

ENTREPRENEURSHIP DEVELOPMENT AND STARTUPS**Course Code : 315002**

Programme Name/s	: Artificial Intelligence/ Artificial Intelligence and Machine Learning/ Automation and Robotics/ Cloud Computing and Big Data/ Civil Engineering/ Chemical Engineering/ Computer Technology/ Computer Engineering/ Civil & Rural Engineering/ Construction Technology/ Computer Software Technology/ Computer Science & Engineering/ Digital Electronics/ Data Sciences/ Electrical Engineering/ Electronics & Tele-communication Engg./ Electrical and Electronics Engineering/ Electrical Power System/ Electronics & Communication Engg./ Electronics Engineering/ Computer Hardware & Maintenance/ Industrial Electronics/ Information Technology/ Computer Science & Information Technology/ Civil & Environmental Engineering/ Computer Science/ Electronics & Computer Engg.
Programme Code	: AI/ AN/ AO/ BD/ CE/ CH/ CM/ CO/ CR/ CS/ CST/ CW/ DE/ DS/ EE/ EJ/ EK/ EP/ ET/ EX/ HA/ IE/ IF/ IH/ LE/ SE/ TE
Semester	: Fifth
Course Title	: ENTREPRENEURSHIP DEVELOPMENT AND STARTUPS
Course Code	: 315002

I. RATIONALE

Entrepreneurship and Startups are introduced in this curriculum to develop the entrepreneurial traits among the students before they enter into professional life. Exposing and interacting with entrepreneurship and startup eco-system, students will develop entrepreneurial mind set. The innovative thinking with risk-taking ability along with other traits will be inculcated in the students through micro-projects and training. This exposure will be instrumental in orienting the students in transforming them to become job generators after completion of Diploma in Engineering.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Develop project proposals for launching small scale enterprises and starts up.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Identify one's entrepreneurial traits.
- CO2 - Use information collected from stakeholder for establishing/setting up/founding starts up
- CO3 - Use support systems available for Starts up
- CO4 - Prepare project plans to manage the enterprise effectively

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme										Total Marks	
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory			Based on LL & TL				Based on SL			
				CL	TL	LL					Practical			SLA							
											FA-TH	SA-TH	Total	FA-PR	SA-PR	Max	Min				
315002	ENTREPRENEURSHIP DEVELOPMENT AND STARTUPS	ENDS	AEC	1	-	2	-	3	1	-	-	-	-	-	50	20	25@	10	-	-	75

ENTREPRENEURSHIP DEVELOPMENT AND STARTUPS**Course Code : 315002****Total IKS Hrs for Sem. : Hrs**

Abbreviations: CL- Classroom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @\$ Internal Online Examination
Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 10 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Compare advantages and disadvantages of Entrepreneurship TLO 1.2 Identify entrepreneurial traits through self-analysis TLO 1.3 Compare risk associated with different type of enterprise	Unit - I Introduction to Entrepreneurship Development 1.1 Entrepreneurship as a career – charms, advantages, disadvantages , scope- local and global 1.2 Traits of successful entrepreneur: consistency, creativity, initiative, independent decision making, assertiveness, persuasion, persistence, information seeking, handling business communication, commitment to work contract, calculated risk taking, learning from failure 1.3 Types of enterprises and their features : manufacturing, service and trading	Presentations Lecture Using Chalk-Board
2	TLO 2.1 Explain Important factors essential for selection of product/service and selection of process TLO 2.2 Suggest suitable place for setting up the specified enterprise on the basis of given data/circumstances with justification. TLO 2.3 Suggest steps for the selection process of an enterprise for the specified product or service with justification. TLO 2.4 Plan a market study /survey for the specified enterprise	Unit - II Startup Selection Process 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 Industries Commission[KVIC]	Presentations Lecture Using Chalk-Board

ENTREPRENEURSHIP DEVELOPMENT AND STARTUPS**Course Code : 315002**

Sr.No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
3	<p>TLO 3.1 Explain categorization of MSME on the basis of turnover and investment</p> <p>TLO 3.2 Describe support system provided by central and state government agencies</p> <p>TLO 3.3 State various schemes of government agencies for promotion of entrepreneurship</p> <p>TLO 3.4 Describe help provided by the non governmental agencies for the specified product/service</p> <p>TLO 3.5 Compute breakeven point, ROI and ROS for the specified business enterprise, stating the assumptions made</p>	<p>Unit - III Support System for Startup</p> <p>3.1 Categorization of MSME, ancillary industries</p> <p>3.2 Support systems- government agencies: MCED, NI MSME, PMEGP, DI, KVIC</p> <p>3.3 Support agencies for entrepreneurship guidance, training, registration, technical consultation, technology transfer and quality control, marketing and finance.</p> <p>3.4 Breakeven point, return on investment (ROI) and return on sales (ROS).</p>	<p>Presentations</p> <p>Lecture Using Chalk-Board</p>
4	<p>TLO 4.1 Explain key elements for the given business plan with respect to their purpose/size</p> <p>TLO 4.2 Justify USP of the given product/ service from marketing point of view.</p> <p>TLO 4.3 Formulate business policy for the given product/service.</p> <p>TLO 4.4 Choose relevant negotiation techniques for the given product/ service with justification</p> <p>TLO 4.5 Identify risks that you may encounter for the given type of business/enterprise with justification.</p> <p>TLO 4.6 Describe role of the incubation centre and accelerators for the given product/service.</p>	<p>Unit - IV Managing Enterprise</p> <p>4.1 Techno commercial Feasibility study, feasibility report preparation and evaluation criteria</p> <p>4.2 Ownership, Capital, Budgeting, Matching entrepreneur with the project</p> <p>4.3 Unique Selling Proposition [U.S.P.]: Identification, developing a marketing plan.</p> <p>4.4 Preparing strategies of handling business: policy making, negotiation and bargaining techniques</p> <p>4.5 Risk Management: Planning for calculated risk taking, initiation with low cost projects, integrated futuristic planning, definition of startup cycle, ecosystem, angel investors, venture capitalist</p> <p>4.6 Incubation centers and accelerators : Role and procedure</p>	<p>Presentations</p> <p>Lecture Using Chalk-Board</p>

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Collect information of successful entrepreneurial traits	1	*Preparation of report on entrepreneurship as	2	CO1
LLO 2.1 Identify different traits as an entrepreneur from various field LLO 2.2 Suggest different traits from identified problem	2	Case study on 'Traits of Entrepreneur'	2	CO1
LLO 3.1 Explore probable risks for identified enterprise.	3	*Case study on 'Risks associated with enterprise	2	CO1
LLO 4.1 Identify new product for development LLO 4.2 Prepare a newly developed product	4	*Preparation of report on 'Development of new Product	2	CO1 CO2

ENTREPRENEURSHIP DEVELOPMENT AND STARTUPS**Course Code : 315002**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 5.1 Identify Process for development of product for new startup	5	Preparation of Report on ' Process selection 'for new startup	2	CO1 CO2 CO3
LLO 6.1 Develop questioner for market survey	6	*Market survey for setting up new Start up	2	CO2 CO3
LLO 7.1 Interpret the use of Technology Life Cycle	7	A Case study on ' Technology life cycle' of any successful entrepreneur.	2	CO3
LLO 8.1 Use information related to support of startups from Government and non-government agencies' LLO 8.2 Prepare report for setting up startup	8	*Preparation of report on 'Information for setting up new startup' from MCED/MSME/KVIC etc	2	CO3 CO4
LLO 9.1 Compute ROI of successful enterprise.	9	Case study on 'Return on Investment (ROI)'of any successful startup	2	CO3
LLO 10.1 Calculate of ROS of any successful enterprise	10	Case study on 'Return on sales (ROS)'of any successful startup	2	CO3
LLO 11.1 Calculate Brake even point of any enterprise	11	Preparation of report on 'Brake even point calculation' of any enterprise.	2	CO3 CO4
LLO 12.1 Prepare feasibility report of given business	12	*Preparation of report on 'feasibility of any Techno-commercial business"	2	CO4
LLO 13.1 Plan a USP of any enterprise.	13	*A case study based on 'Unique selling Proposition (USP) of any successful enterprise	2	CO4
LLO 14.1 Prepare a project report using facilities of Atal Incubation center.	14	*Prepare project report for starting new startup using 'Atal incubation center (AIC)	2	CO1 CO2 CO3 CO4

Note : Out of above suggestive LLOs -

- '*' Marked Practicals (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)**Micro project**

- Prepare a 'Pitch- desk' for your start up
- Prepare a business plan for a. Market research b. Advertisement agency c. Placement Agency d. Repair and Maintenance agency e. Tour and Travel agency
- Prepare a 'Social entrepreneurship business plan, plan for CSR funding.
- Prepare a ' Women entrepreneurship business plan ' Choose relevant government scheme for the product/service
- Prepare a business plan for identified projects by using entrepreneurial eco system for the same (Schemes, incentives, incubators etc.)

ENTREPRENEURSHIP DEVELOPMENT AND STARTUPS**Course Code : 315002****Note :**

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicious mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Computers with internet and printer facility	All

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Introduction to Entrepreneurship Development	CO1	4	0	0	0	0
2	II	Startup Selection Process	CO2	2	0	0	0	0
3	III	Support System for Startup	CO3	2	0	0	0	0
4	IV	Managing Enterprise	CO4	2	0	0	0	0
Grand Total				10	0	0	0	0

X. ASSESSMENT METHODOLOGIES/TOOLS**Formative assessment (Assessment for Learning)**

- Assessment during practicals

Summative Assessment (Assessment of Learning)

- End of term examination

XI. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	2	2	2	-	-	3	2			
CO2	2	2	2	2	-	3	2			
CO3	2	2	2	2	-	3	2			
CO4	2	2	2	2	-	3	2			

Legends :- High:03, Medium:02,Low:01, No Mapping: -

*PSOs are to be formulated at institute level

ENTREPRENEURSHIP DEVELOPMENT AND STARTUPS**Course Code : 315002****XII. SUGGESTED LEARNING MATERIALS / BOOKS**

Sr.No	Author	Title	Publisher with ISBN Number
1	Dr. Nishith Dubey, Aditya Vyas , Annu Soman , Anupam Singh	Un- boxing Entrepreneurship your self help guide to setup a successful business	Indira Publishing House ISBN 2023,978-93-93577-70-2
2	Gujral, Raman	Reading Material of Entrepreneurship Awareness Camp	Entrepreneurship Development Institute of India (EDI), GOI, 2016 Ahmedabad
3	Chitale, A K	Product Design and Manufacturing	PHI Learning, New Delhi, 2014; ISBN: 9788120348738
4	Charantimath, Poornima	Entrepreneurship Development Small Business Entrepreneurship	Pearson Education India, New Delhi; ISBN: 9788131762264
5	Khanka, S.S.	Entrepreneurship and Small Business Management	S.Chand and Sons, New Delhi, ISBN: 978-93-5161-094-6

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	http://www.mced.nic.in/allproduct.aspx	MCED Product and Plan Details
2	http://niesbud.nic.in/Publication.html	The National Institute for Entrepreneurship and Small Business Development Publications
3	http://niesbud.nic.in/docs/1standardized.pdf	Courses : The National Institute for Entrepreneurship and Small Business Development
4	https://www.nabard.org/Tenders.aspx?cid=501andid=24	NABARD - Information Centre
5	http://www.startupindia.gov.in/pdf/file.php?title=Startup%20India%20Action%20Planandtype=Actionandq=Action%20Plan.pdf&content_type=Actionandsubmenupoint=action	Start Up India
6	http://www.ediindia.org/institute.html	About - Entrepreneurship Development Institute of India (EDII)
7	http://www.nstedb.com/training/training.htm	NSTEDB - Training

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

MSBTE Approval Dt. 24/02/2025

Semester - 5, K Scheme

SEMINAR AND PROJECT INITIATION COURSE

Course Code : 31

Programme Name/s	: Automobile Engineering./ Artificial Intelligence/ Artificial Intelligence and Machine Learning/ Automation and Robotics/ Cloud Computing and Big Data/ Civil Engineering/ Chemical Engineering/ Computer Technology/ Computer Engineering/ Civil & Rural Engineering/ Construction Technology/ Computer Software Technology/ Computer Science & Engineering/ Digital Electronics/ Data Sciences/ Electrical Engineering/ Electronics & Tele-communication Engg./ Electrical and Electronics Engineering/ Electrical Power System/ Electronics & Communication Engg./ Electronics Engineering/ Computer Hardware & Maintenance/ Industrial Electronics/ Information Technology/ Computer Science & Information Technology/ Civil & Environmental Engineering/ Mechanical Engineering/ Mechatronics/ Manufacturing Technology/ Metallurgical Engineering/ Production Engineering/ Computer Science Electronics & Computer Engg.
Programme Code	: AE/ AI/ AN/ AO/ BD/ CE/ CH/ CM/ CO/ CR/ CS/ CST/ CW/ DE/ DS/ EE/ EJ/ EK/ EP/ ET/ EX/ HA/ IE/ IF/ IH/ LE/ ME/ MK/ MRT/ MY/ PG/ SE/ TE
Semester	: Fifth
Course Title	: SEMINAR AND PROJECT INITIATION COURSE
Course Code	: 315003

I. RATIONALE

Most of the diploma graduates lack the confidence and fluency while presenting papers or interacting verbally and expressing them with a large gathering. Seminar presentation boosts the confidence of the students and prepares them precisely for facing the aud interviews and group discussions. The course on seminar is to enhance student's ability in the art of academic writing and to present also helps broaden the minds of the participants. Through this course on Seminar, students will develop new ideas and perspectives subject /themes of emerging technologies and services of their area of studies. Project initiation enhances project planning skill establishes measurable objectives and interaction skills.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences: Present a seminar on the selected theme/area of study effectively and confidently to the specific audience and stakeholder. Plan innovative solutions independently or collaboratively to the identified problem statement.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Identify topics of seminar presenting to the large gathering at the institute/conference.
- CO2 - Collect relevant and updated research-based data and information to prepare a paper of seminar presentation.
- CO3 - Apply presentation skills.
- CO4 - Create conducive environment for learning and discussion through seminar presentation.
- CO5 - Identify a problem statement and establish the action plan for the successful completion of the project.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme						Credits	Paper Duration	Assessment Scheme								
				Actual Contact Hrs./Week			SLH	NLH	Theory			Based on LL & TL				Based on SL				
				CL	TL	LL						Practical				SLA				
							FA-TH	SA-TH				Total		FA-PR	SA-PR	Max	Min			
315003	SEMINAR AND PROJECT INITIATION COURSE	SPI	AEC	-	-	1	2	3	1	-	-	-	-	-	25	10	25@	10	25	10

V. General guidelines for SEMINAR and Project Initiation

- The seminar must be related to emerging trends in engineering / technology programme or may be inter/ multi-disciplinary, base industry expected outcomes of the programme.
- The individual students have different aptitudes and strengths. Therefore, SEMINAR should match the strengths of students. For purpose, students shall be asked to select the TITLE (Theme)of SEMINAR they would like to prepare and present.
- Seminar titles are to be finalized in consultation with the faculty mentor.
- Seminar must involve logic development of applications of various technologies/ processes applicable in industry.
- Seminar must be assigned to the single student. However, support of other students may be sorted while presenting the seminar
- Students are required to prepare using relevant software tools, write ups for presentation

SEMINAR AND PROJECT INITIATION COURSE**Course Code : 31**

- Students shall submit One Hard copy and one Soft copy each of the presentation and may be encouraged to keep a recorded copy presentation made during the seminar.
- Batch of 3-4 students shall be formed for project initiation.
- Projects give a platform for the students to showcase an attitude of inquiry to identify the problem statement related to the program. Students shall Identify the information suggesting the cause of the problem and possible solutions
- Students shall study and assess the feasibility of different solutions and the financial implications.
- Students should collect relevant data from different sources (books/internet/market/suppliers/experts through surveys/interviews)
- Students shall prepare required drawings/ designs and detailed plan for the successful execution of the work.
- Students may visit the organisation pertaining to the problem statement as part of initial study.

VI.Guidelines for Seminar preparation and presentation :

Once the title/topic of a seminar has been finalized and allotted to the student, the teacher's role is important as guide, mentor and motivator, to promote learning and sustain the interest of the students.

Following should be kept in mind while preparing and presenting the seminar:

- **Seminar Orientation cum -briefing:** the seminar topics/themes should be innovative, novel and relevant to the curriculum of the programme, and also aligned to the expectations of industry.
- **Seminar Literature survey:** Information search and data collection: the information and data should be authentic, realistic and relevant to the curriculum of the programme.
- **Seminar Preparation, and presentation:** The seminar shall be present with suitable software tools and supporting handout/notes. The presentation of seminar should not be more than 20 minutes including Q-A session.

The following guidelines may be followed for Project Initiation

- **Establishing project scope:** Determine the boundaries of the project.
- **Defining project objectives:** Set clear and measurable objectives that align with the project's purpose.
- **Stakeholder identification and analysis:** Perform an exercise in identifying all stakeholders involved in the project and analyze their needs and expectations.
- **Team Formation:** Carefully build a team with the necessary skills and expertise to execute the project successfully.
- **Documentation.** Create a project planner showcasing the action plan, define the project's scope, outline the project definition, and design of the project. The document has to be made available to all stakeholders

VII. Criteria of Assessment /Evaluation of Seminar**A. Formative Assessment (FA) criteria**

The assessment of the students in the fifth semester Progressive Assessment (PA) for 50 marks is to be done based on following criteria

A. Suggestive RUBRICS for assessment

Sr. No.	Criteria	Mar
1	Selection Topic/Theme of seminar	05
2	Literature review and data presentation	05
3	Quality of Preparation and innovativeness	05
4	Q-A handling	05
5	Time Management	05
6	Seminar Presentation report	10

Rubrics for assessment of Project Initiation

Sr. No.	Criteria	M
1	Selection of Theme of Problem Statement and its innovativeness	
2	Stages of development of Action plan	
3	Prototyping	

The total marks as per above out of 50, shall be converted in proportion of 25 marks.

B. Summative Assessment criteria/

The summative assessment of the students in the fifth semester End-Semester-Examination (ESE) for 50 marks is to be done based on following criteria.

This assessment shall be done by the Faculty.

SEMINAR AND PROJECT INITIATION COURSE

Course Code : 31

Suggestive **RUBRICS** may be developed by the faculty

Sr. No.	Criteria	Mark
1	Quality of information/Knowledge presented in SEMINAR	
2	Creativity, Innovation in SEMINAR presentation	
3	Response to the question during seminar presentation	
4	Establishment of Innovative Problem Statement and its presentation	
5	Objectives of the project and action plan	

The total obtained marks shall be converted in proportion of 25 marks.

VIII. Suggestive CO-PO Mapping

Course Outcomes (COs)	Programme Outcomes (POs)							Program Specific Outcomes (PSOs)
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1
CO-1	3	1	0	-	2	2	3	
CO-2	2		2	-	2	1	3	
CO-3	3	1	1	2	1	2	3	
CO-4	2	0	0	2	1	2	3	
CO-5	3	3	3	2	2	3	3	

VIII. Typographical instructions/guidelines for seminar preparation & presentation

- The seminar PPT shall be computer typed (English- British)
- Text Font -Times New Roman (TNR), Size-12 point
- Subsection heading TNR- 12 point bold normal
- Section heading TNR- 12 capital bold
- Chapter Name/ Topic Name – TNR- 14 Capital
- All text should be justified. (Settings in the Paragraph)
- Different colors text/diagrams /tables may used
- The name of the candidate, diploma (department), year of submission, name of the institute shall be printed on the first slide PPT.

IX. Seminar and Project Initiation Report

On completion and presentation of Seminar, every student will submit a brief report which should contain the following:

- Cover Page (as per annexure 1)
- Title page (as per annexure 2)
- Certificate by the Guide (as per annexure 3)
- Acknowledgment (The candidate may thank all those who helped in the execution of the project).
- Abstract of Paper presented in the seminar (It should be in one page and include the purpose of the seminar & methodology.)
- Index
- List of Figures
- Introduction
- Literature Review
- Information/Chapters related to Seminar topic
- Advantages and Disadvantages
- Conclusion
- Project Initiation : a) Description of problem statement. b) Scope and objectives. c) State holder d) Platform/ Equipment/ Resource identification.
- Bibliography
- References

NOTE: Seminar report must contain only relevant – technology or platform or OS or tools used and shall not exceed 25-30 pages.

SEMINAR AND PROJECT INITIATION COURSE**Course Code : 31**

Details of Softcopy to be submitted:

The soft copy of seminar presentation is required to be provided on the back cover of the seminar report in clear packet, which should include the following folders and contents:

1. Presentation (should include a PPT about project in not more than 15 slides)
2. Documentation (should include a word file of the project report)

NOTE: Soft copy must be checked for any harmful viruses before submission.

X. Sample Formats

- 1) Cover Page - Annexure-I
- 2) Index - Annexure-II
- 3) Assessment - Annexure-III

MSBTE
LOGO

Institut
Logo

Annexure - I

SEMINAR Report

“SEMINAR Title _____”

as a partial fulfilment of requirement of the

THIRD YEAR DIPLOMA IN

Submitted by

Name of Student

Enrollment Number

FOR THE ACADEMIC YEAR 20__ 20__

(H.O.D)

(Principal)

(Internal Guide)

(External Examiner)

Annexure - II

Institute Name

(An Affiliated Institute of Maharashtra State Board of Technical Education)

Table of Contents

Title Page	i
Certificate of the Guide	ii
Acknowledgement	iii
Index	iv
Abstract	v
List of Figures	vi
List of Tables (optional)	vii

INDEX

Sr. No.	Chapter	Page No.
1.	Chapter-1 Introduction (background of the seminar)	1
2.	Chapter-2 Literature review for the seminar topic/theme	5
3.	Chapter-3 -	
-	-	
-	Seminar Report	
-	Bibliography	
-	Referances	

*Students can add/remove/edit chapter names as per the discussion with their guide

Annexure - III

Format for SEMINAR and PROJECT INITIATION Assessment /Evaluation

Formative Assessment

CRITERIA AND WEIGHTAGE

Enrollment No	1 Selection Topic/Theme of seminar (5)	2 Literature review and data presentation (5)	3. Quality of Preparation and innovativeness (5)	4 Q-A handling (5)	5 Time Management (5)	6. Seminar Presentation report (10)	7 Selection of Theme of Problem Statement and its innovativeness (5)	8 Stages of development of Action plan (5)	9. Prototyping (5)	10. Total (50)

Summative Assessment

CRITERIA AND WEIGHTAGE

Enrollment No	1. Quality of information/Knowledge presented in SEMINAR 10	2 Creativity, Innovation in SEMINAR presentation 10	3. Response to the question during seminar presentation 10	4 Establishment of Innovative Problem Statement and its presentation 10	5 Objectives of the project and action plan 10	Total (50)	Scale (20)

SEMINAR AND PROJECT INITIATION COURSE**Course Code : 31**

Sign: Name: ----- (Course Expert/s)	Sign: Name: ----- (Program Head) (Information Technology)

MSBTE Approval Dt. 24/02/2025**Semester - 5, K Sc**

INTERNSHIP(12 WEEKS)

Course Code : 315004

Programme Name/s	: Automobile Engineering./ Artificial Intelligence/ Artificial Intelligence and Machine Learning/ Automation and Robotics/ Cloud Computing and Big Data/ Civil Engineering/ Chemical Engineering/ Computer Technology/ Computer Engineering/ Civil & Rural Engineering/ Construction Technology/ Computer Software Technology/ Computer Science & Engineering/ Digital Electronics/ Data Sciences/ Electrical Engineering/ Electronics & Tele-communication Engg./ Electrical and Electronics Engineering/ Electrical Power System/ Electronics & Communication Engg./ Electronics Engineering/ Computer Hardware & Maintenance/ Industrial Electronics/ Information Technology/ Computer Science & Information Technology/ Civil & Environmental Engineering/ Mechanical Engineering/ Mechatronics/ Manufacturing Technology/ Metallurgical Engineering/ Production Engineering/ Computer Science/ Electronics & Computer Engg.
Programme Code	: AE/ AI/ AN/ AO/ BD/ CE/ CH/ CM/ CO/ CR/ CS/ CST/ CW/ DE/ DS/ EE/ EJ/ EK/ EP/ ET/ EX/ HA/ IE/ IF/ IH/ LE/ ME/ MK/ MRT/ MY/ PG/ SE/ TE
Semester	: Fifth
Course Title	: INTERNSHIP(12 WEEKS)
Course Code	: 315004

I. RATIONALE

Globalization has prompted organizations to encourage skilled and innovative workforce. Internships are educational and career development opportunities, providing practical/ hands-on experience in a field or discipline. Summer internship is an opportunity for students to get accustomed to modern industry practices, apply the knowledge and skills they've acquired in the classroom to real-world situations and become familiar with industry environments before they enter the professional world. Keeping this in mind, industrial training is incorporated to all diploma programmes as it enables the student to get equipped with practical skills, soft skills and life skills

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences: Apply skills and practices to industrial processes.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Observe time/resource management and industrial safety aspects.
- CO2 - Acquire professional experience of industry environment .
- CO3 - Establish effective communication in working environment.
- CO4 - Prepare report of assigned activities and accomplishments.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme						Credits	Assessment Scheme										Total Marks
				Actual Contact Hrs./Week			SLH	NLH	Paper Duration		Theory			Based on LL & TL				Based on SL			
				CL	TL	LL					Total	Practical		SLA							
							FA-TH	SA-TH				Max	Min	FA-PR	SA-PR	Max	Min	Max	Min		
315004	INTERNSHIP(12 WEEKS)	ITR	INP	-	-	-	-	36 - 40	10	-	-	-	-	-	100	40	100#	40	-	-	200

INTERNSHIP(12 WEEKS)**Course Code : 315004**

Legends: # External Assessment

Note: Credits for Industrial Training are in-line of guidelines of NCrF : The industrial training is of 12 weeks considering 36-40 hours per week engagement of students (as per Guidelines of GR of Maharashtra Govt.) under Self Learning with guidance of industry supervisor / Mentor

V General guidelines for organizing Industrial training

The Industry/organization selected for Industrial training/ internships shall be Government/Public Limited/ Private limited / Startup /Centre of Excellence/Skill Centers/Skill Parks etc.

1. Duration of Training - 12 weeks students engagement time
2. Period of Time slot - Between 4th and 5th semester (12 weeks) i.e. commencement of internships will be immediately following the 4th semester exams.
3. Industry area - Engineering Programme Allied industries of large, medium or small-scale, Organization/Govt./ Semi Govt Sectors.

VI Role(s) of Department at the Institute:

Following activities are expected to be performed by the concerned department at the Polytechnics.

Table of activities to be completed for Internship

S.No	Activity	Suggested Schedule
		WEEKS
1	Collection of information about industry available and ready for extending training with its offered capacity of students (Sample Format 1)	1 st to 3 rd week of 4 th Semester
2	Allocations of Student and Mentor as per availability (Mentor: Student Ratio (1:15))	4 th to 6 th week of 4 th semester
3	Communication with Industry and obtaining its confirmation Sample letter Format	6 th to 8 th week of 4 th semester
4	Securing consent letter from parents/guardians of students (Sample Format 2)	Before 10 th week of 4 th semester
5	Enrollment of Students for industrial training (Format 3)	Before 12 th week of 4 rd semester
6	Issue of letter to industry for training along with details of students and mentor (Format 4)	Before 14 th week of 4 th Semester
7	Organize Internship Orientation session for students	Before end of 4 th Semester
8	Progressive Assessment of industry training by Mentor	Each week during training period
9	Assessment of training by institutional mentor and Industry mentor	5 th Semester ESE

Suggestions-

1. Department can take help of alumina or parents of students having contact in different industries for securing placement.

INTERNSHIP(12 WEEKS)**Course Code : 315004**

2. Students would normally be placed as per their choices, in case of more demand for a particular industry, students would be allocated considering their potentials. However preference for placement would be given to students who have arranged placement in company with the help of their parents or relatives.
3. Principal/HOD/Faculty should address students about industrial safety norms, rules and discipline to be maintained in the industry during training before relieving students for training.
4. The faculty members during the visit to industry or sometimes through online mode will check the progress of the student in the training, student attendance, discipline, and project report preparation each week.

VII Roles and Responsibilities of students:

1. Students may interact with the mentor to suggest choices for suitable industry, if any. If students have any contact in industry through their parents or relatives then the same may be utilized for securing placement for themselves and their peers.
2. Students have to fill the forms/formats duly signed by institutional authorities along with a training letter and submit it to a training officer/mentor in the industry on the first day of training.
3. Students must carry with him/her Identity card issued by the institute during the training period.
4. Students should follow industrial dressing protocols, if any. In absence of specific protocol students must wear college uniform compulsorily.
5. Students will have to get all necessary information from the training officer/mentor at industry regarding schedule of training, rules and regulation of the industry and safety norms to be followed. Students are expected to observe these rules, regulations and procedures.
6. Students must be fully aware that if they disobey any rule of industry or do not follow the discipline then non-disciplinary action will be taken .
7. Students must maintain a weekly diary (**Format 6**) by noting daily activities undertaken and get it duly signed from industry mentor or Industrial training in charge.
8. In case students face any major problems in industry such as an accident or any disciplinary issue then they should immediately report the same to the mentor at the institute.
9. Prepare a final report about the training for submitting to the department at the time of presentation and viva-voce and get it signed from a mentor as well as industry training in charge.
10. Students must submit the undertaking as provided in **Format 5**.

VIII Typographical guidelines for Industry Training report

Following is the suggestive format for preparing the training report. Actual report may differ slightly depending upon the nature of industry. The training report may contain the following

1. The training report shall be computer typed (English- British) and printed on A4 size paper.
2. Text Font -Times New Roman (TNR), Size-12 point
3. Subsection heading TNR- 12 point bold normal
4. Section heading TNR- 12 capital bold
5. Chapter Name/ Topic Name – TNR- 14 Capital
6. All text should be justified. (Settings in the Paragraph)

INTERNSHIP(12 WEEKS)**Course Code : 315004**

7. The report must be typed on one side only with double space with a margin 3.5 cm on the left, 2.5 cm on the top, and 1.25 cm on the right and at bottom.
8. The training report must be hardbound/ Spiralbound with a cover page in black color. The name of the candidate, diploma (department), year of submission, name of the institute shall be printed on the cover.
9. The training report, the title page should be given first then the Certificate followed by the acknowledgment and then contents with page numbers.

IX Suggestive format of industrial training report

Following format may be used for training report. Actual format may differ slightly depending upon the nature of Industry/ Organization.

- Title Page
- Certificate
- Abstract
- Acknowledgement
- Content Page

Chapter 1	Organization structure of Industry and general layout.
Chapter 2	Introduction to Industry / Organization (history, type of products and services, turn over and number of employees etc.)
Chapter 3	Types of Major Equipments/raw materials/ instruments/machines/ hardware/software used in industry with their specifications, approximate cost, specific use and routine maintenance done
Chapter 4	Processes/ Manufacturing Manufacturing techniques and methodologies and material handling procedures
Chapter 5	Testing of Hardware/Software/ Raw materials/ Major material handling product (lifts, cranes, slings, pulleys, jacks, conveyor belts etc.) and material handling procedures.
Chapter 6	Safety procedures followed and safety gears used by industry.
Chapter 7	Particulars of Practical Experiences in Industry/Organization if any in Production/Assembly/Testing/Maintenance
Chapter 8	Detailed report of the tasks undertaken (during the training).
Chapter 9	Special/challenging experiences encountered during training if any (may include students liking & disliking of workplaces).
Chapter 10	Conclusion
Chapter 11	References / sources of information

X Suggested learning strategies during training at Industry

- Students should visit the website of the industry where they are undergoing training to collect information about products, processes, capacity, number of employees, turnover etc.
- They should also refer to the handbook of the major machines and operations, testing, quality control and testing manuals.
- Students may also visit websites related to other industries wherein similar products are being manufactured.

XI Tentative week wise schedule of Industry Training

Industrial training is a common course to all Diploma programmes, therefore the industry selection will depend upon the nature of the programme and its related industry. The training activity may vary according to nature and size of industry.

The following table details of activities to be completed during industrial training.

Details of Activities to be completed during Industry training
Introduction of Industry and departments.
Study of Layout of Industry, Specifications of Machines, raw materials, components available in the industry

INTERNSHIP(12 WEEKS)**Course Code : 315004**

Study of setup and manufacturing processes
Execute given project or work assigned to the students, study of safety and maintenance procedures
Validation from industry mentor regarding project or work allocated
Report writing

XII CO-PO Mapping Table to be created by respective Department/faculty.

XIII. Formative Assessment of training : Suggested RUBRIC

(Note : Allot the marks in proportion of presentations and outcome observed. Marks excluding component of week 11 are to be filled by Institute mentor)

Week No	Task to be assessed	Outcome Achievement - Poor	Outcome Achievement - Moderate	Outcome Achievement - High		Week-wise total Marks
		Poor Marks	Average Marks	Good Marks	Excellent Marks	
1	Introduction of Industry	Minimal Knowledge of Departments, processes, products and work culture of the company (Marks -1)	Moderate Knowledge of Departments, processes, products and work culture of the company (Marks -2)	Good Knowledge of Departments, processes, products and work culture of the company (Marks -3/4)	Extensive Knowledge of Departments, processes, products and work culture of the company (Marks -5)	
2	Presentation of Layout of Industry, Specifications of Machines, raw materials, components available in the industry	Minimal w.r.t. tasks (Marks -1)	Moderate w.r.t. tasks (Marks -2)	Good w.r.t. tasks (Marks -3/4)	Extensive w.r.t. tasks (Marks -5)	
3	Participation in setup and manufacturing processes/platforms	Minimal Participation with poor understanding (Marks -1-8)	Moderate Participation with poor understanding (Marks -9-12)	Good Participation with poor understanding (Marks -13-17)	Extensive Participation with poor understanding (Marks -18-20)	
4 to 10	Execution of given project or work to the students, Follow of safety and maintenance procedures	Minimal Participation with poor understanding (Marks -1-8)	Moderate Participation with lower level understanding (Marks - 9-12)	Good Participation with Good understanding (Marks - 13-17)	Extensive Participation with excellent understanding (Marks - 18-20)	
11	Validation by industry mentor regarding project or work allocated	Minimal Participation with poor performance (Marks -1-10)	Moderate Participation with acceptable performance (Marks - 11-15)	Good Participation with Good performance (Marks - 16-20)	Extensive Participation with excellent performance (Marks - 21-25)	

INTERNSHIP(12 WEEKS)**Course Code : 315004**

12	Diary writing	<ul style="list-style-type: none"> Results are not Presented properly, Project work is summarized and concluded not acceptable Future extensions are not specified (Marks –1-10)	<ul style="list-style-type: none"> Results are Presented just casually Project work is summarized and concluded casually Future extensions are casually specified (Marks –11-15)	<ul style="list-style-type: none"> Results are Presented well and properly, Project work is summarized and concluded to a Good level Future extensions are well specified (Marks –16-20)	<ul style="list-style-type: none"> Results are Presented exhaustively Project work is summarized and elaborated in excellent manner , concluded Future extensions are excellently specified (Marks –21-25)	
Total Out of :100						

Marks for (FA) are to be awarded for each week considering the level of completeness of activity observed as per table specified in Sr.No. XIII above, from the daily diary maintained . Feedback from industry supervisor shall also be considered.

XIV Summative Assessment (SA) of training:

Academic year : 20 -20

i) Suggested RUBRIC for SA

Enrollment Number	Observations from Orals				Presentations				Total (100)
	Tasks undertaken (20)	Overall Understanding (20)	Creativity /Innovation demonstrated (10)	Knowledge acquired (10)	Speech Clarity (10)	Body Language (10)	Presentations (10)	Diary , Report writing and / Product (10)	

Name of mentor:
Signature of Mentor

XV FORMATS**Format-1: Collecting Information about Industry/Organization available for training along with capacity**

- 1) Name of the industry/organization:
- 2) Address/communication details with email :
- 3) Contact person details:
 - a) Name:
 - b) Designation:
 - c) Email
 - d) Contact number/s:
- 4) Type:

Govt / PSU / Pvt /

Large scale / Medium scale / Small scale
- 5) Products/services offered by industry:
- 6) a) Whether willing to offer Industrial training facility during May/ June for Diploma in Engineering students:
Yes / No.
b) If yes, whether you offer 12 weeks training: **Yes/No**
c) Possible Industrial Capacity:

Students	Programme name/ Title					Total
	Civil	Mechanical	Chemical			
Male						
Female						
Total						

- 7) Whether accommodation available for interns **Yes / No.**

If yes capacity: _____

- 8) Whether internship is charged or free:

If charged please specify amount per candidate: _____

Signature of responsible person at Industry:

Format-2: Obtaining Consent Letter from parents/guardians

(Undertaking from Parents)

To,

The Principal,
_____ ,Subject: Consent for Industrial Training.
Sir/Madam,

I am fully aware that -

- i) My ward studying in _____ semester at your _____ institute has to undergo 12 weeks of Industrial training for partial fulfillment _____ towards completion of Diploma in _____ Engineering.
- ii) For this fulfillment he/she has been deputed at _____ industry, located at _____ for Industrial training /internship _____ for the period from _____ to _____ .

With respect to above I give my full consent for my ward to travel to and from the mentioned industry. Further I undertake that –

- My ward will undergo the training at his/her own cost and risk during training and/or stay.
- My ward will be entirely under the discipline of the organization where he/she will be placed and will abide by the rules and regulations in face of the said organization.
- My ward is NOT entitled to any leave during the training period.
- My ward will regularly submit a prescribed weekly diary, duly filled and countersigned by the training supervisor of the organization to the mentor faculty of the polytechnic.

I have explained the contents of the letter to my ward, who has also promised to adhere strictly to the requirements. I assure that my ward will be properly instructed to take his own care to avoid any accidents/injuries in the industry. In case of any accident neither industry nor the institute will be held responsible.

Signature :

Name : _____

Address : _____

Phone Number :

Format-4: Issue Letter to the Industry/Organization for the training along with details of students and mentors

To,

The HR Manager,

Subject: Placement for Industrial training of ___ weeks in your organization....

Reference: Your consent letter no:

Sir,

With reference to the above we are honored to place the following students from this institute for Industrial training in your esteemed organization as per the arrangement arrived at.

The purpose of this training is to equip the student with some essential skills relevant to the demands of the industry and world of work, as well as to provide exposure to the professional environment and work culture. It is hoped that this training may enhance his/her employability and livelihood opportunities. In view of the above, we kindly request your support in facilitating this Industrial Training for the student. He/she has been adequately oriented and guided on the expectations of this training, including the maintenance of a daily diary during the training period. Additionally, the institute has secured the necessary consent and undertaking from the parent/guardian regarding the guidelines for exit training. In view of all the above industry shall refrain from involving students into the mundane and housekeeping activities. Your cooperation in this regard will be highly appreciated.

Diploma programme in _____ Engg.

Sr.No	Enrollment No	Name of Student	Name and designation of Mentor

Diploma programme in _____ Engg.

Sr.No	Enrollment No	Name of Student	Name and Designation of Mentor

Kindly extend all possible cooperation to the students for above.

Thanking you

Yours sincerely,

(Principal)
Name of the Institute:
with Seal

Cc- To HoD/Mentor

Format-5: Undertaking by the students

TO
Principal

Subject: Undertaking regarding Placement for Industrial training of 12/16/18 weeks duration

IReg No:..... S/o/D/o.

.....Studying in ----- at -----
Institute at -----fully aware of the Industrial Training requirement and related responsibilities
and participation in the, Industrial training between From:
To.....

I assure you that I will be of good behavior and be obedient to the staff and mentor during the
...../Industrial training. I will also abide and will not participate in all activity. I will also discipline
myself within the rules and regulations of the Institution. I am also aware that I am participating in the
..... at my own risk and I will not hold the -----Institute responsible in any way in any
eventuality namely Accident /Injury/death or whatever mishap and I myself will be solely responsible for my safety.

Place :Signature of the student

Date :Reg. No.

INTERNSHIP(12 WEEKS)**Course Code : 315004****Format-6: Internships Daily Diary**

Name of the Student: _____ Name of the mentor (Faculty) :

Enrollment Number: _____ Semester: _____ Academic Year

Week	Day & Date	Discussion Topics/Activity	Details of Work Allotted Till Next Session /Corrections Suggested/Faculty Remarks	Signature of Industry Mentor
Week 01	Mon, Date			
	Tue, Date			
	Wed, Date			
	Thu, Date			
	Fri, Date			
	Sat, Date			
.	Mon, Date			
	Tue, Date			
	Wed, Date			
	Thu, Date			
	Fri, Date			
	Sat, Date			
Week n	Mon, Date			
	Tue, Date			
	Wed, Date			
	Thu, Date			
	Fri, Date			
	Sat, Date			

MSBTE Approval Dt. 24/02/2025**Semester - 5, K Scheme**

DATA ANALYTICS**Course Code : 315326**

Programme Name/s : Computer Technology/ Computer Engineering/ Computer Software Technology/ Computer Science & Engineering/ Information Technology/ Computer Science & Information Technology/ Computer Science/ Electronics & Computer Engg./

Programme Code : CM/ CO/ CST/ CW/ IF/ IH/ SE/ TE

Semester : Fifth

Course Title : DATA ANALYTICS

Course Code : 315326

I. RATIONALE

Data Analytics uses statistical and computational methods to analyze data, aiding informed decision-making. Excel dashboards effectively present vital data at a glance, enhancing user interactivity. A Data Analyst collects, cleans, and visualizes Datasets to solve problems.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Perform Data Analytics in various business domains for improved decision making

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Elaborate the fundamental concepts of Data Analytics.
- CO2 - Apply appropriate statistical techniques to analyze and interpret complex Datasets.
- CO3 - Analyze numerical data by creating pivot table.
- CO4 - Represent data in terms of various types of charts.
- CO5 - Visualize the data using a Python library.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme						Credits	Paper Duration	Assessment Scheme										Total Marks
				Actual Contact Hrs./Week			SLH	NLH	Theory			Based on LL & TL				Based on SL						
				CL	TL	LL			FA-TH			SA-TH	Total	Practical		SLA						
														FA-PR	SA-PR	Max	Min	Max	Min			
315326	DATA ANALYTICS	DAN	DSE	4	-	2	-	6	2	3	30	70	100	40	25	10	25#	10	-	-	150	

Total IKS Hrs for Sem. : 0 Hrs

Abbreviations: CL- Classroom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @\$ Internal Online Examination

Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 10 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	<p>TLO 1.1 Describe the importance of data analytics.</p> <p>TLO 1.2 Differentiate between types of data analytics.</p> <p>TLO 1.3 Describe the quality and quantity of data.</p> <p>TLO 1.4 Measures the central tendency of given dataset.</p> <p>TLO 1.5 Use various sampling techniques.</p>	<p>Unit - I Introduction to Data Analytics</p> <p>1.1 Data Analytics: An Overview, Importance of Data Analytics</p> <p>1.2 Types of Data Analytics: Descriptive Analysis, Diagnostic Analysis, Predictive Analysis, Prescriptive Analysis, Visual Analytics</p> <p>1.3 Life cycle of Data Analytics, Quality and Quantity of data, Measurement</p> <p>1.4 Data Types, Measure of central tendency, Measures of dispersion</p> <p>1.5 Sampling Funnel, Central Limit Theorem, Confidence Interval, Sampling Variation</p>	<p>Presentations</p> <p>Lecture Using Chalk-Board</p> <p>Case Study</p>
2	<p>TLO 2.1 Create a box plot of the test scores and interpret its key components.</p> <p>TLO 2.2 Perform correlation and regression analysis.</p> <p>TLO 2.3 Use various methods to address missing values in Dataset.</p> <p>TLO 2.4 Apply Anova and Chi Square test.</p> <p>TLO 2.5 Use scatter diagrams.</p> <p>TLO 2.6 Test hypothesis.</p> <p>TLO 2.7 Explain the concept of a sampling distribution.</p> <p>TLO 2.8 Analyze the probability distribution.</p>	<p>Unit - II Statistical Analysis</p> <p>2.1 Graphical techniques, box plot, skewness and kurtosis, Descriptive Stats</p> <p>2.2 Correlation and Regression, Data Cleaning</p> <p>2.3 Imputation Techniques</p> <p>2.4 Anova and Chi Square</p> <p>2.5 Scatter Diagram</p> <p>2.6 Estimation and Hypothesis Testing</p> <p>2.7 Sampling Distributions, Counting</p> <p>2.8 Probability, Probability Distributions</p>	<p>Presentations</p> <p>Lecture Using Chalk-Board</p> <p>Hands-on</p>
3	<p>TLO 3.1 Describe the steps for making excel dashboard.</p> <p>TLO 3.2 Create a pivot Table.</p> <p>TLO 3.3 Sort and filter the pivot tables.</p> <p>TLO 3.4 Create a pivot chart for different types of grouping items.</p> <p>TLO 3.5 Describe various formatting operations on pivot table.</p>	<p>Unit - III Data Analytics with Excel</p> <p>3.1 Excel Dashboard: Tables and Data Grids, Dynamic Filters and Controls, Trend Analysis and Forecasting</p> <p>3.2 Pivot Tables: Creating a Pivot Table Specifying Pivot Table Data</p> <p>3.3 Changing a Pivot Tables, Calculation Filtering and Sorting a Pivot Table</p> <p>3.4 Creating a Pivot Chart, Grouping Items</p> <p>3.5 Updating a Pivot Table, formatting a Pivot Table using Slicers</p>	<p>Presentations</p> <p>Hands-on</p> <p>Demonstration</p>

DATA ANALYTICS**Course Code : 315326**

Sr.No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
4	<p>TLO 4.1 Create relevant chart based on requirement.</p> <p>TLO 4.2 Describe the process of selecting the data range.</p> <p>TLO 4.3 Explain the features of Chart Wizard.</p> <p>TLO 4.4 Explain the steps to move an embedded chart to a new position within the same worksheet.</p> <p>TLO 4.5 Format various components of given type of chart.</p>	<p>Unit - IV Data Visualization</p> <p>4.1 Creating a Simple Chart, Charting Non-Adjacent Cells</p> <p>4.2 Creating a Chart Using the Chart Wizard, Modifying Charts, Moving an Embedded Chart, Sizing an Embedded Chart</p> <p>4.3 Changing the Chart Type, Changing the Way Data is Displayed, Moving the Legend</p> <p>4.4 Formatting Charts, Adding Chart Items, Formatting All Text, Formatting and Aligning Numbers, Formatting the Plot Area, Formatting Data Markers</p> <p>4.5 Pie Charts, Creating a Pie Chart Moving the Pie Chart to its Own Sheet Adding Data Labels, Exploding a Slice of a Pie Chart</p>	<p>Presentations Hands-on Demonstration</p>
5	<p>TLO 5.1 Describe the steps for Installing and setting up Matplotlib in Python.</p> <p>TLO 5.2 Create various types of plots.</p> <p>TLO 5.3 Customize Plots.</p> <p>TLO 5.4 Write steps to Export plots in different formats.</p>	<p>Unit - V Data Visualization using Python</p> <p>5.1 Overview of Matplotlib and its role in data visualization, Installing and setting up Matplotlib in Python</p> <p>5.2 Basic plotting with Matplotlib, Line plot, Scatter plots, Bar charts, Histograms, adding titles, labels, and legends to plots</p> <p>5.3 Changing figure size and aspect ratio, Customizing axes (limits, ticks, and labels)</p> <p>5.4 Exporting and Saving Visualizations: Saving plots in different formats (PNG, PDF, SVG), Adjusting the resolution and quality of saved plots, creating interactive visualizations using Matplotlib widgets</p>	<p>Presentations Hands-on Demonstration</p>

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Perform Statistical Analysis in Excel.	1	<p>*a. Calculate mean, median, and mode for a given dataset using Excel functions (AVERAGE, MEDIAN, MODE).</p> <p>*b. Calculate range, interquartile range (IQR), variance, and standard deviation using Excel functions (STDEV, VAR).</p> <p>*c. Calculate the correlation coefficient between two variables using the CORREL function</p>	2	CO1
<p>LLO 2.1 Construct box plot.</p> <p>LLO 2.2 Perform the different types of function using linear regression.</p> <p>LLO 2.3 Perform T-test in Excel.</p> <p>LLO 2.4 Calculate confidence intervals for the mean of a dataset.</p> <p>LLO 2.5 Apply Chi-square test for independence.</p>	2	<p>*a. Construct a box plot using the Insert Chart feature to identify the median, quartiles, and outliers of a dataset.</p> <p>*b. Perform a simple linear regression analysis</p> <p>*c. Conduct a t-test to compare means between two groups</p> <p>*d. Calculate confidence intervals</p> <p>*e. Conduct a Chi-square test</p>	2	CO2

DATA ANALYTICS

Course Code : 315326

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 3.1 Create a table to execute the function using dashboard. LLO 3.2 Perform various operations for data cleaning.	3	<p>*Create a Data Table</p> <p>a. Import a sample dataset (e.g., sales data) into Excel.</p> <p>b. converts the dataset into an Excel Table using the "Format as Table" feature and apply appropriate styles.</p> <p>c. Create a dashboard sheet that summarizes key metrics (e.g., total sales, average sales per region) using tables.</p> <p>*Data Cleaning</p> <p>a. Identify and remove duplicates from a dataset.</p> <p>b. Use functions like TRIM, UPPER, LOWER, and PROPER to clean text data.</p> <p>c. Find and replace values using the Find & Replace feature.</p>	2	CO3
LLO 4.1 Create a pivot table to analyze the data set. LLO 4.2 Sort and filter the given data set.	4	<p>Create a Pivot Table</p> <p>a. A basic pivot table from a dataset</p> <p>b. Specify and filter data in a pivot table</p> <p>c. Add a calculated field to a pivot table</p> <p>d. Group data within a pivot table. Refresh pivot table data after making changes to the source data.</p> <p>Filter and sort a PivotTable</p> <p>a. Apply a Filter to the PivotTable</p> <p>b. Sort Data in the Pivot Table.</p> <p>c. Add slicers to the PivotTable for interactive filtering.</p>	2	CO3
LLO 5.1 Customize your chart with titles, labels, colors, and legends as desired.	5	<p>Create a Pivot Chart</p> <p>a. A basic pivot chart from a dataset</p> <p>b. A dynamic pivot chart that updates based on user selection</p> <p>c. Group date items in a pivot table to summarize data by month or year</p> <p>d. Group product categories in a pivot table</p>	2	CO3

DATA ANALYTICS

Course Code : 315326

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 6.1 Create a simple chart to visualize the data sets.	6	*Create a Simple Chart a. A simple bar chart to visualize data sets b. A chart using non-adjacent cells to visualize data from different ranges. *Create a Chart Using the Chart Wizard a Select the chart you created and experiment with the Chart Tools options b. Modifying Charts c. Moving an Embedded Chart d. Sizing an Embedded Chart	2	CO4
LLO 7.1 Change the chart type with adding data labels, axis format, and adjusting the gridlines.	7	*Change the Chart Type a. Create a basic bar chart using a dataset and change its type to a different chart b. Experiment with different data display options, such as adding data labels, changing the axis format, and adjusting the gridlines c. Experiment with position and style of the legend	2	CO4
LLO 8.1 Design a pie chart.	8	a. Create a pie chart from a dataset b. Move the pie chart to a new worksheet for better visibility c. Emphasize a specific category by exploding a slice of the pie chart d. Customize the appearance of the pie chart for better presentation	2	CO4
LLO 9.1 Generate and Save the plot in various formats.	9	* Create different types of plots. Write a Python script to save the plot in different formats: PNG, PDF, and SVG.	2	CO5
LLO 10.1 Analyze data analytics applications across various business domains.	10	Application of data analytics across various industries through case study	2	CO5
Note : Out of above suggestive LLOs - <ul style="list-style-type: none"> * Marked Practicals (LLOs) Are mandatory. Minimum 80% of above list of lab experiment are to be performed. Judicial mix of LLOs are to be performed to achieve desired outcomes. 				

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)

Other

- NA

DATA ANALYTICS**Course Code : 315326****Note :**

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicious mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Microsoft Office ,Office 365	1,2,3,4,5,6,7,8,9
2	Software: Editor: Python setup	10,11
3	Computer (i5 preferable), RAM minimum 8 GB onwards.	All
4	Operating system: Windows 10 onward	All

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Introduction to Data Analytics	CO1	10	4	4	8	16
2	II	Statistical Analysis	CO2	8	2	4	10	16
3	III	Data Analytics with Excel	CO3	8	2	2	8	12
4	IV	Data Visualization	CO4	8	2	4	6	12
5	V	Data Visualization using Python	CO5	6	2	4	8	14
Grand Total				40	12	18	40	70

X. ASSESSMENT METHODOLOGIES/TOOLS**Formative assessment (Assessment for Learning)**

- Continuous assessment based on process and Product related performance indicator. Each practical will be assessed considering 1) 60% weightage is to process 2) 40% weightage to product

Summative Assessment (Assessment of Learning)

- End Semester Examination, Lab Performance ,Viva-voce

XI. SUGGESTED COS - POS MATRIX FORM

DATA ANALYTICS**Course Code : 315326**

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	2	2	1	-	2	-	2			
CO2	2	2	2	2	1	1	1			
CO3	2	2	3	2	1	1	1			
CO4	2	2	3	1	1	2	1			
CO5	1	2	2	2	2	2	2			

Legends :- High:03, Medium:02,Low:01, No Mapping: -
*PSOs are to be formulated at institute level

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Jinjer Simon	Excel Data Analysis: Your visual blueprint for analyzing data, charts, and PivotTables	Wiley Publication Edition: 3rd ISBN: 978-0-470-59160-4
2	A. J. Smalley	Data Analysis with Excel	SAGE Publications Edition: 1st, 2007 ISBN 10: 0070139903 / ISBN 13: 9780070139909
3	Fabio Nelli	Python Data Analytics: With Pandas, NumPy, and Matplotlib	Apress publication ISBN-13 :978-1484239124 ISBN-13978-1484247372
4	Jake VanderPlas	Python Data Science Handbook	Shroff/O'Reilly Publication ISBN-10-9355422555 ISBN-13-978-9355422552
5	Business Analytics with MindTap	Jeffrey D. Camm James J Cochran Michael J. Fry Jeffrey W. Ohlmann	Cengage Learning India Pvt. Ltd. Publication Edition:4th ISBN: 9789360533533

XIII. LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://spreadsheetpoint.com/excel/dashboard-in-excel/	Advance Excel
2	https://www.javatpoint.com/how-to-create-a-dashboard-in-excel	Excel Dashboard
3	https://www.simplilearn.com/tutorials/excel-tutorial/data-analysis-excel	Data Visualization
4	https://www.freecodecamp.org/news/introduction-to-data-visualization-using-matplotlib/	Matplotlib in Python
5	https://archive.nptel.ac.in/courses/106/107/106107220/	Introduction to data analytics

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

EMBEDDED SYSTEM**Course Code : 315338**

Programme Name/s : Automation and Robotics/ Digital Electronics/ Electronics & Tele-communication Engg./ Electrical and Electronics Engineering/ Electronics & Communication Engg./ Electronics Engineering/ Industrial Electronics/ Electronics & Computer Engg./

Programme Code : AO/ DE/ EJ/ EK/ ET/ EX/ IE/ TE

Semester : Fifth

Course Title : EMBEDDED SYSTEM

Course Code : 315338

I. RATIONALE

Embedded systems are designed for specific tasks to excel in real-time performance, resource utilization and reliability. These systems are playing vital role in modern technology, enabling sophisticated functionalities in a wide array of devices and applications. Embedded systems are integral to the advancement of technology across multiple sectors. By learning this course, students will develop skills to use embedded system for simple applications. It will also enable them to use open-source embedded system for solving real time problems.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to help students to attain the following industry/employer expected outcome through various teaching learning experiences:

"Develop simple applications based on embedded system."

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Select the relevant microcontrollers for various industrial applications.
- CO2 - Choose appropriate family of microcontroller for different applications.
- CO3 - Interpret the communication standards of embedded systems.
- CO4 - Analyze the features of Real Time Operating System.
- CO5 - Develop the basic applications using Arduino.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Paper Duration	Assessment Scheme										Total Marks
				Actual Contact Hrs./Week			SL	LH			NLH	Theory			Based on LL & TL				Based on SL		
				CL	TL	LL						FA-TH	SA-TH	Total		Practical		SLA			
														Max	Min	Max	Min	Max	Min	Max	
315338	EMBEDDED SYSTEM	ESY	DSC	5	-	2	2	9	3	3	30	70	100	40	25	10	25#	10	25	10	175

EMBEDDED SYSTEM**Course Code : 315338****Total IKS Hrs for Sem. : 0 Hrs**

Abbreviations: CL- Classroom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @\$ Internal Online Examination

Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 10 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	<p>TLO 1.1 Identify the components of the embedded system and their functions.</p> <p>TLO 1.2 Describe the given characteristic of the specified embedded system.</p> <p>TLO 1.3 Classify the embedded system.</p> <p>TLO 1.4 List the selection factors of the embedded systems.</p>	<p>Unit - I Overview of Embedded Systems</p> <p>1.1 Embedded system, block diagram description, layered model</p> <p>1.2 Characteristics of embedded system: CPU type, maximum CPU speed, processing power, memory, performance</p> <p>1.3 Classification of embedded system: small scale, medium scale, sophisticated, stand-alone, reactive/real time (soft and hard real time)</p> <p>1.4 Selection criteria of embedded system: operating system, reliability, NRE cost, unit cost, size, flexibility, time to prototype, time to market, maintainability, correctness and safety</p>	Lecture using Chalk-Board Presentations
2	<p>TLO 2.1 Compare different types of micro controllers used for embedded system designing.</p> <p>TLO 2.2 Describe AVR microcontroller with the help of block diagram.</p> <p>TLO 2.3 Sketch the block diagram of ATmega 8 and describe the functions of each block.</p> <p>TLO 2.4 Compare specifications of microcontrollers ATmega 8 and ATmega 328.</p> <p>TLO 2.5 List the features of Arduino specific microcontrollers.</p>	<p>Unit - II Microcontroller Architecture</p> <p>2.1 Microcontroller Types: PIC, AVR, ARM, features and applications</p> <p>2.2 AVR microcontroller: types , architecture</p> <p>2.3 ATmega 8: features, internal architecture</p> <p>2.4 Programming configurations of ATmega 8: I/O port, peripherals counter, timer</p> <p>2.5 Comparison of ATmega 8 and ATmega 328</p> <p>2.6 Features of Arduino specific AVR microcontroller ATmega 168/328</p>	Presentations Lecture using Chalk-Board Site/Industry Visit

EMBEDDED SYSTEM**Course Code : 315338**

Sr.No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
3	TLO 3.1 Describe the given type of modes for communication. TLO 3.2 Describe the given communication protocol(s) with relevant sketches. TLO 3.3 Describe the given wireless serial communication interface. TLO 3.4 Differentiate between given protocols for given parameters.	Unit - III Communication Standards and Protocols 3.1 Modes of communication: serial, parallel, synchronous and asynchronous 3.2 Communication Protocols its types: Serial: I2C, CAN, USB 3.3 Serial peripheral interface (SPI), IEC 61850 GOOSE (Protocol for Electric power system applications) 3.4 Wireless protocol : IrDA, Bluetooth, Zigbee, WiFi, LORA, LoWPAN	Lecture using Chalk-Board Presentations
4	TLO 4.1 Describe the functions of the given operating system. TLO 4.2 Compare RTOS and general OS for the given parameters. TLO 4.3 Describe features of RTOS with neat sketch. TLO 4.4 Explain deadlock condition in RTOS with suitable sketch.	Unit - IV Real Time Operating System 4.1 Operating system: general and real time operating system 4.2 Characteristics of real time operating system: consistency, reliability, scalability, performance, predictability 4.3 Functions of RTOS, Task management: inter task communication and multitasking, Scheduling: scheduling algorithms, resource allocation and interrupt handling 4.4 Features of RTOS: watchdog timer, semaphore 4.5 Deadlock: reasons of occurrence, handling of deadlock	Lecture using Chalk-Board Flipped Classroom Presentations
5	TLO 5.1 Enlist the different types of Arduino boards and their major features. TLO 5.2 Describe the working of development board using block diagram. TLO 5.3 Describe the given Arduino functions. TLO 5.4 Write steps to interface the given peripheral with Arduino. TLO 5.5 Interface the given sensor with Arduino.	Unit - V I/O Interfacing with Arduino 5.1 Arduino Board: introduction, types: Arduino UNO, NANO, MEGA 5.2 Functional Block Diagram of Arduino, pin functions of Arduino 5.3 Functions used in Arduino: math, analog I/O, digital I/O, timer 5.4 Peripheral interfacing with Arduino: keyboard, LCD, seven segment LED, relay, stepper motor, DC motor 5.5 Sensor interfacing with Arduino: temperature sensor, ultrasonic sensor	Lecture using Chalk-Board Presentations

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Identify pins and functions of AVR and PIC microcontroller.	1	*Identification of pins of AVR and PIC Microcontroller	2	CO1 CO2
LLO 2.1 Use an Integrated Development Environment (IDE) tool for developing C Programs of ATmega 168/328.	2	Use an IDE for ATmega 168/328 programming	2	CO2
LLO 3.1 Develop AVR C program to perform addition, subtraction, and multiplication operations on two constant data and output the result to port with some delay between each output.	3	*Write C program to perform various arithmetic operations	2	CO2
LLO 4.1 Interface 4 x 4 LED matrix with AVR. LLO 4.2 Develop C program to display various patterns.	4	*Interface LED matrix with AVR microcontroller	2	CO2

EMBEDDED SYSTEM**Course Code : 315338**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 5.1 Configure USB protocol on PC .	5	Serial Communication using USB	2	CO3
LLO 6.1 Install Arduino IDE and its development tool for Windows/MacOS/Linux operating systems.	6	*Installation of Arduino IDE for Windows/MacOS/Linux operating Systems	2	CO5
LLO 7.1 Build the circuit using 4 switches and 4 LEDs to Arduino Board. LLO 7.2 Test the LED on/off as per switch positions.	7	Building and Testing switch and LED interface using Arduino	2	CO5
LLO 8.1 Develop programs to perform arithmetic operation using math functions: constrain (), max (), min (), Pow(), sq(), sqrt() uisng Arduino.	8	*Programs to perform arithmetic operations on Arduino	2	CO5
LLO 9.1 Interface two 16 x 2 LCD modules with Arduino using I2C serial communication protocol.	9	*LCD Interfacing to Arduino board	2	CO5
LLO 10.1 Develop program to read the data from the temperature sensor through Arduino and display on LCD.	10	Temperature sensor interfacing to Arduino board	2	CO5
Note : Out of above suggestive LLOs - <ul style="list-style-type: none"> *1 Marked Practicals (LLOs) Are mandatory. Minimum 80% of above list of lab experiment are to be performed. Judicial mix of LLOs are to be performed to achieve desired outcomes. 				

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)

Assignment

- List different types of sensors and actuators used with embedded system and also write application of each sensor
- Create a program to control a DC motor using PWM (Pulse Width Modulation).
- Interface a temperature sensor with Arduino and display the readings on the serial monitor
- Develop a simple program to blink an LED using assembly language.
- Implement SPI communication to control an LED matrix display.
- Conduct a market survey for various types of Arduino boards available

Micro project

- Control the position of a servo motor using Arduino
- Control home appliances using Arduino and relays
- Design digital soil moisture meter using Arduino
- Implement a digital clock using an RTC (Real-Time Clock) module
- Create a digital thermometer using arduino and a temperature sensor
- Implement an RFID-based door lock system using Arduino
- Create a simple home automation system to control appliances using an AVR/PIC microcontroller
- Measure distances using an ultrasonic sensor and display the results on an LCD
- Interface any I/O deice to Raspberry pi development board

EMBEDDED SYSTEM**Course Code : 315338****Note :**

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicious mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Components: AVR, PIC Microcontroller	1
2	PIC Microcontroller: 32.768 KHz and 20 MHz Crystal, On-Board Debugger, USB Powered or externally powered, Adjustable target voltage	1
3	Temperature sensors; range -55 to 125°C	10
4	Simulation softwares: Arduino IDE, Atmel studio, Microchip studio.	3,4,7,8,9,10
5	Microcontroller kit (AVR ATmega 168/328 board and PIC): single board systems with minimum 8K RAM, ROM memory with battery backup, 16 x 4 LCD display, seven segment display, PC keyboard interfacing facility, cross 'C' compiler, USB, interfacing facility with built in power supply.	4
6	Arduino board UNO/ Nano or available microcontroller: ATmega328P, operating voltage: 5V input voltage (recommended): 7-12V input voltage (limit): 6-20V digital I/O pins: 14 (of which 6 provide PWM output) analog input pins: 6 DC current per I/O Pin: 20 mA DC current for 3.3V pin: 50 mA flash memory: 32 KB (ATmega328P) of which 0.5 KB used by bootloader SRAM: 2 KB (ATmega328P) EEPROM: 1 KB (ATmega328P) clock speed: 16 MHz LED built in: 13 dimensions: 68.6 mm x 53.4 mm weight: 25 g	6,7,8,9
7	LCD 16x2 Modules	9
8	Desktop PC with minimum RAM 4GB, Windows OS	All

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Overview of Embedded Systems	CO1	8	4	4	4	12
2	II	Microcontroller Architecture	CO2	12	2	6	8	16
3	III	Communication Standards and Protocols	CO3	8	2	4	8	14
4	IV	Real Time Operating System	CO4	10	4	6	2	12
5	V	I/O Interfacing with Arduino	CO5	12	2	6	8	16
Grand Total				50	14	26	30	70

X. ASSESSMENT METHODOLOGIES/TOOLS**Formative assessment (Assessment for Learning)**

- Two offline unit tests of 30 marks and average of two unit test marks will be consider for out of 30 marks.
- For formative assessment of laboratory learning 25 marks.
- Each practical will be assessed considering 60% weightage to process, 40% weightage to product.

EMBEDDED SYSTEM**Course Code : 315338****Summative Assessment (Assessment of Learning)**

- End semester assessment is of 70 marks.
- End semester summative assessment is of 25 marks for laboratory learning.

XI. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	2	2	2	1	1	-	2			
CO2	3	3	2	2	1	1	2			
CO3	2	2	2	2	1	-	2			
CO4	2	1	2	2	1	1	2			
CO5	3	3	2	3	1	1	2			

Legends :- High:03, Medium:02,Low:01, No Mapping: -
*PSOs are to be formulated at institute level

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Raj Kamal	Microcontroller Architecture Programming, Interfacing and System Design	Pearson Education India, Delhi, 2012 ISBN: 978-8131759905
2	Muhammed Ali Mazidi, Sarmad Naimi, Sepehr Naimi	AVR Microcontroller and Embedded Systems: Using Assembly and C	Pearson Education India, Delhi, 2013 ISBN: 978-9332518407
3	Dawoud Shenouda Dawoud, Peter Dawoud	Serial Communication Protocols and Standards	River Publishers, Denmark, 2020 ISBN: 978-8770221542
4	David E. Simon	An Embedded Software Primer	Addison-Wesley, Delhi, 2002 ISBN: 978-9332518407
5	J.M.Hughes	Arduino: A Technical Reference	O'REILLY, 2016 ISBN: 978-1491921760
6	Jeremy Blum	Exploring Arduino Tools and Techniques for Engineering Wizardry	John Wiley & Sons, 2019 ISBN: 978-1118549360
7	Michael McRoberts	Beginning Arduino	APRESS, 2011 ISBN: 978-1430232414
8	K. V. K. K. Prasad	Embedded Real –Time Systems concepts, Design & Programming Black Book	Dreamtech Press New Delhi, 2003 ISBN: 978-8177224610
9	Frank Vahid, Tony Givargis	Embedded System Design A Unified Hardware/ Software Introduction	Wiley India, New Delhi, 2006 ISBN: 978-0471386780

EMBEDDED SYSTEM**Course Code : 315338****XIII . LEARNING WEBSITES & PORTALS**

Sr.No	Link / Portal	Description
1	https://www.microchip.com/en-us/tools-resources/develop/microchip-studio	Microchip Studio for AVR® and SAM Devices is an integrated development platform from Microchip
2	http://arduino.cc/	Link for Arduino Related Hardware and Software Download and installation
3	https://learn.sparkfun.com/tutorials/what-is-an-arduino	Arduino Basics
4	https://onlinecourses.swayam2.ac.in/aic20_sp04/preview	Introduction and Concepts of Arduino
5	https://support.arduino.cc/	Tutorials, data sheets, guides and other technical documentation
6	http://vlabs.iitkgp.ac.in/rtes/	Virtual lab link for Microcontrollers
7	https://semiconductors.es/datasheet-pdf/219613/ATMEGA32.html	Datasheet for ATmega Microcontrollers
8	https://www.alldatasheet.com/datasheet-pdf/pdf/82338/MICROCHIP/PIC16F877A.html	Datasheet for PIC Microcontroller

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

MSBTE Approval Dt. 24/02/2025**Semester - 5, K Scheme**

OPERATING SYSTEM USING LINUX**Course Code : 315353**

Programme Name/s : Electronics & Computer Engg.
Programme Code : TE
Semester : Fifth
Course Title : OPERATING SYSTEM USING LINUX
Course Code : 315353

I. RATIONALE

The operating system manages memory, processes, hardware, and software of the computer, and also it is possible for the user to interact with the computer without acquainting the computer languages. This course helps students to enhance skills for using Operating System functions, Linux OS principles, Tools, Commands, and Shell Programming.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to attend following industry/employer expected outcome through various teaching learning experiences:

Maintain Linux-Based Operating Systems to deliver high performance, security, flexibility, and cost-effectiveness.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Install linux Operating System and System tools to perform various functions of Operating System.
- CO2 - Apply concept of Process Management and Inter-Process Communication(IPC).
- CO3 - Apply scheduling algorithms to calculate turnaround time and average waiting time.
- CO4 - Use concept of different Memory Management Techniques.
- CO5 - Use File Management Techniques.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme						Credits	Paper Duration	Assessment Scheme										Total Marks
				Actual Contact Hrs./Week			SL	H	NLH			Theory			Based on LL & TL				Based on SL			
				CL	TL	LL						FA-TH	SA-TH	Total	Practical		SLA					
															FA-PR	SA-PR	Max	Min	Max	Min		
315353	OPERATING SYSTEM USING LINUX	OSL	DSC	5	-	2	2	9	3	3	30	70	100	40	25	10	25#	10	25	10	175	

Total IKS Hrs for Sem. : Hrs

Abbreviations: CL- Classroom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @\$ Internal Online Examination

Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 10 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	<p>TLO 1.1 Explain functions of Linux OS.</p> <p>TLO 1.2 List types of Operating System.</p> <p>TLO 1.3 Execute Linux commands on command line for the given task.</p> <p>TLO 1.4 Enumerate system calls and describe functions of each.</p>	<p>Unit - I Overview of Operating System</p> <p>1.1 Operating System: Concept, Components of Operating System, Operating System Structure (Simple Structure, Monolithic Structure, Layered Structure, Micro-Kernel Structure, Virtual Machines), Functions of Operating Systems, Services of OS</p> <p>1.2 Different Types of Operating Systems: Serial Processing, Batch OS, Multiprogramming OS, Real-Time OS, Time-Sharing OS, Multiprocessor Systems, Distributed OS, Mobile OS-Android, Mac OS</p> <p>1.3 Command Line Interface and Graphical User Interface: LINUX, WINDOWS, Comparison of LINUX and WINDOWS</p> <p>1.4 System Call: Concept, Types of System call (for Process Management, File Management, Directory Management, Miscellaneous System Calls)</p>	Lecture Using Chalk-Board Presentations Demonstration
2	<p>TLO 2.1 Describe Process and Process State with suitable diagram.</p> <p>TLO 2.2 Describe functions of the given component of process stack in Process Control Block.</p> <p>TLO 2.3 Explain working of Inter-Process Communication(IPC) with suitable diagram.</p> <p>TLO 2.4 Explain characteristics of the given multithreading model.</p>	<p>Unit - II Process Management</p> <p>2.1 Process: Process States, Process Control Block(PCB)</p> <p>2.2 Process Scheduling- Scheduling Queues, Schedulers, Context Switch</p> <p>2.3 Inter-Process Communication(IPC): Introduction, Shared Memory System and Message Passing System</p> <p>2.4 Threads - Benefits, Users and Kernel Threads, Multithreading Models – One to One, Many to One, Many to Many</p>	Lecture Using Chalk-Board Presentations Demonstration
3	<p>TLO 3.1 Discuss need for given job scheduling criteria.</p> <p>TLO 3.2 Calculate turnaround time and average waiting time of the given scheduling algorithm.</p> <p>TLO 3.3 Explain necessary conditions leading to Deadlock.</p>	<p>Unit - III CPU Scheduling and Algorithms</p> <p>3.1 Scheduling Types, Scheduling Objectives, CPU and I/O burst cycles, Pre-emptive, Non Pre-emptive Scheduling, Scheduling Criteria</p> <p>3.2 Types of Scheduling Algorithms - First Come First Serve(FCFS), Shortest Job First(SJF), Shortest Remaining Time(SRTN), Round Robin(RR), Priority Scheduling, Multilevel Queue Scheduling</p> <p>3.3 Deadlock - System Models, Necessary conditions leading to Deadlocks, Deadlock Handling, Preventions, Avoidance, Recovery from deadlock banker's algorithm</p>	Lecture Using Chalk-Board Presentations Demonstration
4	<p>TLO 4.1 Describe working of Memory Management in Linux OS.</p> <p>TLO 4.2 Describe characteristics of Memory Management Techniques.</p> <p>TLO 4.3 Write algorithm for the given page replacement technique to calculate page fault for the given page reference string.</p>	<p>Unit - IV Memory Management</p> <p>4.1 Basic Memory Management: Partitioning, Fixed and Variable, Free Space Management Techniques Bitmap, Linked List, Swapping</p> <p>4.2 Virtual Memory: Introduction to Paging, Segmentation, Fragmentation and Page fault</p> <p>4.3 Page Replacement Algorithms: FIFO, LRU, Optimal</p>	Lecture Using Chalk-Board Presentations Demonstration

OPERATING SYSTEM USING LINUX**Course Code : 315353**

Sr.No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
5	<p>TLO 5.1 Explain structure of the given file system with example.</p> <p>TLO 5.2 Describe step by step procedure for the given file access method.</p> <p>TLO 5.3 Describe step by step file allocation method with diagram.</p> <p>TLO 5.4 Describe the process for managing files/directories and assign access permissions to the specified files/directories.</p> <p>TLO 5.5 Explain features of the given Raid level structure of hard disk.</p>	<p>Unit - V File Management</p> <p>5.1 File: Concepts of file, types of files, File Attributes, File Operations, File System Structure, Linux File System</p> <p>5.2 Access Methods: Sequential, Direct, Swapping</p> <p>5.3 File Allocation Methods - Contiguous, Linked, Indexed, File protection</p> <p>5.4 Directory Structure: Single level, Two levels, Tree-structured Directory</p> <p>5.5 Disk Organization and Disk Structure: Physical structure, Logical structure, Raid structure of disk, Raid level 0 to 6</p>	Lecture Using Chalk-Board Presentations Demonstration

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Install Linux (or alike) Operating System. LLO 1.2 Execute General Purpose Commands: date, time, cal, clear, banner/figlet, tty, script, man, who, whoami, passwd, pwd, echo, bc.	1	* 1) Installation of Linux (or alike) Operating Systems 2) Execution of general purpose commands in Linux	2	CO1
LLO 2.1 Execute Process related Commands: ps, wait, sleep, exit, kill, pr.	2	* Execution of process related commands	2	CO2
LLO 3.1 Execute file and directory manipulation commands: ls, rm, mv, cp, cat (file saving and redirection operator), touch, join, split.	3	* Execution of file and directory manipulation commands(part -1)	2	CO2
LLO 4.1 Execute file and directory manipulation commands: mkdir, rmdir, cd, cmp, comm, diff, tar, zip, Use of wild card character (i.e. ?, *, []), chmod.	4	Execution of file and directory manipulation commands(part -2)	2	CO2
LLO 5.1 Execute text processing head, tail, sort, wc, grep, tac, nl, tr, cut, paste, spell, more.	5	Execution of filter commands in Linux	2	CO2
LLO 6.1 Develop a 'C' program to calculate turn around time and waiting time of any one given scheduling algorithm: FCFS, SJF, Priority, Round-Robin Algorithm.	6	* Write a 'C' program to calculate turn around time and waiting time of given scheduling algorithm	2	CO3
LLO 7.1 Execute memory manipulation commands: top, htop, free, df, du, vmstat.	7	* Execution of memory manipulation commands	2	CO4
LLO 8.1 Explore vi editor and execute all editor commands.	8	Use vi editor to create and edit files	2	CO5
LLO 9.1 Develop a Shell Script using Numeric Comparison, String Comparison, File Comparison for the given task.	9	Execution of Shell Script using comparison statement	2	CO5
LLO 10.1 Develop Shell Script using control statements and loops for a given task.	10	* Execution of Shell Script using control structure and loops	2	CO5

OPERATING SYSTEM USING LINUX**Course Code : 315353**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
Note : Out of above suggestive LLOs -				
<ul style="list-style-type: none"> • '*1 Marked Practicals (LLOs) Are mandatory. • Minimum 80% of above list of lab experiment are to be performed. • Judicial mix of LLOs are to be performed to achieve desired outcomes. 				

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)**Micro project**

- The microproject has to be Industry Application based, internet-based, workshop-based, laboratory-based or field based as suggested by Teacher.
- 1) Develop menu driven program to show the result of Linux Commands.
 - 2) Develop Small Game based on Shell Script.
 - 3) Develop Shell Script to circulate message among users.
 - 4) Develop a Shell Script to perform file operations like create, delete directory, create, delete, copy, rename files.
 - 5) Develop a Shell Script to Automate backups of important files and directories.

Assignment

- Complete an Assignment on any relevant topic given by the Teacher:
- 1) Prepare report depicting features of different types of Operating System, Batch OS, Multi-programmed OS, Time Shared, Multiprocessor OS, Real Time Systems, Mobile OS with Example.
 - 2) Write a comparative statement to calculate page fault for given page reference string by using different Page Replacement Algorithms.
 - 3) Prepare a report to calculate total waiting time and turn around time of n processes with different CPU scheduling algorithm.
 - 4) Prepare a report about Linux operating systems and its flavors from starting to till date its features, uses etc.
 - 5) Prepare a report on different types of operating system architecture. Example: Simple structure, Monolithic structure, Layered Structure, Microkernel
 - 6) Prepare a report on Editors available in Linux i.e. Nano, Sed, gawk.

Other

- Join and Complete the course on Operating System/Linux OS/Shell Scripting on Infosys Springboard/MOOC Courses

Note :

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicial mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number

OPERATING SYSTEM USING LINUX**Course Code : 315353**

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Computer system with all necessary components like; motherboard, random access memory (RAM), read-only memory (ROM), internal hard disk drives, Mouse, Keyboard, and Open Source Operating System. (Linux or Alike)	All

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Overview of Operating System	CO1	12	4	4	8	16
2	II	Process Management	CO2	10	2	4	8	14
3	III	CPU Scheduling and Algorithms	CO3	12	2	4	10	16
4	IV	Memory Management	CO4	10	2	4	8	14
5	V	File Management	CO5	6	2	4	4	10
Grand Total				50	12	20	38	70

X. ASSESSMENT METHODOLOGIES/TOOLS**Formative assessment (Assessment for Learning)**

- Two offline unit test of 30 marks and average of two-unit test will be considered for out of 30 marks. For formative assessment of laboratory learning 25 marks. Each practical will be assessed considering 60% weightage to process, 40% weightage to product.

Summative Assessment (Assessment of Learning)

- End semester assessment of 70 marks. End semester summative assessment of 25 marks for laboratory learning.

XI. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	2	1	1	1	1	2	1			
CO2	2	1	2	2	1	3	1			
CO3	1	1	-	2	1	1	1			
CO4	2	2	1	3	2	1	2			
CO5	2	3	3	3	1	2	3			

Legends :- High:03, Medium:02,Low:01, No Mapping: -
*PSOs are to be formulated at institute level

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
-------	--------	-------	----------------------------

OPERATING SYSTEM USING LINUX**Course Code : 315353**

Sr.No	Author	Title	Publisher with ISBN Number
1	Silberschatz, Galvin	Operating System Concepts	John Wiley and Sons, Ninth Edition, 2015, ISBN: 978-1119800361, Edition-10th
2	Godbole, Achyut S.	Operating System	Tata McGraw Hill Education, 2015, ISBN: 978-0070702035
3	Stallings, William	Operating Systems: Internals and Design Principles	Pearson, ISBN: 978-0133805918
4	Dhamdhare, Dhanjay M	Operating System	McGraw Hill, 2015 ISBN: 978-0072957693
5	Dr. Rajendra Kawale	Operating System	Devraj Publications, Mumbai ISBN: 978-8193355114
6	Das, Sumitabha	Unix Concept and Programming	McGraw Hill education, 2015, ISBN: 9780070534759
7	Richard Blum	Linux command line and shell scripting	Wiley India ISBN Number 978-1118983843
8	Jon Emmons, Terry Ckark	Easy Linux Commands	SPD, ISBN 13:978-81-8404-329-7

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.geeksforgeeks.org/operating-systems/	Operating System
2	https://www.tutorialspoint.com/operating_system/index.htm	Operating System
3	https://www.mygreatlearning.com/academy/learn-for-free/courses/operating-system	Operating System
4	https://www.javatpoint.com/linux-file-contents	Linux Commands
5	https://www.shellscript.sh/	Shell Script
Note :		
<ul style="list-style-type: none"> Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students 		

MSBTE Approval Dt. 24/02/2025

Semester - 5, K Scheme