in consultation with project guide.

9. Project Planning Report

At the end of fifth Semester, the student will prepare a Semester V ,**Project Planning Report** with the following sub-titles:

- Certificate (in the Format given in this document as annexure A)
- Acknowledgements
- Abstract (in one paragraph not more than 150 words)
- Content Page
- Chapter-1 Introduction and background of the Industry or User based Problem
- Chapter-2 Literature Survey for Problem Identification and Specification,
- Chapter-3 Proposed Detailed Methodology of solving the identified problem with action plan
- References and Bibliography

Note: The report should contain relevant diagrams and figures, charts.

10. ASSESSMENT OF CAPSTONE PROJECT – PLANNING

Like other courses, assessment of Project work also has two components, first is progressive assessment, while another is end of the term assessment. The faculty will undertake the progressive assessment to develop the COs in the students. They can give oral informal feedback about their performance and their interpersonal behaviour while guiding them on their project work every week. There will also be regular progressive assessment by the teacher as per the criteria no 12 and 13 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.

11. PROGRESSIVE ASSESSMENT (PA) GUIDELINES AND CRITERIA

The assessment of the students in the fifth semester Progressive Assessment (PA) for 25 marks is to be done based on following criteria.

S. No.	Criteria	Marks
1	**Problem Identification/Project Title**	**10**
2	**Industrial Survey and Literature Review**	
3	**Punctuality and overall contribution**	
4	**Project Diary**	
5	**Report writing including documentation.**	**10**
6	**Presentation**	**05**
	Total	**25**

12 END-SEMESTER-EXAMINATION (ESE) ASSESSENT CRITERIA

The assessment of the students in the fifth semester end-semester-examination (ESE) for 25 marks is to be done based on following criteria. This assessment shall be done by the HOD/Senior Faculty in the presence of Project guide.

S. No.	Criteria	Marks
1	**Report writing including documentation.**	**10**
2	**Presentation**	**15**
	Total	**25**

Annexure- A
CERTIFICATE

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

from (institute)..... having Enrolment No: .....

has completed ***Project Planning Report*** having title .....

Individually/ in a group consisting of..... Candidates under the guidance of the Faculty Guide.

Name & Signature of Guide.....

.Name & Signature of HOD: .....

Appendix–B
Evaluation Sheet (ESE)

for

Capstone Project Planning

Name of Student: .....Enrollment No.....

Name of Program..... **Semester:** .....

Course Title and Code:.....

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**	**Max Marks**	**Marks Obtained**
1	**Problem Identification/Project Title**	**10**	
2	**Industrial Survey and Literature Review**		
3	**Punctuality and overall contribution**		
4	**Project Diary**		
5	**Report writing including documentation.**	**10**	
6	**Presentation**	**05**	
	Total	**25**	

Name and Signature of Project Guide:

Appendix–C

SUGGESTED RUBRIC FOR ASSESSMENT OF CAPSTONE PROJECT

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	i. 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)

S. No.	Characteristic to be assessed	Poor	Average	Good	Excellent
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 omitted, some details are wrong	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, 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	**Question and Answer session**	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 D
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 : **Diploma in Medical Electronics**

Program Code : **MU**

Semester : **Fifth**

Course Title : **Therapeutic Equipment**

Course Code : **22546**

1. RATIONALE

Therapeutic equipment is heart of physiotherapy department that are used not only in the hospitals, but also exclusively used in cosmetics, dermatology, and injuries occurred in sports. This therapy equipment are based on high frequency stimulations, heat radiations, ultrasound and laser. This course will aid the students to apply the knowledge to maintain the therapy equipment after graduation as biomedical engineers while serving in hospitals and industries.

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 the physiotherapy equipment.**

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 specifications of physiotherapy equipment.
b. Maintain ultrasound and diathermy machines.
c. Maintain electrotherapy and cold therapy technique for pain relief.
d. Use the different electrodes used in surgical unit.
e. Follow general safety aspects and equipment safety in hospital environment.

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	2	7	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.

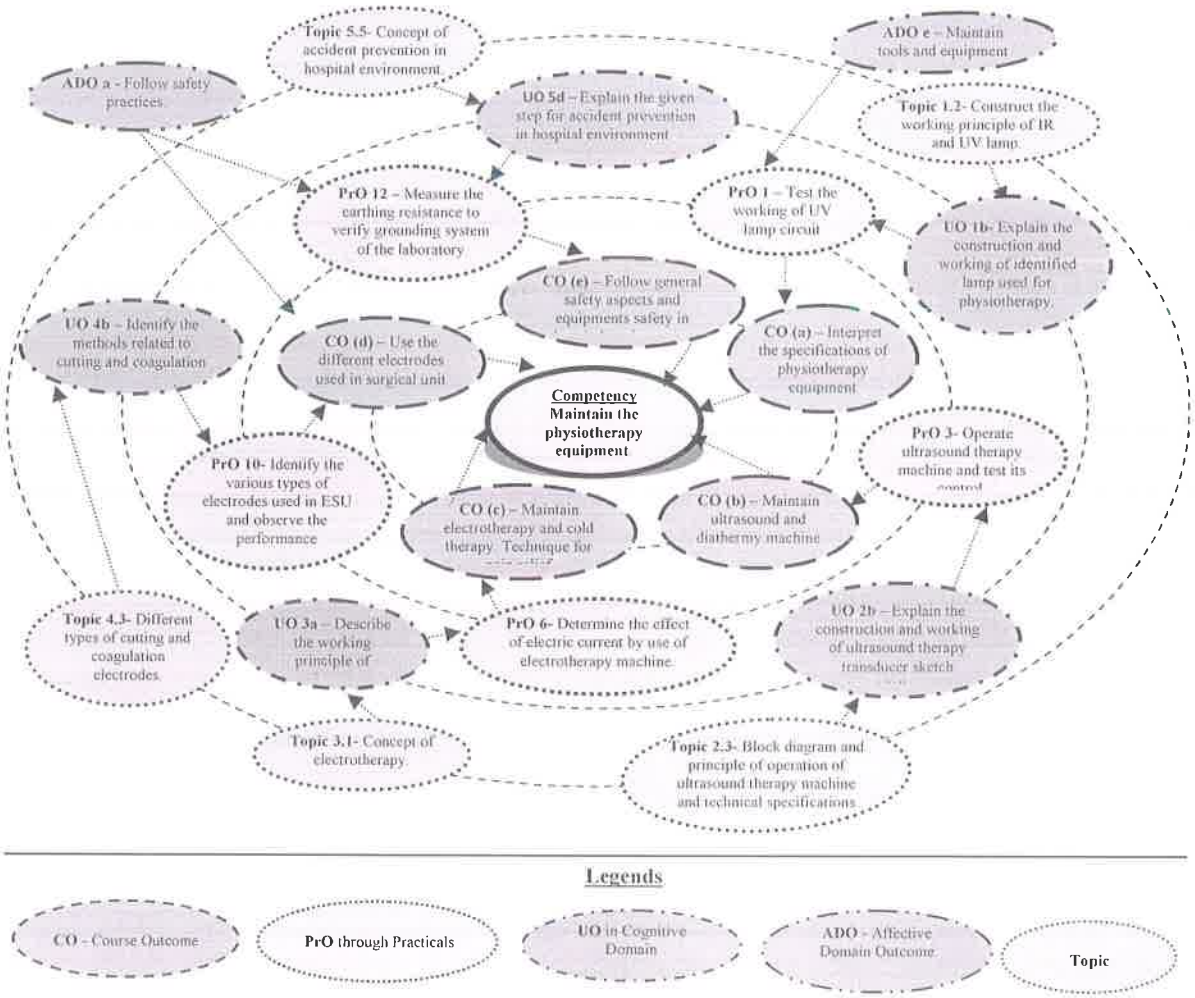

Figure 1 - Course Map

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	Test the working principle of UV lamp circuit.	I	02*
2	Test the working principle of IR lamp circuit.	I	02*
3	Operate ultrasound therapy machine and test its control.	II	02
4	Test the performance of short wave diathermy machine and various controls.	II	02
5	Use the capacitive and inductive method as application techniques of short wave diathermy.	II	02
6	Determine the effect of electric current by use of electrotherapy machine.	III	02
7	Draw the different types of waveforms of nerve- muscle stimulator using CRO.	III	02
8	Draw the different types of waveforms of nerve- muscle stimulator using analyzer.	III	02
9	Use different cold therapy techniques.	III	02*

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
10	Identify the various types of electrodes used in electrosurgical unit and observe the performance.	IV	02
11	Operate the ESU machine in different modes of ESU and observe its waveforms.	IV	02*
12	Measure the earthing resistance to verify grounding system of the laboratory.	V	02
	Total		**24**

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.
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
- '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	**IR Lamp:** power 200W, Voltage 110 or 220-230V, Frequency 50/60Hz, Cord-length 200cm	1
2	**UV Lamp:** Curing Width 50-1700mm, Lamp Housing: 300-1998mm, UV pulsing power: Up to 240W/cm, power of 15 W, wavelength of UV A spectrum (365 nm), length of 436 mm – Vilber or a corresponding one	1
3	**Ultrasound Therapy machine:** Frequency 1MIIZ and 3MIIZ, Therapy modes Continuous/Pulsed, Pulse Settings/Hz 9 settings/100 HZ, Output power -0-3W/cm^2,Timer-0-60mins	2
4	**Nerve Muscle Stimulator:** 4 Channel, 8 Electrodes; Modes: Continuous, Burst, Ramp, Wide Low Freq, Narrow Low Freq, Auto All; Pulse width: 50 - 350 µS, (10 µs/step); Pulse rate: 1 - 200 Hz; Contraction Time: 6 sec, 9 sec. Relaxation Time: 2 sec., 3 sec., 4 sec; Waveform: Symmetrical biphasic square pulse; Timer: 1 - 60 min. (1 min. / step)	3
5	**Electrosurgical machine:** Pure cut: 400W a 500 ohms Blend I : 230W at 300 ohms Blend II : 180W AT 300 ohms Blend III : 120W at 300 ohms Two Modes of Monopolar Coagulation Contact coagulation: 100 W at 300 ohms Spray coagulation: 80W at 500 ohms	4

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 Physiotherapy	1a. Explain the specified therapeutic effect of IR and UV radiations. 1b. Explain with sketches the construction and working of identified lamp used for physiotherapy. 1c. Describe with sketches the principle of given type of Laser used in biomedical field. 1d. Compare the feasibility of use of traction and CPM with reference to given application. 1e. Explain with sketches the use of given type of CPM.	1.1 Concept of IR and UV radiation and effects on human body 1.2 Construct the working principle of IR and UV lamp 1.3 Introduction of Laser used in biomedical field 1.4 Types of Laser as Pulsed ruby, Nd-YAG, He-Ne 1.5 Block diagram and principle of traction and continuous passive movement (CPM) 1.6 Types of CPM as knee and shoulder
Unit– II Ultrasound Therapy and Diathermy	2a. Describe with sketches the given ultrasound imaging technique used for visualization. 2b. Explain with sketches the construction and working of given type of transducer with sketch. 2c. Explain the specified	2.1 Concept of Ultrasound 2.2 Principle of ultrasound therapy transducer 2.3 Block diagram and principle of operation of ultrasound therapy machine and technical specifications 2.4 Concept of diathermy and effects on human body 2.5 Type of diathermy as a Shortwave

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	application techniques of diathermy. 2d. Differentiate between ultrasound and shortwave diathermy with respect to given aspects. 2e. List the technical specifications of the given equipment used for ultrasound therapy /SWD.	diathermy(SWD) 2.6 Application techniques of SWD as capacitive and inductive field 2.7 Block diagram and principle of operation of SWD and technical specifications 2.8 Installation and maintenance of diathermy equipment
Unit-III Electrotherapy and Cold therapy	3a. Describe with sketches the working principle of specified therapy technique. 3b. Explain with sketches the working of the given stimulator. 3c. List the technical specification of the given stimulator. 3d. Explain the specified cold therapy physiological effect. 3e. Differentiate between electrotherapy and cold therapy with respect to given aspect.	3.1 Concept of Electrotherapy 3.2 Effects of Electric current on nerve and muscles of human body 3.3 Block diagram and principle of operation of nerve and muscle stimulator 3.4 Technical specification and application technique of nerve and muscle stimulator 3.5 Concept of cold therapy 3.6 Physiological effects of cold therapy on human body and their uses 3.7 Contra-indications of cold therapy on human body
Unit –IV Electrosurgical Unit	4a. Explain with sketches the electro-surgery and the specified mode. 4b. Identify the methods related to cutting and coagulation. 4c. Explain with sketches the given solid-state cautery machine. 4d. Describe the safety precautions while handling ESU. 4e. List the technical specifications of specified electro-surgical machine.	4.1 Effect of electric current on human tissue 4.2 Concept of electro-surgery and modes as a uni-polar and bipolar 4.3 Different types of cutting and coagulation electrodes 4.4 Methods of cutting and coagulation 4.5 Block diagram, principle of operation and technical specifications of solid-state cautery machine 4.6 Patient safety in cautery machine 4.7 Maintenance of electrosurgical unit(ESU)
Unit-V Safety Instrumentation	5a. Describe the specified effect of electric shock on human body. 5b. Explain the specified electric hazard in hospital environment. 5c. Describe the specified step for testing the grounding system. 5d. Explain the given step for accident prevention in hospital environment.	5.1 Physiological effects of electric shock as a micro and macro on human body 5.2 Electric hazard in hospital environment and leakage current through equipment 5.3 Testing of proper grounding system in patient care area in hospitals 5.4 Concept of electro static discharge(ESD) 5.5 Concept of accident prevention in hospital environment

***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	Physiotherapy	10	04	05	07	16
II	Ultrasound Therapy and Diathermy	10	04	05	07	16
III	Electrotherapy and Cold Therapy	08	03	03	06	12
IV	Electrosurgical Unit	10	04	04	08	16
V	Safety Instrumentation	10	03	03	04	10
Total		48	**18**	**20**	**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) Identify the various types of electrodes use in electrosurgical unit and develop a chart.
b) Visit a nearby hospital and prepare the report on following basis;
   i) Location of the physiotherapy department and equipment.
   ii) Problems frequently encountered in therapeutic equipment.
   iii) Name of the equipment, manufacturer, cost, technical specifications of equipment.
c) Prepare a troubleshooting chart of diathermy machine.
d) Prepare a presentation of ultrasound therapy with its new trends and technologies.
e) Prepare the chart of different transducer and electrodes in therapy machines.
f) Prepare the chart for different electrodes related to Electro-surgical unit.
g) Prepare a presentation on accident prevention.
h) Use different method of accident preventions.

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) Correlate subtopics with power system utility and electrical equipments.
g) Use proper equivalent analogy to explain different concepts.
h) Use Flash/Animations to explain various theorems in circuit analysis.
i) Use open source PSpice/Matlab models to explain different concepts of electric circuit.
j) Use the tutorial time period for micro projects, students suggested activities.

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 circuit for IR Lamp and test it, and visit to the nearest hospital and compare the safety parameters which are use by them.
b) Design a circuit for UV lamp and test it, and visit to the nearest hospital and compare the safety parameters which are use by them.
c) Design the nerve - muscle stimulator circuit.
d) Test for proper earthing/grounding in labs and prepare a report of it.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Handbook of Biomedical Instrumentation	Khandpur, R.S.	Tata McGraw-Hill publishing company Ltd, New Delhi, Third Edition, ISBN: 9789339205430
2	Clayton's Electrotherapy	Nigel , Angela Forster	Bailliere Tindall , London ,Eighth Edition, ISBN: 9780702009020
3	Biomedical Instrumentation and Measurement	Anandnatrajan, R.	Prentice Hall of India pvt. Ltd, ISBN: 9788120352155

14. SOFTWARE/LEARNING WEBSITES

a) https://www.healthline.com/health/diathermy#risks5
b) http://www.sportsinjuryclinic.net/treatments-therapies/electrotherapy/ultrasound-therapy
c) http://physioworks.com.au/


MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION

Program Name : **Diploma in Medical Electronics**

Program Code : **MU**

Semester : **Fifth**

Course Title : **Intensive Care Equipment**

Course Code : **22548**

1. RATIONALE

In the hospitals, Intensive Care Unit (ICU) is equipped with various emergency and special care equipment. Intensive Care Unit equipment are pacemaker, defibrillator, patient monitors etc. Such equipment are also used in operation theatre. This course will cover detail study of their working principle, operating modes, block diagram and technical specifications. The skills developed through this course will facilitate to maintain Intensive Care Unit equipment needed for hospitals as well as medical equipment manufacturing industry.

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 intensive care equipment.**

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 intensive care equipment for the upkeep and maintenance of ICCU.
b. Maintain and troubleshoot defibrillator.
c. Maintain various types of respiratory aids like ventilator and nebulizer.
d. Maintain bed side monitor to record various physiological parameters.
e. Maintain the performance of life support equipment.

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

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
12	Use Infusion pump.	IV	02
13	Test the performance of hemodialysis machine.	V	02
14	Plot characteristics of temperature control in baby incubator.	V	02
	Total		**28**

Note

i. Given in above tables is suggestive list of practical exercises. Teachers can design other similar exercises.

ii. To attain the COs and competency, a judicial mix of 10 or more practicals/exercises from the above listed LOs need to be performed to achieve up to the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy'.

Assessment of the 'Process' and 'Product' related skills in the laboratory/workshop/field work should be done as per suggested sample 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.
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
- '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.

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 Critical care Instrumentation and Cardiac Pacemaker	1a. Describe the layout of specified critical care unit with sketch. 1b. Explain need of given type of cardiac pacemaker along with block diagram. 1c. Compare between internal and external pacemaker with respect to specified aspect. 1d. Explain with sketches the use of given type of leads of pacemaker. 1e. Describe the procedure to use given type of leads. 1f. List the technical specifications of the specified type of pacemaker.	1.1 Critical care instruments used in ICU of the hospital. 1.2 Concepts of NICU, ICU, ICCU 1.3 Cardiac arrhythmias; heart block and need of cardiac pacemaker 1.4 Types of pacing modes, types of pacemaker; internal, external, fixed /asynchronous, demand /synchronous and programmable pacemaker 1.5 Pacemaker leads 1.6 Technical specifications of pacemaker
Unit– II Defibrillator	2a. Describe the function of specified section of dc-defibrillator with simplified circuit diagrams. 2b. Explain with sketches the use of given type of electrode of DC-defibrillator. 2c. Describe the advantage of DC- defibrillator as compared to AC defibrillator with respect to specific aspect. 2d. Explain with sketches the working principle and waveform of specified type of defibrillator along with its merits and demerits. 2e. Prepare the technical specifications and important steps of maintenance of given DC defibrillator.	2.1 Fibrillation of heart, need of defibrillator, types of defibrillator 2.2 Modes of defibrillator; asynchronous and synchronous 2.3 Electrodes of defibrillator 2.4 Charging and discharging of DC-defibrillator 2.5 Automated External Defibrillator (AED), biphasic and monophasic defibrillator 2.6 Technical specifications of DC defibrillator
Unit-III Ventilator, Nebulizer and Suction Apparatus	3a. Describe with sketches the function of specified type of ventilator with respect to the concept of artificial ventilation. 3b. Explain the specified measurable parameter related with respiratory system. 3c. Describe with sketches the given mode of ventilator. 3d. Explain with sketches the working	3.1 Respiration and apnea, artificial ventilation, types of ventilator 3.2 Measurable parameters related to lung mean airway pressure, inspiratory pause time, tidal volume, minute volume, conventional mechanical ventilation, positive end expiratory pressure (PEEP) 3.3 Ventilator, nebulizer, suction

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
II	Defibrillator	08	03	04	06	13
III	Ventilator, Nebulizer and Suction Apparatus	10	03	04	06	13
IV	Patient monitoring systems, Infusion pump and Balloon Pump	10	03	04	06	13
V	Life Support Equipment	10	04	04	08	16
Total		48	**16**	**21**	**33**	**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 a hospital and prepare a report on following basis.
   i) Name of equipment, manufacturer, Cost of the equipment.
   ii) Location of the equipment where it is utilized.
   iii) Problems frequently encountered in various intensive care equipment.
b) Identify the component from the given intensive care equipment.
c) Guide student(s) in undertaking micro-projects.
d) Library / Internet survey of Instruments used in Intensive Care Unit of the hospital
e) Collect the videos/ animations on working of given following equipment;
   i) Defibrillator
   ii) Pacemaker
   iii) Bedside monitor

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) Correlate subtopics with power system utility and electrical equipments.
g) Use proper equivalent analogy to explain different concepts.

Program Name : **Diploma in Medical Electronics**

Program Code : **MU**

Semester : **Fifth**

Course Title : **Energy and Biomedical Waste Management**

Course Code : **22549**

1. RATIONALE

This course will facilitate students to understand the basics of energy resources and biomedical waste management. The students need to appreciate the significance of green and clean energy with renewable energy based applications through solar photovoltaic, wind energy system, etc. and the need for energy conservation for sustainable development. Biomedical waste management is a vital area about which any medical electronics personnel should be well acquainted with.

2. COMPETENCY

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

- **Implement energy conservation for sustainable environment ensuring safe handling of biomedical waste.**

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. Correlate the present scenario of conventional and non-conventional energy in India
b. Use renewable energy resources for energy conservation.
c. Use energy conservation techniques for different applications.
d. Manage biomedical waste effectively.
e. Apply safety and precautionary measures during waste management.

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.

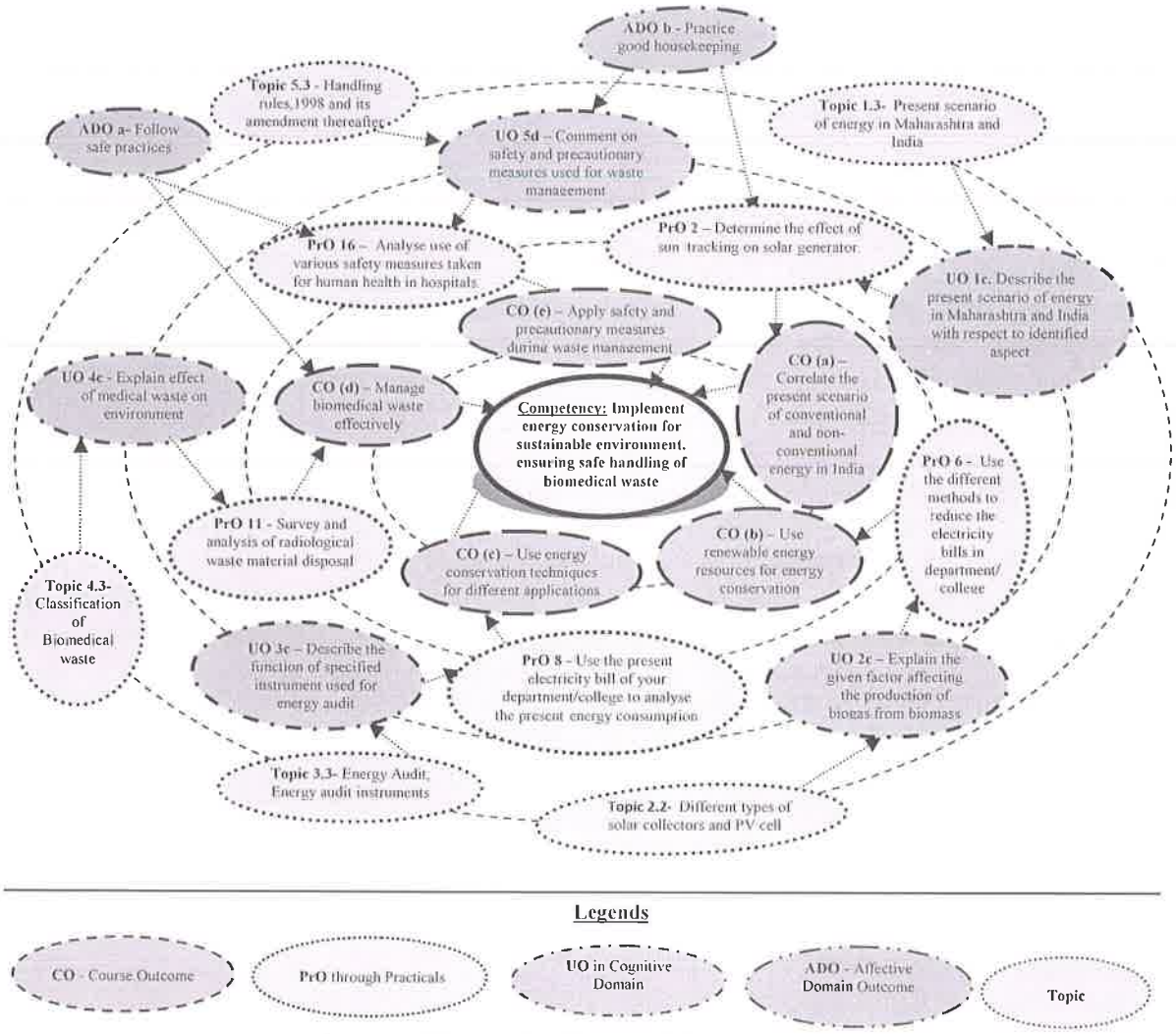

Figure 1 - Course Map

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	Measure V-I characteristics of PV module.	I	02*
2	Determine the effect of sun tracking on solar generator.	II	02
3	Test the thermal performance of solar water heater.	II	02
4	Analyse the charging and discharging cycle of solar battery.	II	02
5	Test the thermal performance of solar dryer.	III	02
6	Use the different methods to reduce the electricity bills in department/college.	III	02
7	Use the electricity act 2001 and 2003, and find the difference between them.	III	02
8	Use the present electricity bill of your department/college to analyse the present energy consumption.	III	02

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
9	Perform analysis of various hospital biomedical waste sources.	IV	02
10	Perform analysis of pathological waste material disposal.	IV	02
11	Perform analysis of radiological waste material disposal.	IV	02*
12	Perform analysis of hospital chemical waste material disposal.	IV	02
13	Interpret the nature of care and maintenance of various biomedical waste management devices.	IV	02*
14	Perform analysis of various biochemical waste hazards on human health.	V	02
15	Simulate the collection and handling of Biomedical waste processes	V	02
16	Practice the safety measures taken for human health in hospitals.	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. 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
- '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. No.
1.	A photovoltaic panel (BP Solar 10W, 12V), A solar panel rack (support and change positions of a PV panel) , 2 multi-meters (or an ammeter and a voltmeter) or a AVO meter , Insulated wires with alligator clips or other cables, A resistor panel (1Ω, 4.7Ω, 10Ω, 22Ω, 32Ω, 47Ω, 51Ω, 82Ω, 100Ω, 220Ω, 10W), The system can convert solar rays into AC power 230V/ 50Hz.	1,4
2.	Solar tracker system: 1pcs 18inch linear actuator with 2pcs bracket.(12V option), 1pcs single axis solar tracker controller.	2
3.	Trainer kit for solar water heater with inbuilt meter-board.	3
4.	A pyranometer (Kipp & Zonen model CM 11, accuracy ± 0.50%) was placed on the top of dryer to measure solar radiation Relative humidity from ambient and in any parts of dryer were employed, used hygrometer (Electronic, model EE23, accuracy ± 2%). Temperatures in the collectors, product container, air duct and ambient were measured by Thermocouple Type K (accuracy ± 0.1°C). Moreover, the air speed in the dryer also measured by anemometers (Airflow, model TA5, accuracy ± 2%).	5
5.	THD meter, power analyzer, Lux-meter, energy meter and wattmeter	8
6.	Various equipment available at Pathologies, radiology and chemical labs from nearest hospitals.	13,14, 15,16

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 Energy Sources	1a. Compare conventional and non-conventional Energy sources with respect to specified aspect. 1b. Explain with sketches the working of given type of conventional power plants 1c. Describe the present scenario of energy in Maharashtra and India with respect to identified aspect.	1.1 Non-conventional energy and conventional energy sources, Advantages and disadvantages 1.2 Overview of different types of conventional power plants 1.3 Present scenario of energy in Maharashtra and India.
Unit– II Renewable energy	2a. Describe with sketches the use of specified type of solar collector. 2b. Explain with sketches the function of given component of wind energy turbine. 2c. Explain with sketches the given factor affecting the production of biogas from biomass.	2.1 Solar energy and its applications. 2.2 Different types of solar collectors and PV cell. 2.3 Wind energy, principle of wind power , basic components of wind turbine 2.4 Bio-fuel, Principle of biogas production from waste biomass.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit-III Energy Conservation for Sustainable Environment	3a. Explain need of energy conservation 3b. State the features of energy Conservation act 2001. 3c. Describe the function of specified instrument used for energy audit. 3d. State the features of electricity act 2003. 3e. Explain rules, regulation laws regarding environment protection.	3.1 Need of energy conservation. 3.2 Energy conservation act 2001 and its features. 3.3 Energy Audit, Energy audit instruments 3.4 Electricity act 2003, Industrial energy policies, energy vision, rules, regulation 3.5 Laws regarding environment protection
Unit –IV Hospital waste management.	4a. List the precaution to 4b. Describe remedies for managing the specified hospital waste. 4c. Explain effect of specified medical waste on the environment. 4d. Describe WHO guidelines for management of a specific waste of medical hospital	4.1 Hospital waste management introduction, sources of biomedical waste, Need of biomedical waste management system 4.2 Classification of Biomedical waste (Pathological, microbiological and radiological, chemical waste etc.). 4.5 Environmental pollution due to medical waste, Health impact of biochemical waste. 4.6 International scenario, World Health Organisation guidelines on management of wastes from hospitals wastes.
Unit-V Biomedical waste treatment	5a. Explain flow chart of biomedical waste management process. 5b. Explain Incineration technology in detail. 5c. Describe microwave irradiation process used in biomedical waste treatment. 5d. Comment on safety and precautionary measures used for waste management.	5.1 Biomedical waste management Processes. (waste collection, segregation, transportation and storage, treatment and disposal) 5.2 Biomedical Waste Treatment and Disposal (Incineration Technology, Non-Incineration Technology, Autoclaving, Microwave Irradiation, Chemical Methods, Plasma Pyrolysis) 5.3 Handling rules, 1998 and its amendment thereafter.

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	Energy Sources	10	04	07	03	14
II	Renewable energy	10	04	08	02	14
III	Energy Conservation for	08	02	06	04	12

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
	Sustainable Environment					
IV	Hospital Waste Management	10	04	08	04	16
V	Biomedical Waste Treatments	10	04	06	04	14
Total		**48**	**18**	**35**	**17**	**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 to various conventional and non conventional power plants.
b) Visit to multi-specialty hospitals for waste management methods.
c) Write report on accidental power off/shut down problem in Hospitals.
d) Read and prepare chart for the safety precautions for disposal of biomedical waste.
e) Prepare a report regarding use of various laws concerned with biomedical waste treatment.
f) Visit to nearby biogas plant.

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) Correlate subtopics with power system utility and electrical equipments.
g) Use proper equivalent analogy to explain different concepts.
h) Use Flash/Animations to explain various theorems in circuit analysis.
i) Use open source PSpice/Matlab models to explain different concepts of electric circuit.

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. **Construct Simple PV system using PV cell.**
The purpose of this activity is to construct a simple photovoltaic (PV) system, using a PV cell(s) and a DC ammeter, in order to learn:
- How the amount and wavelength of light affect the generation of electricity
- How PV systems are connected to produce different voltages and currents
- How temperature affects the efficiency of a PV cell

b. **Pinwheel Wind Turbine**
Make a pinwheel model to see how a very basic turbine works, and then use it to create electricity.

c. **Knowledge and awareness regarding biomedical waste management in dental teaching institutions in India**
Literature review should contain:
- Knowledge, awareness and practice regarding biomedical waste management among staff and students in dental teaching institutions in India.
- Attitude of staff towards disposal of biomedical waste.
- To suggest possible remedial measures if required.

d. **Evaluate the economic feasibility of producing biogas from nearby Dairy farm.**
It should contain:
- Process Flowchart
- Suitable conditions for anaerobic digestion.
- Biogas potential from selected livestock manure.
- Check the following: Applicability, re-plicability, marketability, affordability, reliability, feasibility.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Non-Conventional Energy Resources	Khan, B.H.	Mc Graw Hill, New Delhi, 2015 IBSN:0070606544
2	Energy Management Handbook	Wayne, C. Turner	The Fairmont Press, Inc.) 0-8493-8234-3 (Taylor & Francis Ltd.)
3	Hospital Waste management and its monitoring	Sharma, Madhuri	Jaypee Brothers Medical Publishers(P) Ltd. ISBN-9789386056788
4	Hospital Administration and Management	Gupta, Joydeep Das	Jaypee Brothers Medical Publishers(P) New Delhi, 2015 Ltd. ISBN-9789352501328
5	Memories in Hospital Management	Parmar ,H.B.	Jaypee Brothers Medical Publishers(P) New Delhi, 2015 Ltd. ISBN-

S. No.	Title of Book	Author	Publication
			9789352700967
6	Hospital Administration	Francis, C.M.; De Souza, Mario C.	Jaypee Brothers Medical Publishers(P) New Delhi, 2015 Ltd. ISBN-8171797210
7	Biomedical Waste Disposal	Singh, Anantpreet; Kaur Sukhjit	Jaypee Brothers Medical Publishers(P) New Delhi, 2015 Ltd. ISBN-9789350255544

14. SOFTWARE/LEARNING WEBSITES

a) www.mornsun-power.com/html/product/Photovoltaic-Power-Supply
b) https://energy.gov/science-innovation/energy-sources
c) www.youtube.com /Biomedical waste management
d) www.dreamtechpress.com /ebooks
e) www.nptelvideos.in/ renewable energy sources
f) www.cwejournal.org
g) Mpcp.gov.in/biomedical/pdf
h) https://beeindia.gov.in/