SHIVAJI UNIVERSITY, KOLHA

Revised Syllabus for Bachelor of Arts (Part- III)

SEMESTER V & VI

HISTORY

(Syllabus to be implemented from June 2020 onwards)

EQUIVALANCE OF B.A. III HISTORY SEMESTER- V

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b. Pandharpur movement

c. Pilgrimage Centers: Kolhapur, Shikhar Shinganapur, Taljapur

Module 4-Chhatrapati Shivaji Maharaj: Policy and Contribution

a. Administration and Management

b. Trade and Agriculture

c. Religion

List of References:

Apte, Bhalchandra Krishna., *A History of the Maratha Navy and Merchantships*, State Board for Literature and Culture, 1973.

Gordon, Stewart, T*he Marathas 1600-1818*, Cambridge University Press, 1993.

Gune, Vithal Trimbak, *The Judicial System of the Marathas: A Detailed Study of the Judicial Institutions in Maharashtra, from 1600-1818 A.D.* Deccan College Postgraduate and Research Institute, 1953.

Kulkarni A. R., *Maharashtra in the Age of Shivaji*, R.J. Deshmukh, 1969.

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Kulkarni A. R. *Medieval Maratha Country*, Diamond Publications, 2008.

Kulkarni A. R., *The Marathas*, Diamond Publications, 2008.

Mahajan, T. T., *Aspects Of Agrarian And Urban History Of The Marathas*, Commonwealth Publishers, 1991.

Mahajan, T. T., *Courts and Administration of Justice Under Chhatrapati Shivaji*, Commonwealth Publishers, 1992.

Pagdi, Setumadhava Rao, *Shivaji*, National Book Trust, New Delhi, 1993.

Ranade, M. G. *Rise of the Maratha Power* (Classic Reprint), Publications Division Ministry of Information & Broadcasting (ebook), 2017

Sarkar, Jadunath, *Shivaji and His Times*, Orient Blackswan, 1992.

Sen S.N. *Military System of the Marathas with a Brief Account of Their Maritime Activities*, Calcutta, 1928.

मराठी संदर्भग्रंथ

सरदेसाई, गो. स., *मराठी रियासत, खंड १ ते ८*, पॉप्युलर प्रकाशन, मुंबई, १९८८ ते १९९२

कुलकर्णी, अ. रा., खरे ग. ह., *मराठ्यांचा इतिहास, खंड १ ते ३*, कॉन्टिनेंटल प्रकाशन, पुणे, १९८४, १९८५, १९९३

काळे द. वि., *छत्रपती शिवाजी महाराज*, पुणे विद्यापीठ, पुणे, १९५९

आठवले सदाशिव, *शिवाजी व शिवयुग*, मेहता पब्लिशिंग हाउस, पुणे, १९९२

कुलकर्णी अ. रा., *शिवकालीन महाराष्ट्र*, राजहंस प्रकाशन, पुणे, १९९७

पवार जयसिंगराव (प्रमुख संपादक), *छत्रपती शिवाजीमहाराज स्मृतिग्रंथ*, महाराष्ट्र राज्य पाठ्यपुस्तक निर्मिती व अभ्यासक्रम संशोधन मंडळ, पुणे, २०११.

जयसिंगराव पवार, *छत्रपती संभाजी स्मारक ग्रंथ*, रिया पब्लिकेशन्स, कोल्हापूर, १९९०

पवार जयसिंगराव, *शिवपुत्र छत्रपती राजाराम*, महाराष्ट्र इतिहास प्रबोधिनी, कोल्हापूर, २०१७

पवार जयसिंगराव, *शिवछत्रपती एक मागोवा*, सुमेरु प्रकाशन, डोंबिवली, २००५

खोबरेकर वि.गो., *मराठा अंमलाचे स्वरूप*, शिवाजी विद्यापीठ प्रकाशन, कोल्हापूर, १९८८

पित्रे का.ग., *मराठ्यांचा युद्धेतिहास १६०० – १८१८*, कॉन्टिनेंटल प्रकाशन, पुणे, २००४

कुलकर्णी अ. रा, *अशी होती शिवशाही*, राजहंस प्रकाशन, पुणे, २००७

पठाण इस्माईल हुसेनसाहेब, छत्रपती शिवाजी महाराज, महाराष्ट्र इतिहास प्रबोधिनी, कोल्हपुर, २०२१

पठाण इस्माईल हुसेनसाहेब, छत्रपती संभाजी महाराज, महाराष्ट्र इतिहास प्रबोधिनी, कोल्हापूर, २०१८

Semester II, Paper II: Polity, Society and Economy under the Marathas (1600-1707)

(Objectives: 1600 to 1707 was a period of rapid change in the history of Marathas. Chhatrapati Shivaji Maharaj established the Maratha state and initiated fundamental changes in the political socio-economic and cultural life of the people. The course is designed to acquaint the students with the political, socio-economic and religious life of the people during the 1600-1707 period. It will educate the students about the policy and contribution of Chhatrapati Shivaji Maharaj)

Module 1- Polity

a. Civil administration: administrative structure, Ashtapradhan

b. Judicial administration: judicial structure, gotsabha, divya

c. Military administration: forts and navy

Module 2- Economy

a. Agriculture: types of land and crops, revenue settlement, irrigation

b. Industry: local craftsmen and major Industries

c. Trade: trade centers, trade routes, transport and communications

Module 3- Society and Religion

a. Village communities: Vatandar, Mirasdar, Balutedar-Alutedar and Upare

B.A. Part III:
Semester V, Course No. XI DSE E-65
History: Its Theory
(Field visit to any important historical place, monuments and record-offices is essential)

Course Objectives:

This course has been designed to impart knowledge of the discipline of history to the students. The students will learn the nature and scope of the discipline. They will have a clear understanding of the nature of the evidence collected from primary and secondary sources. They will be introduced to the process of presenting and writing history. They will know the methods of writing history.

Course Outcomes:

After studying the course the student will be able to...

1) Understand the definition and scope of the subject of History
2) Know the process of acquiring historical data
3) Explain the process of presenting and writing history
4) Understand the methods of writing history

Module I: History: Definition and Scope

a) Meaning, Scope and Nature
b) Types of History
c) Interdisciplinary Approach

Module II: Acquisition of Historical Data

a) Sources: Nature and Types
b) Methods of Data Collection
c) Methods of Critical Enquiry

Module III: Process of presenting and writing history

a) Steps of Historical Research
b) Data Analysis and Interpretation
c) Presentation

Module IV: Methods of History writing

a) Notetaking
b) Footnotes and Endnotes
c) Index, Appendix, Bibliography

Select Reference books:

- B. Shaik, Ali., History, Its Theory and Method, Macmillan India Ltd, Madras, 1978
- Carr, E. H., What is History, Palgrave Publishers Ltd., Macmillan, 1986
- Chitnis, K. N., Research Methodology in History, Poona, 1979

B.A. Part - III
Semester V, Course No. X DSE E-04
Political History of the Marathas

Course Objectives: The course is designed to study the political condition of Marathas after 1707. The Maratha polity was transformed into the largest political entity of India in the eighteenth century. The course introduces the students to the political developments which led to the expansion of Maratha power in the eighteenth century. It also explores the causes and events which led to the eventual decline of Maratha power.

Course Outcomes:

After studying the course the student will be able to...

1) Describe the political conditions of the Marathas upto the year 1740
2) Explain the role of Balaji Bajirao.
3) Explain the causes and effects of the Battle of Panipat.
4) Understand the political condition of the Marathas after 1761.
5) Critically analyze the causes for the decline of Maratha power.

Module I: Political condition up to 1740

a. Release of Shahu; Struggle between Shahu and Maharani Tarabai.
b. Balaji Vishwanath : Delhi Campaign, Maratha Confederacy
c. Bajirao Peshwa: Northern Policy, Relations with Nizam

Module II: Balaji Bajirao and Battle of Panipat(1761)

a. Relations with Angre
b. Conflict with Raghuji Bhosale
c. Battle of Panipat-1761

Module: III Political condition after 1761

a. Madhavrao Peshwa
b. Mahadji Shinde
c. Nana Phadnavis

Module IV: Decline of the Maratha Power

a. Peshwa Bajirao II
b. Second and Third Anglo- Maratha War
c. Causes for the decline of Maratha power

Select Reference books :

- अप्पासाहेब पवार (संपा) : ताराबाई कालीन कागदपत्रे, खंड १, शिवाजी विद्यापीठ, २०१८
- भावे, वा. कृ., पेशवेकालीन महाराष्ट्र, पुनर्मुद्रित, इंडियन काउन्सिल अव्ह हिस्टॉरिकल रिसर्च, नवी दिल्ली, १९७६
- सेतुमाधवराव पगडी : मराठ्यांचे स्वातंत्र्ययुद्ध , पुणे, १९६२

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B.A. Part III

Semester V, Course No: IX DSE P-03

Age of Revolutions

Course Objectives: This course introduces the students to the pathbreaking events of global history. The students will study the accounts of the causes and consequences of the transformative revolutions which changed the history of mankind. They brought about sudden big changes not only in the country in which they happened but also the world in general. Most of them left a lasting effect on the thought and the socio-political and cultural conditions of mankind. The course has been framed to make the students aware of the change and impact of these revolutionary events.

Course Outcomes:

After studying the course the student will be able to…

1) Explain the causes and consequences of the Reformation
2) Give an account of the role played by Martin Luther
3) Explain the salient features of the Industrial revolution
4) Given an account of the American revolution
5) Explain the causes, effects and major events of French Revolution
6) Explain the role of major leaders of the French Revolution

Module I: Reformation (16th Century)

a) Causes
b) Role of Martin Luther
c) Consequences

Module II: Industrial Revolution (18th Century)

a) Causes
b) Major Developments
c) Effects

Module III: American Revolution (1776)

a) Causes
b) Important events
c) Impact

Module IV: French Revolution (1789)

a) Causes
b) Important events and major leaders
c) Impact on the world

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B.A. Part III

Semester V, Course No: VIII DSE E-02

History of Medieval India (1206-1526 AD)

Course Objectives: This course covers the important period of Medieval Indian History. It was during this period that the Sultans established their rule in India. They introduced fundamental changes in polity, society, religion and culture of India. This course will acquaint the with various sources of medieval Indian history. They will get knowledge about the activities of major rulers and the policies followed by them. The students will know about the agricultural condition, development of trade and industry as well as the social, religious and architectural milieu of the period.

Course Outcomes:

After studying the course the student will be able to…

1) Describe the different types of historical sources available for writing the history of medieval India

2) Explain the contributions of medieval rulers like Allaudin Khilji, Muhammad-bin-Tuqhlaq, Krishnadevraya, and Mahmud Gavan

3) Give an account of the administration and economy of the Delhi sultanate and Vijayanagar Empire

4) Elucidate the significant developments which took place in religion, society and culture

Module I - Sources:

a) Literary: Tarikh-i- Firozshahi, Amuktamalyada

b) Archaeological (excluding Monuments)

c) Account of Foreign Travelers: Ibn Battuta, Domingo Paes

Module II - Major Rulers

a)Allaudin Khilji: Internal policy and reforms

b) Muhammad - bin- Tughlaq : Experiment of Token Currency

c) Krishnadevraya: Military success and cultural contribution

d) Mahmud Gavan: Contribution to Bahmani Kingdom

Module III - Administration and Economy(Delhi Sultanate and Vijaynagar)

a) Administration : Central and Provincial

b) Agriculture and Land Revenue

c) Industry and Trade

Module IV) Religion, Society and Culture:

a) Sufi Order: Chishti Silsila; Bhakti Movement: Sant Kabir; Sikh Religion: Guru Nanak

b) Society: Hindu and Muslim

c)Architecture: Delhi Sultanate, Vijaynagar and Bahamani.

Select Reference Books:

- Rizvi, S.A.A., The Wonder that was India, Part II, Rupa, Delhi,2002
- Chitnis, K.N., Glimpses of Medieval Indian Ideas and Institutions, 1974

B.A. Part III
Semester VI, Course No. XV USEC-2189
Polity, Economy and Society under the Marathas

Course Objectives : The objective of the course is to explore the nature of the Maratha polity. It will acquaint the students with the economic and social conditions prevalent under Maratha rule. The course will also introduce the students to the sources of Maratha history.

Course Outcomes:

After studying the course the student will be able to...

1) Know the various sources for writing the history of the Marathas
2) Explain the significant developments in the polity of the Marathas
3) Describe the economic conditions
4) Explain the social conditions.

Module I: Sources

a. Importance of sources
b. Indian Sources: Sanskrit, Marathi, Persian
c. Foreign sources : Portuguese and English

Module II: Polity under the Marathas

a. Concept of Kingship
b. Asthapradhan Mandal
c. Transfer of power – Chhatrapati to Peshwa, Peshwa to Karbhari

Module III: Economic condition

a. Agrarian system – Land Revenue, Irrigation
b. Industry
c. Trade and Commerce

Module IV: Social condition

a. Social Structure - Family , Untouchability, Vethbegar , Slavery.
b. Condition of women and caste system
c. Education and Festivals

Select Reference books :

- शेणोलीकर ह.श्री. महाराष्ट्र संस्कृती : घडण आणि विकास, मोघे प्रकाशन, कोल्हापूर, १९७२
- भावे. व. कृ. : शिवराज्य व शिवकाल, भावे प्रकाशन, पुणे, १९५९
- अत्रे. त्र्यं. ना. गाववाडा, राजहंस प्रकाशन प्रा लि., पुणे, २०१८
- वि. गो. खोबरेकर , महाराष्ट्रातील दप्तरखाने: वर्णन आणि तंत्र, १९६८
- कुलकर्णी अ. रा. : शिवकालीन महाराष्ट्र, १९९३ आवृत्ती

B.A. Part III

Semester VI , Course No: XIV, DSE E-188

Making of the Modern World (16th to 19th Century)

Course Objectives: This course deals with significant events in global history. The primary objective of the course is to introduce the students to the important events which have happened in the world in modern times. These events which were revolutionary in character had a profound impact on the making of the modern world. The students will be acquainted with the events of the Glorious revolution in England. They will understand the causes for the rise and spread of Nationalism and Imperialism. Moreover, they will know about some select important personalities who contributed to the making of the Modern World.

Course Outcomes:

After studying the course the student will be able to…

1) Know the causes and consequences of the Glorious revolution in England
2) Explain the concept of Nationalism and account for its rise and spread.
3) Describe the unification of Italy and Germany.
4) Give an account of the rise, growth and impact of Imperialism
5) Explain the significance of the Partition of Africa
6) Know the life and thoughts of important leaders like Metternich, Karl Marx and Abraham Lincoln

Module I: Glorious Revolution

a)Causes
b) Major events
c) Consequences

Module II: Nationalism

a) Causes for the rise and spread of Nationalism
b) Unification of Italy and Germany
c) Impact

Module III : Imperialism

a) Causes for rise and growth of Imperialism
b) Partition of Africa
c) Impact on the world

Module IV: Important Personalities

a) Metternich
b) Karl Marx
c)Abraham Lincoln

Select Reference books:

- Arun Bhattacharjee, World Revolutions, Ashish Publishing House, New Delhi, 1988
- L. Mukherjee, A Study of Modern Europe and the World, Calcutta, 2011
- David Thompson, Europe Since Napoleon, Penguin books, 1971
- T.C.W. Blanning, The Oxford History of Modern Europe, OUP, 2000

B.A. Part III
Semester VI, Course No. XIII-DSE-E-187
History of Medieval India (1526-1707 AD)

Course Objectives : This course explores the history of the Mughal period in India. The Mughals introduced fundamental changes in the polity, economy, society, culture and religion of India. The Bahamani kingdom in the Deccan also split up into five smaller kingdoms during this period. In the course the students will be introduced to the important events, personalities and developments in India. They will know the policies followed by important rulers and will acquaint themselves with the general scenario prevalent in India during the period. They will understand how a syncretic culture developed in India during the period.

Course Outcomes:

After studying the course the student will be able to…

1) Know about the various sources for writing Medieval Indian history
2) Explain the role of rulers like Babar, Akbar, Chandbibi and Ibrahim Adilshah II
3) Gain knowledge about the administrative and revenue system
4) Describe the condition of Industry and trade
5) Explain important developments in religion, society and culture

Module I: Sources

a) Literary: Akbarnama, Gulshan -i -Ibrahimi
b) Archaeological (excluding monuments)
c) Accounts of Foreign Travelers: Francois Bernier, Niccolo Manucci

Module II - Major Rulers

a) Babar: Battle of Panipat and foundation of Mughal empire.
b) Akbar: Rajput policy
c) Chandbibi
d) Ibrahim Adilshah II

Module III- Administration and Economy

a) Administration: Central and Provincial
b) Land Revenue: Akbar and Malik Ambar
c) Industry and Trade

Module IV: Religion, Society and Culture

a) Religious Policy: Akbar and Aurangzeb
b) Society: Hindu and Muslim
c) Architecture: Mughal and Adilshahi

Select Reference Books:

- Rizvi, S.A.A., The Wonder that was India, Part II, Rupa, Delhi, 2002
- Chitnis, K.N., Glimpses of Medieval Indian Ideas and Institutions, 1974
- Chitnis K. N. Socio- Economic Aspects of Medieval India, Poona, 1979

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SEMESTER VI

B.A. Part III

Semester VI, Course No. XII DSE E-18

Ancient India (From 4th c. BC to 7th c. AD)

Course Objectives: This course explores the history of India from the 4th century BC to the 7th century A.D. It takes a panoramic survey of the historical developments during this crucial period of Indian history. The course studies the eventful changes which took place under the Satavhana, Kushanas, Guptas, Vakatakas , Chalukyas and Pallavas. The students will be introduced to the incomparably vivid picture of India which prevailed during the ancient period. They will be acquainted with not only the glory of Ancient India but also the social inequality and social evils which have shaped India in the past.

Course Outcomes:

After studying the course the student will be able to…

1) Know the political ,economic and religious developments which took place in early historic India

2) Explain the role played by Major Satavahana, Kushana, Gupta and Vakataka Kings

3) Give an account of the developments in the Post-Gupta period

4) Have an informed opinion about the society and culture of Ancient India

Module I: Early Historic India

a)Sources: Gatha Saptashati, Periplus of the Erythraean Sea

b)Major Kings: Satavahana and Kushanas

c)Industry and Trade

d) Hinayana Buddhism

Module II: The Classical Age

a) Major Kings: Guptas and Vakatakas

b)Economy and Greater India

c)Literature and Science

d)Religion

Module III: The Post-Gupta Period

a) Source: Hiuen Tsang

b)North India: Harshavardhana

c) Deccan: Early Chalukyas of Badami

d) South India: Pallavas

Module IV: Society and Culture

a) Position of Women and Varna Structure (From Vedic period to Post-Gupta period)

b) Education

c) Art (From Mesolithic Art to Ajanta Paintings)

d) Architecture- (Rock-Cut Caves (Maharashtra) to Constructed Temples (Madhya Pradesh)

d. Madhavrao Peshwa
e. Mahadji Shinde
f. Nana Phadnavis
d. Contribution of Chhatrapati Sambhaji II and Maharani Jijabai of Karvir

Module IV: Decline of the Maratha Power

a. Peshwa Bajirao II
b. Second and Third Anglo- Maratha War
c. Causes for the decline of Maratha power
d. Chhatrapatis of Karvir and the British

Select Reference books:

1. पवार,अप्पासाहेब (संपा), ताराबाई कालीन कागदपत्रे, खंड १, शिवाजी विद्यापीठ, २०१८
2. भावे, वा. कृ., पेशवेकालीन महाराष्ट्र, पुनर्मुद्रित, इंडियन काउन्सिल ऑफ हिस्टॉरिकल रिसर्च, नवी दिल्ली १९७६
3. पगडी,सेतुमाधवराव., मराठ्यांचे स्वातंत्र्ययुद्ध , पुणे, १९६२
4. रानडे,महादेव गोविंद., मराठी सत्तेचा उत्कर्ष, वरदा प्रकाशन, २०१६
5. देशपांडे,प्र.न.,मराठी सत्तेचा उदय आणि उत्कर्ष, स्नेहवर्धन पब्लिशिंग हाऊस, पुणे, २००१
6. फाटक,न.र.(अनु.), मराठी सत्तेचा उत्कर्ष, (म.गो.रानडेकृत राईज ऑफ मराठा पॉवर चे भाषांतर)
7. पवार,जयसिंगराव ,महाराणी ताराबाई, तत्त्वशोधी विद्यापीठ प्रकाशन, १९७५
8. पवार,जयसिंगराव., मराठी साम्राज्याचा उदय आणि अस्त,कोल्हापूर , १९९३
9. रेगेजवलकर,ज्ञ.श., श्री शिवछत्रपती-संकल्पित शिवचरित्राची प्रस्तावना, आराखडा व साधने, मराठा बुक प्रकाशन, मुंबई, १९६४.
10. रेगेजवलकर,ज्ञ.श.,पानिपत १७६१, जोशी आणि लोखंडे प्रकाशन, १९६१
11. सरदेसाई,गो. स.,मराठी रियासत, १ ते ८ खंड , पॉप्युलर प्रकाशन, पुणे
12. आठवले, वि. अ., कोल्हापूर राज्याचे सातारा व पुणे दरबारशी संबंध, श्री गणेश प्रकाशन, नागपूर, २००३
13. गर्गे, स. मा., कर्वीर रियासत, प्रकाशक गो. य. राणे, कोल्हापूर, १९८०
14. शिंदे, खंडेराव , कोल्हापूर राज्याचा इतिहास, निर्मिती प्रकाशन, कोल्हापूर, २०२०
15. राणे, अमरसिंह., खपे, बी. डी., रश्मि उमाकांत (संपा) युगयुगीन करवीर, इतिहास दर्शन, भारतीय इतिहास संकलन समिति, कोल्हापूर २०१३
16. Dighe,V.G., Peshwa Bajirao and Maratha expansion, Karnatak Publishing Hous Bombay, 1944
17. Ranade,M.G., Rise of Maratha Power, 1900
18. Sharma,S.R.,The founding of Maratha freedom, Orient Longmans, Bombay, 1964
19. Sinha,H.N.,Rise of the Peshwas, The Indian Press (Publications) Ltd, Allahabad, 195
20. Sen,S.N.,Anglo Maratha Relations 1785-1796, Macmillan , Madras, 1974
21. Gupta ,P.C., Bajirao II and East India Company, Allied Publications Private Limited Calcutta, 1964
22. Brij Kishore, Tarabai and his Times , Bombay , 1963
23. Sardesai,G.S. - New History of Maratha's Vols I,II and III, Bombay, 1948

B.A. Part - III

Semester V, Course No. V

Political History of the Marathas (1707-1818)

Course Objectives: The course is designed to study the political history of the Marathas after the year 1707. The Maratha polity was transformed into the largest political entity of India in the eighteenth century. At the same time the state of Kolhapur (Karvir) came into existence and flourished during this period. This course examines the tripartite relations between the Peshwa, Karvir Chhatrapati and the Nizam. It highlights contribution of Chhatrapati Sambhaji –II and Maharani Jijabai to the making of Karvir state. The course introduces the students to the political developments responsible for the expansion of Maratha power in the eighteenth century. Lastly, the course explores the causes and events that led to the eventual decline of Maratha power.

Course Outcomes:

After studying the course the student will be able to...

1. Describe the political conditions of the Marathas upto the year 1740
2. Explain the role of Balaji Bajirao.
3. Understand the establishment of Karvir state and political significance of the treaty of Warna.
4. Explain the causes and effects of the Battle of Panipat.
5. Describe the Peshwa-Karvir -Nizam relations.
6. Understand the political condition of the Marathas after 1761.
7. Know and evaluate the contribution of Chhatrapati Sambhaji II and Maharani Jijabai of Karvir
8. Explain the relations between Chhatrapatis of Karvir and the British.
9. Critically analyze the causes for the decline of Maratha power.

Module I: Political condition up to 1740

a. Release of Chhatrapati Shahu; Struggle between Chhatrapati Shahu and Maharani Tarabai; Establishment of Karvir State; Treaty of Warna

b. Peshwa BalajiVishwanath : Delhi Campaign, Maratha Confederacy

c. Peshwa Bajirao - Northern Policy

d. Peshwa Bajirao - Nizam relations

Module II: BalajiBajirao and Battle of Panipat(1761)

a. Relations with Angre

b. Conflict with Raghuji Bhosale

c. Battle of Panipat-1761

d. Peshwa -Karvir- Nizam relations

Module: III Political condition after 1761

Module IV -Understanding Heritage Tourism

a) Concept, Scope and Significance of Heritage Tourism

b) Meaning and Historical Perspective of Tourism

c) World Heritage Sites in India

Select Reference books:

- B. Shaik, Ali., History:Its Theory and Method, Macmillan India Ltd, Madras, 1978
- Chitnis, K. N., Research Methodology in History, Poona, 1979
- Bajaj, S. K., Research Methodology in History, Anmol Publications Pvt. Ltd., New Delhi, 1998
- Sreedharan, E., A Textbook of Historiography 500 BC to AD 2000, Orient Longman, Hyderabad, 2000
- Sarkar, H., Museums and Protection of Monument and Antiquities in India, New Delhi, 1980
- Agarwal, O. P. Conservation of Manuscripts and Pantings of South East Asia, London, 1984
- कोठेकर, शांता., इतिहास तंत्र आणि तत्त्वज्ञान, श्री साईनाथ प्रकाशन, नागपूर, २००५
- गायकवाड, आर. डी., सरदेसाई, बी. एन. आणि हनमाने, व्ही. एन. इतिहासलेखन पद्धत व ऐतिहासिक स्मारके यांचा अभ्यास, फडके प्रकाशन, कोल्हापूर, १९८८
- गद्रे, प्रभाकर., इतिहास लेखनाच्या परंपरा, श्री मंगेश प्रकाशन, नागपूर, २००४
- सरदेसाई, बी. एन., इतिहासलेखनपद्धती, फडके प्रकाशन, कोल्हापूर, २००४
- राजदेरकर, सुहास., इतिहासलेखनशास्त्र, विद्या प्रकाशन, नागपूर, १९९८
- सरदेसाई, बी. एन., इतिहासलेखन परिचय, फडके प्रकाशन, कोल्हापूर, २००६
- देशमुख, प्रशांत., इतिहासाचे तत्त्वज्ञान, विद्या बुक्स पब्लिशर्स, औरंगाबाद, २००५
- बेंद्रे, वा. सी., शिवशाहीचा चर्चात्मक इतिहास: साधन चिकित्सा, लोकवाङ्मय गृह, मुंबई, १९७६
- आठवले, सदाशिव., इतिहासाचे तत्त्वज्ञान, प्राज्ञपाठशाला, वाई, १९६७
- घाटावकर, भास्कर., महाराष्ट्रातील शासकीय पुरालेखागारांची निर्मिती आणि कार्य, चेतन प्रकाशन, मुंबई, २०१०
- खोबरेकर, वि. गो., महाराष्ट्रातील दफ्तरखाने वर्णन व तंत्र, मुंबई, १९८८
- बोरकर, रघुनाथ, संग्रहालयशास्त्र, पिंपळापुरे बुक, नागपूर , २००७
- खतीब, के. ए., पर्यटन भुगोल, मेहता पब्लिशिंग हाऊस, पुणे, २००६

B.A. Part III

Semester VI , Course No. XVI DSE-190

Methods and Applications of History

Couse Objectives: This course has been designed to impart knowledge of the methods of history to the students. The students will understand the nature of archival sources. They will be introduced to the trends of local and oral history and will know about the tools of local history like Survey, Interview and Questionnaire. The students will be introduced to the technique of collecting data through oral interviews. The students will understand the concept of the museum and learn the basic principles of museology. Moreover, the course will introduce the students to the relevance of monumental heritage and its relationship with the discipline of history through the concept of Heritage Tourism

Course Outcomes:

After studying the course the student will be able to…

1) Understand the nature of archival sources
2) Gain conceptual clarity about recent trends in history.
3) Know about the application of history in museums.
4) Explain the concept and scope of heritage tourism.

(Note: The students should undertake Individual/ Group field projects for assignments in which they could take oral interviews / surveys/ regarding persons, events and local socio-political, economic and cultural developments related to local history. They should make audio recordings of the interviews and develop an archive of local oral history in the college department. These audio interviews would form an important source of local history)

Module I: Archival Sources

a) Meaning, types, and importance of Archives
b) Types of Records
c) Concept of Digital Archives

Module II: Recent Trends in History

a) Local History
b) Oral History
c) Tools of Local History (Survey, Interview, Questionnaire)
d) Interview Technique

Module III: Museology

a) Definition, Nature and Importance of Museum
b) Types of Museums
c) Methods of Collection, Conservation and Preservation Techniques of Objects

SHIVAJI UNIVERSITY, KOLHAPUR

Syllabus B.A.-II

SEMESTER - IV

IDS PAPER- II: SOCIAL REFORMS IN MAHARASHTRA

(CHOICE BASED CREDIT SYSTEM - (CBCS)

Credits: 04

(introduced from June 2019

Fundamental changes took place in the society of Maharashtra during the 19th and 19th centuries. The beginnings of Western education, press and industrialization made a lasting impact on the thinking of people. Eventually some reform-oriented people started movements to reform the society. This course introduces the students to the salient features of social reforms in Maharashtra.

After studying the course, the student will be able to...

CO1. Know about the beginnings of social reforms in Maharashtra by the Paramhansa Mandali and Prarthana Samaj.

CO2. Understand the contribution of women reformers

CO3. Explain the contribution of Social reformers in the fight for social justice

CO4. Explain the role played by educational reforms in transformation of society.

MODULE-1 Beginnings of Social Reform — 15

a) Social condition in early 19th century

b) Paramhansa Mandali

c) Prarthana Samaj

MODULE -2 Women Reformers — 15

a) Savitribai Phule

b) Tarabai Shinde

c) Pandita Ramabai

MODULE -3 Social Reformers — 15

a) Lahuji Salve

b Maharshi Vitthal Ramji Shinde

c) Gadage Maharaj

d) Annabhu Sathe

MODULE -4 Educational Reforms — 15

a) Karmaveer Bhaurao Patil

b) Dr. Bapuji Salunkhe

c) Punjabrao Deshmukh

Readings:

- Kenneth W. Jones, Socio-religious reform movements in British India, Cambridge University Press, 1994
- Amiya P. Sen, Social and Religious Reform, Oxford University Press, 2005
- Articles on Paramhansa Sabha, Prarthana Samaj, Satyashodhak Samaj in Murali Ranganathan (ed.), The Collected Works of JV Naik, Asiatic Society of Mumbai, 2016

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Syllabus

B.A.-II

SEMESTER - III

IDS PAPER I: SOCIAL REFORMS IN INDIA

(CHOICE BASED CREDIT SYSTEM – (CBCS)

Credits: 04

(introduced from June 2019)

This course is conceived to introduce the students to the social and religious change in India expressed in various social reform movements. Students will explore the significance and impact of prominent social and reform movements. It will help the students to understand how the ideals of rationalism, humanism and universalism were encouraged by the Indian social reformers. The course will attract students from a wide variety of social science disciplines.

After completion of the course, the student will be able to ...

CO1. Understand the salient features of prominent socio-religious reform movements

CO2. Explain the thought and work of Mahatma Phule for radical transformation of Indian society

CO3. Know the measures taken by Rajashri Shah Maharaj for emancipation of lower classes and women

CO4. Understand the thoughts of Ambedkar on the annihilation of the caste system and untouchability in India

CO5. Know how the Indian constitution embodies the values of social justice and equality

MODULE-1	**Socio-Religious Reform Movements**	
	a) Raja Ram Mohan Roy and Brahmo Samaj	15
	b) Swami Dayanand Saraswati and Arya Samaj	
	c) Swami Vivekanand and Ramakrishna Mission	
MODULE-2	**Mahatma Phule**	
	a) Educational and Social Work	15
	b) Satyashodhak Samaj	
	c) Thoughts of Mahatma Phule (with special reference to *Shetkaryancha Asud* and *Gulamgiri*)	
MODULE-3	**Rajashri Shahu Maharaj**	
	a) Educational and Social upliftment of lower classes	15
	b) Women's Rights	
	c) Hostel Movement	
MODULE-4	**Dr Babasaheb Ambedkar**	
	a) Thoughts on Annihilation of Caste	15
	b) Mahad Incident and the Temple entry movement	
	c) Social Justice and Indian Constitution	

SHIVAJI UNIVERSITY, KOLHAPUR

Syllabus B.A.-II

SEMESTER - IV

PAPER- V: HISTORY OF MODERN MAHARASHTRA (1960-2000)

(CHOICE BASED CREDIT SYSTEM – (CBCS)

Credits: 04

(Introduced from June 2019)

After 1960 a new period of development began in the state of Maharashtra. The eminent leaders played a pioneering role in this period of rapid transformation. This was also a period of massive expansion of education as well as social transformation. This course introduces the students to significant leaders, events and transformations in history of Maharashtra

After completion of the course, the student will...

CO1. Acquaint himself with the contribution of eminent leaders of Maharashtra
CO2. Know about the economic transformation of Maharashtra
CO3. Understand the salient features of changes in society
CO4. Explain the growth of education

MODULE -1	**Leaders:**	
	a) Congress : Y B Chavan, Vasantdada Patil	15
	b)Socialist: Nagnath Nayakawadi, S M Joshi, P K Atre	
	c) Communist: Comrade S.A. Dange	
MODULE -2	**Major Issues and Events**	
	a) Agriculture Development with special reference to role of Vasantrao Naik	15
	b) Industry –Sugar (Pravara Sugar Factory) and Milk (Aarey Dairy Mumbai)	
	c) Natural Disasters (Earthquakes- Koyna 1967 and Latur 1993)	
MODULE -3	**Social Movements**	
	a) Muslim Satyshodhak Samaj	15
	b) Satyshodhak Communist Party	
	c) Vidrohi Movement	
MODULE -4	**Educational Development**	
	a) Primary	15
	b) Secondary	
	c) Higher and Technical Education	

SHIVAJI UNIVERSITY, KOLHAPUR

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B.A.-II

SEMESTER - III

PAPER III- HISTORY OF MODERN MAHARASHTRA (1900 to 1960)

(CHOICE BASED CREDIT SYSTEM – (CBCS)

Credits: 04

(introduced from June 2019)

The first sixty years of 20th century was a period of great upheaval in Maharashtra. The events and changes that took place during this period made a lasting impact on the polity, society and economy of the region. The identity of Maharashtra region was forged during this period. This course introduces the students to the key historical events and transformations which have played an important role in making of modern Maharashtra

After studying the course the student will be able to...

CO1.Understand the beginnings and growth of nationalist consciousness in Maharashtra

CO2. Explain the contribution of Maharashtra to the national movement

CO3. Give an account of various movements of the peasants, workers, women and backward classes

CO4. Know the background and events which led to the formation of separate state of Maharashtra.

MODULE-1	**Rise and Growth of Nationalism**	
	a) Rise of Nationalism	15
	b) Contribution of Gopal Krishna Gokhale	
	c) Contribution of Lokmanya Tilak	
MODULE -2	**Role of Maharashtra in the National Movement**	
	a) Revolutionary Movement	15
	b) Non-Cooperation Movement	
	c) Civil Disobedience Movement with special reference to the uprising in Solapur	
	d) Quit India Movement with special reference to Prati Sarkar Movement	
MODULE -3	**Social Movements**	
	a) Peasants and Workers	15
	b) Women's rights	
	c) Emancipation of Backward Classes	
MODULE -4	**Samyukta Maharashtra Movement**	
	a) Background	15
	b) Contribution of the Samyukta Maharashtra Samiti	
	c) Events leading to the formation of Maharashtra State	

SHIVAJI UNIVERSITY, KOLHAPUR

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SEMESTER - IV

PAPER- V: HISTORY OF MODERN MAHARASHTRA (1960-2000)

(CHOICE BASED CREDIT SYSTEM – (CBCS)

Credits: 04

(introduced from June 2019)

After 1960 a new period of development began in the state of Maharashtra. The eminent leaders played a pioneering role in this period of rapid transformation. This was also a period of massive expansion of education as well as social transformation. This course introduces the students to significant leaders, events and transformations in history of Maharashtra

After completion of the course, the student will...

CO1. Acquaint himself with the contribution of eminent leaders of Maharashtra
CO2. Know about the economic transformation of Maharashtra
CO3. Understand the salient features of changes in society
CO4. Explain the growth of education

MODULE -1	**Leaders:**	
	a) Congress : Y B Chavan, Vasantdada Patil	15
	b)Socialist: Nagnath Nayakawadi, S M Joshi, P K Atre	
	c) Communist: Comrade S.A. Dange	
MODULE -2	**Major Issues and Events**	
	a) Agriculture Development with special reference to role of Vasantrao Naik	15
	b) Industry –Sugar (Pravara Sugar Factory) and Milk (Aarey Dairy Mumbai)	
	c) Natural Disasters (Earthquakes- Koyna 1967 and Latur 1993)	
MODULE -3	**Social Movements**	
	a) Muslim Satyshodhak Samaj	15
	b) Satyshodhak Communist Party	
	c) Vidrohi Movement	
MODULE -4	**Educational Development**	
	a) Primary	15
	b) Secondary	
	c) Higher and Technical Education	

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B.A.-II

SEMESTER - III

PAPER III- HISTORY OF MODERN MAHARASHTRA (1900 to 1960)

(CHOICE BASED CREDIT SYSTEM – (CBCS)

Credits: 04

(introduced from June 2019)

The first sixty years of 20th century was a period of great upheaval in Maharashtra. The events and changes that took place during this period made a lasting impact on the polity, society and economy of the region. The identity of Maharashtra region was forged during this period. This course introduces the students to the key historical events and transformations which have played an important role in making of modern Maharashtra

After studying the course the student will be able to...

CO1.Understand the beginnings and growth of nationalist consciousness in Maharashtra

CO2. Explain the contribution of Maharashtra to the national movement

CO3. Give an account of various movements of the peasants, workers, women and backward classes

CO4. Know the background and events which led to the formation of separate state of Maharashtra.

MODULE-1	**Rise and Growth of Nationalism**	
	a) Rise of Nationalism	15
	b) Contribution of Gopal Krishna Gokhale	
	c) Contribution of Lokmanya Tilak	
MODULE -2	**Role of Maharashtra in the National Movement**	
	a) Revolutionary Movement	15
	b) Non-Cooperation Movement	
	c) Civil Disobedience Movement with special reference to the uprising in Solapur	
	d) Quit India Movement with special reference to Prati Sarkar Movement	
MODULE -3	**Social Movements**	
	a) Peasants and Workers	15
	b) Women's rights	
	c) Emancipation of Backward Classes	
MODULE -4	**Samyukta Maharashtra Movement**	
	a) Background	15
	b) Contribution of the Samyukta Maharashtra Samiti	
	c) Events leading to the formation of Maharashtra State	

SHIVAJI UNIVERSITY, KOLHAPUR

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B.A.-II

SEMESTER – IV

PAPER VI: History of Freedom Struggle (1858-1947)

(CHOICE BASED CREDIT SYSTEM – (CBCS)

Credits: 04

(introduced from June 2019)

The course is designed to study the freedom struggle in India from 1858 to 1947. It will familiarize the students with events leading to emergence of national consciousness in India. They will be acquainted with the prolonged struggle launched by the Indian National Congress under the leadership of Mahatma Gandhi. They will also know about the struggle of the revolutionaries, leftists and the Indian National Army. The course will introduce students to the concept of Communalism and the process which led to the partition of India.

After completion of this course, the student will be able to...

CO1. Understand the events which lead to the growth of nationalism in India

CO2. Acquaint himself with major events of the freedom struggle under the leadership of Mahatma Gandhi

CO3. Explain the contribution of Revolutionaries, Left Movement and Indian National Army

CO4. Know the concept of Communalism and the causes and effects of the partition of India

Module- 1	**Rise of Nationalism** a) Formation of Indian National Congress b) Contribution of Moderates c) Contribution of Extremists (Swadeshi Movement and Home Rule Movement)	15
Module -2	**Gandhian Era** a) Non-Cooperation Movement b) Civil Disobedience Movement c) Quit India Movement	15
Module -3	**Other Strands** a) Revolutionary Movement b) Leftist Movement c) Subhash Chandra Bose and Indian National Army	15
Module -4	**Communalism and Partition** a) Concept of Communalism b) Causes for Partition c) Effects of Partition	15

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B.A.-II

SEMESTER - III

PAPER IV: HISTORY OF INDIA (1757-1857)

(CHOICE BASED CREDIT SYSTEM - (CBCS)

Credits: 4

(introduced from June 2019)

This course will acquaint the students with the history of India under British rule. It will help the students to understand how the East India Company established and consolidated its rule in India. They will know about the impact of colonial rule on the Indian Economy. It will also familiarize the students with the revolts against the company rule.

After studying this course, the student will...

CO1. Acquaint himself with significant events leading to establishment of the rule of East India Company

CO2. Know the colonial policy adopted by the company to consolidate its rule in India

CO3. Understand the structural changes initiated by colonial rule in Indian economy.

CO4. Explain the various revolts against rule of the East India Company.

Module- 1 **Establishment of Company rule in India** **15**

a) Causes for establishment of Company rule

b) Struggle with Native Powers (Bengal and Mysore)

c) Struggle with Marathas

Module -2 **Making of a Colonial Policy** **15**

a) Dual Government - Robert Clive

b) Subsidiary Alliance - Lord Wellesley,

c) Doctrine of Lapse - Lord Dalhousie,

Module -3 **Making of a Colonial Economy** **15**

a) Land revenue settlements- (*Permanent Settlement, Ryotwari, Mahalwari*)

b) De-industrialization

c) Drain of Wealth

Module -4 **Revolts against Company Rule** **15**

a) Tribal Revolts

b) Revolt of 1857

c) Queen's Proclamation of 1858 and its effects

SHIVAJI UNIVERSITY, KOLHAPUR

Syllabus B.A.-II

SEMESTER - IV

IDS PAPER- II: SOCIAL REFORMS IN MAHARASHTRA

(CHOICE BASED CREDIT SYSTEM – (CBCS)

Credits: 04

(introduced from June 2019

Fundamental changes took place in the society of Maharashtra during the 19th and 19th centuries. The beginnings of Western education, press and industrialization made a lasting impact on the thinking of people. Eventually some reform-oriented people started movements to reform the society. This course introduces the students to the salient features of social reforms in Maharashtra.

After studying the course, the student will be able to...

CO1. Know about the beginnings of social reforms in Maharashtra by the Paramhansa Mandali and Prarthana Samaj.

CO2. Understand the contribution of women reformers

CO3. Explain the contribution of Social reformers in the fight for social justice

CO4. Explain the role played by educational reforms in transformation of society.

MODULE-1	**Beginnings of Social Reform** a) Social condition in early 19th century b) Paramhansa Mandali c) Prarthana Samaj	15
MODULE -2	**Women Reformers** a) Savitribai Phule b) Tarabai Shinde c) Pandita Ramabai	15
MODULE -3	**Social Reformers** a) Lahuji Salve b Maharshi Vitthal Ramji Shinde c) Gadage Maharaj d) Annabhu Sathe	15
MODULE -4	**Educational Reforms** a) Karmaveer Bhaurao Patil b) Dr. Bapuji Salunkhe c) Punjabrao Deshmukh	15

Readings:

- Kenneth W. Jones, Socio-religious reform movements in British India, Cambridge University Press, 1994
- Amiya P. Sen, Social and Religious Reform, Oxford University Press, 2005
- Articles on Paramhansa Sabha, Prarthana Samaj, Satyashodhak Samaj in Murali Ranganathan (ed.), The Collected Works of JV Naik, Asiatic Society of Mumbai, 2016

SHIVAJI UNIVERSITY, KOLHAPUR

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B.A.-II

SEMESTER - III

IDS PAPER I: SOCIAL REFORMS IN INDIA

(CHOICE BASED CREDIT SYSTEM – (CBCS)

Credits: 04

(introduced from June 2019)

This course is conceived to introduce the students to the social and religious change in India expressed in various social reform movements. Students will explore the significance and impact of prominent social and reform movements. It will help the students to understand how the ideals of rationalism, humanism and universalism were encouraged by the Indian social reformers. The course will attract students from a wide variety of social science disciplines.

After completion of the course, the student will be able to ...

CO1. Understand the salient features of prominent socio-religious reform movements

CO2. Explain the thought and work of Mahatma Phule for radical transformation of Indian society

CO3. Know the measures taken by Rajashri Shah Maharaj for emancipation of lower classes and women

CO4. Understand the thoughts of Ambedkar on the annihilation of the caste system and untouchability in India

CO5. Know how the Indian constitution embodies the values of social justice and equality

MODULE-1	**Socio-Religious Reform Movements**	
	a) Raja Ram Mohan Roy and Brahmo Samaj	15
	b) Swami Dayanand Saraswati and Arya Samaj	
	c) Swami Vivekanand and Ramakrishna Mission	
MODULE-2	**Mahatma Phule**	
	a) Educational and Social Work	15
	b) Satyashodhak Samaj	
	c) Thoughts of Mahatma Phule (with special reference to *Shetkaryancha Asud* and *Gulamgiri*)	
MODULE-3	**Rajashri Shahu Maharaj**	
	a) Educational and Social upliftment of lower classes	15
	b) Women's Rights	
	c) Hostel Movement	
MODULE-4	**Dr Babasaheb Ambedkar**	
	a) Thoughts on Annihilation of Caste	15
	b) Mahad Incident and the Temple entry movement	
	c) Social Justice and Indian Constitution	

SHIVAJI UNIVERSITY, KOLHAPUR

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B.A.- II

SEMESTER – IV

PAPER VI: History of Freedom Struggle (1858-1947)

(CHOICE BASED CREDIT SYSTEM – (CBCS)

Credits: 04

(introduced from June 2019)

The course is designed to study the freedom struggle in India from 1858 to 1947. It will familiarize the students with events leading to emergence of national consciousness in India. They will be acquainted with the prolonged struggle launched by the Indian National Congress under the leadership of Mahatma Gandhi. They will also know about the struggle of the revolutionaries, leftists and the Indian National Army. The course will introduce students to the concept of Communalism and the process which led to the partition of India.

After completion of this course, the student will be able to...

CO1. Understand the events which lead to the growth of nationalism in India

CO2. Acquaint himself with major events of the freedom struggle under the leadership of Mahatma Gandhi

CO3. Explain the contribution of Revolutionaries, Left Movement and Indian National Army

CO4. Know the concept of Communalism and the causes and effects of the partition of India

Module- 1	**Rise of Nationalism** a) Formation of Indian National Congress b) Contribution of Moderates c) Contribution of Extremists (Swadeshi Movement and Home Rule Movement)	**15**
Module -2	**Gandhian Era** a) Non-Cooperation Movement b) Civil Disobedience Movement c) Quit India Movement	**15**
Module -3	**Other Strands** a) Revolutionary Movement b) Leftist Movement c) Subhash Chandra Bose and Indian National Army	**15**
Module -4	**Communalism and Partition** a) Concept of Communalism b) Causes for Partition c) Effects of Partition	**15**

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B.A.-II

SEMESTER - III

PAPER IV: HISTORY OF INDIA (1757-1857)

(CHOICE BASED CREDIT SYSTEM – (CBCS)

Credits: 4

(introduced from June 2019)

This course will acquaint the students with the history of India under British rule. It will help the students to understand how the East India Company established and consolidated its rule in India. They will know about the impact of colonial rule on the Indian Economy. It will also familiarize the students with the revolts against the company rule.

After studying this course, the student will...

CO1. Acquaint himself with significant events leading to establishment of the rule of East India Company

CO2. Know the colonial policy adopted by the company to consolidate its rule in India

CO3. Understand the structural changes initiated by colonial rule in Indian economy.

CO4. Explain the various revolts against rule of the East India Company.

Module- 1	**Establishment of Company rule In India** a) Causes for establishment of Company rule b) Struggle with Native Powers (Bengal and Mysore) c) Struggle with Marathas	**15**
Module -2	**Making of a Colonial Policy** a) Dual Government - Robert Clive b) Subsidiary Alliance - Lord Wellesley, c)Doctrine of Lapse - Lord Dalhousie,	**15**
Module -3	**Making of a Colonial Economy** a) Land revenue settlements- (*Permanent Settlement, Ryotwari, Mahalwari*) b) De-industrialization c) Drain of Wealth	**15**
Module -4	**Revolts against Company Rule** a) Tribal Revolts b) Revolt of 1857 c) Queen's Proclamation of 1858 and its effects	**15**

B.Sc. (Mathematics) (Part I) (Semester – II)
Choice Based Credit System with Multiple Entry and Multiple Exit Option (NEP-2020)
Syllabus to be implemented from Academic Year 2022-23

urse code: DSC – B5
le of course: Multivariable Calculus
eory: 32 Hrs. (40 lecturers)
arks: 50 (Credit: 02)

urse Learning Outcomes: Upon successful completion of the course students will able to:
. Learn conceptual variations while advancing from one variable to several variables in calculus.
. Set up and solve optimization problems involving several variables.
. Learn the concept of Jacobian of a transformation.

nit – 1: Partial differentiation **(20 lect.)**

Functions of two variables: domain, Neighbourhood of a point, Continuity of functions of two variables (at a point), Limit of functions of two variables, Partial derivatives: first order partial derivatives, partial derivatives of higher order, Geometrical interpretation of partial derivatives, examples,

Homogeneous functions: definition, Euler's theorem on homogeneous functions (Case of two and three variables), examples using Euler's theorem. Total Differentials, Differentiation of composite functions, examples, Implicit function: first and second order derivative of implicit functions and its examples. Taylor's theorem for a function of two variables, its examples.

Unit – 2: Extreme values and Jacobian **(20 lect.)**

Maxima and minima of functions of two variables: Condition for existence of maxima or minima, stationary and extreme points, Sign of quadratic expression, Lagrange's condition for maximum and minimum values of a function of two variables, examples, Lagrange's method of undetermined multipliers, examples using Lagrange's method.

Jacobian: Definition, examples. Jacobian of function of function (for the case of two and three variables and proof of the corollary $J, J' = 1$ is expected), Jacobian of implicit functions, examples using these properties.

Recommended Books:

1. **Differential Calculus**, Shanti Narayan and P.K. Mittal, S. Chand publishing, 15th edition (2016).

Reference Books:

1. **Basic Multivariable Calculus**, J. E. Marsden , A. J Tromba & A. Weinstein: Springer Verlag, New New York, 1993.
2. **Calculus, Early Transcendental**, H. Anton, I. Birens and Davis, John Wiley and Sons, 11th Edition (2015).
3. **Differential Calculus,** Maity and Ghosh, New Central Book Agency (P) limited, Kolkata, India. 2007.
4. **Calculus: Early transcendental,** James Stewart, Brooks/ Cole Cengage Learning, 7th edition (2012).

1.6.4 Theorem: If a function f is continuous on a closed interval $[a, b]$, then it attains its bounds at least once in $[a, b]$.

1.6.5 Theorem: If a function f is continuous at an interior point c of an interval $[a, b]$ and $f(c) \neq 0$, then $\exists$ a $\delta > 0$ such that $f(x)$ has the same sign as $f(c)$ for every $x \in]c - \delta, c + \delta[$.

1.6.6 Corollary (Statement only): If f is continuous at the end point b of $[a, b]$ and $f(b) \neq 0$, then there exists an interval $]b - \delta, b[$ such that $f(x)$ has the sign of $f(b)$ for all x in $]b - \delta, b[$.

1.6.7 Corollary (Statement only): If f is continuous at the end point a of $[a, b]$ and $f(a) \neq 0$, then there exists an interval $[a, a + \delta[$ such that $f(x)$ has the sign of $f(a)$ for all x in $[a, a + \delta[$.

1.6.8 Theorem: If a function f is continuous on a closed interval $[a, b]$ and $f(a)$ and $f(b)$ are of opposite signs ($f(a) \cdot f(b) < 0$), then there exists at least one point $\alpha \in]a, b[$ such that $f(\alpha) = 0$.

1.6.9 Intermediate Value Theorem.

1.6.10 Corollary (Statement only): A function f, which is continuous on a closed interval $[a, b]$, assumes every value between its bounds.

1.7 Discontinuous functions: Definition, Types of discontinuities – (i) removable discontinuity (ii) discontinuity of first kind (iii) discontinuity of second kind.

1.8 Examples on 1.5 and 1.7

1.9 Uniform continuity: definition and simple examples

1.10 Theorem: A function which is uniformly continuous on an interval is continuous on that interval.

1.11 Differentiability at a point and Differentiability in an interval: definitions.

1.12 Examples on 1.11

1.13 (Differentiability and continuity) Theorem: A function which is derivable at a point is necessarily continuous at that point

Unit – 2: Mean Value Theorems, Successive Differentiation, Expansions of functions

(20 lect.)

2.1 Mean Value Theorems

2.1.1 Rolle's Mean Value Theorem, Geometrical interpretation.

2.1.2 Lagrange's Mean Value Theorem, Geometrical interpretation.

2.1.3 Cauchy's Mean Value Theorem.

2.1.4 Examples on 2.1.1, 2.1.2, 2.1.3.

2.2 Successive Differentiation

2.2.1 Higher order derivatives: notations.

B.Sc. (Mathematics) (Part I) (Semester – I)
Choice Based Credit System with Multiple Entry and Multiple Exit Option (NEP-2020)
Syllabus to be implemented from Academic Year 2022-23

Course code: DSC – A5
Title of course: Calculus
Theory: 32 Hrs. (40 lecturers)
Marks: 50 (Credit: 02)

Course Learning Outcomes: Upon successful completion of the course students will able to:

1. Evaluate the limit and examine the continuity of a function at a point.
2. Understand the consequences of mean value theorems for differentiable functions.
3. Apply Leibnitz theorem to obtain higher derivatives of product of two differentiable functions.

(20 lect.)

Unit – I: Limit, Continuity and Differentiability

1.1 Limits: $\varepsilon - \delta$ definition, infinite limit ($f \to \infty$ as $x \to c$), limit at infinity ($f \to l$ as $x \to \infty$ and $f \to \infty$ as $x \to \infty$).

1.2 Left hand and Right hand limits: definition and examples.

1.3 Properties of limits:

Theorem: If f and g are two functions defined on some neighbourhood of c such that $\lim_{x \to c} f(x) = l$, $\lim_{x \to c} g(x) = m$ then

(i) $\lim_{x \to c}(f+g)(x) = l + m$

(ii) $\lim_{x \to c}(f-g)(x) = l - m$

(iii) $\lim_{x \to c}(f \cdot g)(x) = lm$

(iv) $\lim_{x \to c}(f/g)(x) = l/m$ *if* $m \neq 0$ (without proof)

1.4 Evaluation of limit: Examples (using techniques like factorization, rationalization, Left hand and Right hand limits etc.).

1.5 Continuous functions: definition of Continuity at a point, definition of continuity in an interval.

1.6 Properties of continuous functions:

1.6.1 Theorem: Let f and g be two functions continuous at a point c, then the functions $f+g$, $f-g$, fg are also continuous at c and if $g(c) \neq 0$, then f/g is also continuous at c.

Functions continuous on closed intervals:

1.6.2 Definition of bounded function

1.6.3 Theorem (Statement only): If a function f is continuous in a closed interval, then it is bounded therein.

SHIVAJI UNIVERSITY, KOLHAPUR.

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Choice Based Credit System with Multiple Entry and Multiple Exit Option

(NEP-2020)

CHOICE BASED CREDIT SYSTEM

Syllabus for

B.Sc. Part – I

MATHEMATICS

SEMESTER I AND II

(Syllabus to be implemented from Academic Year 2022-23)

B.Sc. (Mathematics) (Part-III) (Semester – V)
(Choice Based Credit System)
(Introduced from June 2020)

...ode: DSE – E9
...Hrs. (40 Lectures of 48 minutes)

Title of Course: Mathematical Analysis
Marks – 40 (Credits: 02)

...urse **Objectives:** The objectives of course is to understand and learn about

1. The integration of bounded function on a closed and bounded interval
2. Some of the families and properties of Riemannintegrablefunctions
3. The applications of the fundamental theorems of integration
4. Extension of Riemann integral to the improper integrals when either the interval of integration is infinite or the integrand has infinite limits at a finite number of pointson the interval of integration
5. The expansion of functions in Fourier series and half range Fourier series

...nit -1 : **Riemann Integration** **(16 hours)**

...finition of Riemann integration, Inequalities for lower and upper Darboux sums, Necessary and sufficient conditions for Riemann integrability, Definition of Riemann integration by Riemann sum and equivalence of the two definitions, Riemann integrability of monotonic functions and continuous functions, Algebra and properties of Riemann integrable functions, First and second fundamental theorems of integral calculus, and the integration by parts.

Unit -2 : **Improper Integrals and Fourier Series** **(16 hours)**

Improper Integrals: Definition of improper integral of first kind, Comparison test, μ – test for Convergence, Absolute and conditional convergence, Integral test for convergence of series, Definition of improper integral of second kind and some tests for their convergence, Cauchy principle value.

Fourier Series: Definition of Fourier series and examples on the expansion of functions in Fourier series. Fourier series corresponding to even and odd functions, half range Fourier series, half range sine and cosine series.

Recommended Books:

1. **Kenneth.A.Ross**, Elementary Analysis: The Theory of Calculus, Second Edition,Undergraduate Texts in Mathematics, Springer , 2013.
(Chapter 6, Art. 32.1 to 32.11, 33.1 to 33.6 and 34.1 to 34.4)
2. **D Somasundaram and B Choudhary**, First Course in Mathematical Analysis, Narosa Publishing House New Delhi, Eighth Reprint 2013 (Chapter 8, Art. 8.5 and Chapter 10, Art. 10.1)

...ence **Books:**

1. **R.R.Goldberg**, Methods of Real Analysis, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
2. **R.G.Bartle and D.R.Sherbert**, Introduction to Real Analysis, Wiley India Pvt. Ltd., Fourth Edition 2016.
3. **Shanti Narayan and Dr.M.D.Raisinghania,** Elements of Real Analysis, S.Chand& Company Ltd. New Delhi, Fifteenth Revised Edition 2014
4. **Shanti Narayan and P.K.Mittal,** A Course of Mathematical Analysis, S.Chand& Company Ltd. New Delhi, Reprint 2016.
5. **Kishan Hari**, Real Analysis, PragatiPrakashan, Meerut, Fourth Edition 2012.

Core Course Practicals in Mathematics (CCPM - I)

Marks – 50, Credits – 4

Pr. No	Title	
1.	Properties of Tracing of Cartesian Curves	
2.	Tracing of Cartesian Curves – I	2
3.	Tracing of Cartesian Curves – II	3
4.	Properties of Tracing of Polar Curves	
5.	Tracing of Polar Curves – I	4
6.	Tracing of Polar Curves – II	5
7.	Examples on Leibnitz's theorem	6
8.	Extreme values of functions of two variables	7
9.	Lagrange's method of undetermined multipliers	8
10.	Jacobian	9
11.	Euclidean Algorithm	10
12.	Examples on Fermat's theorem	
13.	Law of growth	11
14.	Law of decay	12
15.	Newton's law of cooling	13
16.	Electrical circuits	14
17.	Plotting 2D curves (Use any open source software).	
18.	Plotting 3D graphs (Use any open source software).	

B.Sc. (Mathematics) (Part I) (Semester – I) Choice Based Credit System with Multiple Entry and Multiple Exit Option (NEP-2020)
Syllabus to be implemented from Academic Year 2022-23

Course code: DSC – B6
Title of course: Basic Algebra
Theory: 32 Hrs. (40 lecturers)
Marks: 50 (Credit: 02)

Course Learning Outcomes: Upon successful completion of the course students will able to:

1. Use fundamental concepts in Mathematics like sets, relations and functions.
2. Use fundamental concepts in Number theory.
3. Solve examples on congruence.
4. Determine n^{th} roots of unity.
5. Understand various properties of hyperbolic functions.

Unit – 1: Functions, divisibility and congruence **(20 lect.)**

1.1 Set, Relations on sets, type of relations, equivalence relations, Equivalence classes and partitions of a set.

1.2 Functions: One-one, onto functions and bijections, composition of functions (Definitions and examples).

1.3 The induction principle and strong induction principle.

1.4 Divisibility and congruence:

1.4.1 The division algorithm: Theorem and its applications.

1.4.2 Definitions of Greatest common divisor least common multiple.

1.4.3 Euclidean Algorithm.

1.4.4 Fundamental Theorem of Arithmetic.

1.4.5 The theory of Congruence: Basic Properties of congruence.

Unit – 2: Complex numbers **(20 lect.)**

2.1 Complex numbers (Revision): Sums and Products, Basic Algebraic Properties, Moduli, complex conjugates and polar representation of complex numbers.

2.2 Theorem: De Moivre's theorem.

2.2.1 n^{th} roots of unity.

2.2.2 Examples.

2.3 Complex logarithm and complex power.

2.4 Hyperbolic functions and identities.

2.5 Relation between hyperbolic and trigonometric functions.

2.6 Identities of hyperbolic functions.

B.Sc. (Mathematics) (Part I) (Semester-I)
Choice Based Credit System with Multiple Entry and Multiple Exit Option (NEP-2020)
Syllabus to be implemented from Academic Year 2022-23

Course code: DSC – A6
Title of course: Differential Equations
Theory: 32 Hrs. (40 lecturers)
Marks: 50 (Credit: 02)

Course Learning Outcomes: Upon successful completion of the course students will able to:

1. Understand types of differential equations.
2. Solve different types of ordinary differential equations.
3. Understand applications of differential equations.

Unit – 1: Ordinary differential equations of first order and first degree **(22 lect.)**

Definition, Order and Degree, Exact differential equations, Necessary and sufficient condition for exactness, Differential equations reducible to exact, Integrating factors with rules, Linear differential equations, Differential equations reducible to linear differential equation, Bernoulli's differential equations.

Orthogonal trajectories, orthogonal trajectories to Cartesian and polar curves. Differential equations of first order but not of first degree: Equations that can be factorized, Equations solvable for p, Equations that cannot be factorized, Equations solvable for x, Equations solvable for y and Clairaut's form.

Unit – 2: Linear differential equations with constant coefficients **(18 lect.)**

Definition, General solution, Auxiliary equation, Complementary function, Types of complementary function: real and distinct roots, real and repeated roots , complex roots, complex and repeated roots, mixed roots, Examples on different types of complementary function, Particular integral, Particular integrals of the functions: e^{ax}, sin ax, cos ax, x^m, $e^{ax}V$, $x.V$ and general method.

Recommended Books:

1. **Ordinary and partial differential equations**, M. D. Raisinghania, S. Chand and Company Pvt. Ltd, New Delhi, 18th Revised Edition (2016).

Reference Books:

1. **Introductory course in differential equations**, D. A. Murray, Khosala Publishing House, Delhi.
2. **An Introduction to Differential Equations**, R. K. Ghosh and K. C. Maity. Book and Allied (P) Ltd., Seventh Edition (2000).
3. **Differential Equations and Their Applications**, Zafar Ahasan, PHI, Second Edition (2004).

B.Sc. (Mathematics) (Part-III) (Semester-VI)
(Choice Based Credit System)
(Introduced from June 2020)

e Code: DSE – F9 Title of Course: Metric Spaces
D: 32 Hrs. (40 Lectures of 48 minutes) Marks – 40 (Credits: 02)

se objectives :Upon successful completion of this course, the student will be able to:
quire the knowledge of notion of metric space, open sets and closed sets.
monstrate the properties of continuous functions on metric spaces,
ply the notion of metric space to continuous functions on metric spaces.
derstand the basic concepts of connectedness, completeness and compactness of metric
es,
preciate a process of abstraction of limits and continuity to metric spaces,

–1 Limits and Continuous Functions on Metric Spaces 16 hours
Limit of a function on the real line, Metric Spaces, Limitsin Metric Spaces, Functions continuous at a point on the real line, Reformulation, Functions continuous on a metric space, Open Sets, Closed Sets, More about open sets.

2: Connectedness, Completeness and Compactness 16 hours
Connected Sets, Bounded sets and totally bounded sets,Complete metric spaces, Compact metric spaces, Continuous functions on compact metric spaces.

ommended Book:

. R. Goldberg, Methods of Real Analysis,Oxford and IBH Publishing House.(2017).

ference Books:

. M. Apostol, Mathematical Analysis,Narosa Publishing House.(2002)
atish Shirali, H. L. Vasudeva, Mathematical Analysis,Narosa Publishing House.(2013)
. Somasundaram, B. Choudhary, First Course in Mathematical Analysis,
osa Publishing House,(2018).
W. Rudin, Principles of Mathematical Analysis,McGraw Hill BookCompany(1976).
Shantinarayan, Mittal, A Course of Mathematical Analysis,S.Chand and
mpany(2013).
J.N. Sharma, Mathematical Analysis-I, Krishna PrakashanMandir, Meerut.(2014)
S.C.Malik, Savita Arora,Mathematical Analysis,New age International Ltd(2005).

B.Sc. (Mathematics) (Part-III) (Semester-V)
(Choice Based Credit System)
(Introduced from June 2020)

Title of Course: Integral Transforms
Marks – 4[illegible] (Credits 02)

...ule: DSE – E12
... Hrs. (40 Lectures of 48 minutes)
...Objective : Students be able to
1. understandconcept of Laplace Transform.
2. properties of Laplace Transform to solve differential equations.
3. ...onal relation between Laplace and Fourier Transform.
4. understand infinite and finite Fourier Transform.
5. ...pply Fourier transform to solve real life problems.

Unit: 1 Laplace and Inverse Laplace Transform. 16 Hours

...Laplace Transform : Definitions; Piecewise continuity, Function of exponential order, Function of ...A Existence theorem of Laplace transform. Laplace transform of standard functions.First ...ing theorem and Second shifting theoremand examples,Change of scale propertyand ...mples. Laplace transform of derivativesand examples, Laplace transform of integralsand ...mples.Multiplication by power of tand examples.Division by tand examples.Laplace ...form of periodic functions and examples.Laplace transform of Heaviside's unit step function. ...se Laplace Transform: Definition Standard results of inverse Laplace transform, Examples , ...t shifting theorem and Second shifting theoremand examples.Change of scale propertyand ...se Laplace of derivatives, examples.The Convolution theorem and Multiplication by S, ...mples.Division by S,inverse Laplace by partial fractions ,examples, Solving linear differential ...ations with constant coefficients by Laplace transform.

Unit 2 Fourier Transform 16Hours

The infinite Fourier transform and inverse:1Definition examples Infinite Fourier sine and cosine ...nsform and examples.Definition: Infinite inverse Fourier sine and cosine transform and ...amples.Relationship between Fourier transform and Laplace transform.Change of Scale ...opertyand examples.Modulation theorem.The Derivative theorem.Extension theorem. Convolution theoremand examples.Finite Fourier Transform and Inverse, Fourier Integrals : Finite Fourier sine and cosine transform with examples.Finite inverse Fourier sine and cosine ...nsform with examples.Fourier integral theorem.Fourier sine and cosine integral (without proof) ...d examples.

Recommended Book:

1. J.K.Goyal, K.P.Gupta, Laplace and Fourier Transforms, A Pragati Edition (2016).

Reference Books:

1. Dr.S.Shrenadh, Integral Transform, S.ChandPrakashan.
2. B.Davies, Integral Transforms and Their Applications, Springer Science Business Media ...LC(2002)
3. Murray R. Spiegel, Laplace Transforms,Schaum's outlines.

B.Sc. (Mathematics) (Part-III) (Semester-V)
(Choice Based Credit System)
(Introduced from June 2020)

...ule: DSE – E11 Title of Course: Optimization Techniques
...Hrs. (40 Lectures of 48 minutes) Marks – 40 (Credits: 02)

Course Objectives: The aim of this course is to

provide studentbasic knowledge of a range of operation research models and techniques, which can be applied to a variety of industrial and real life applications.

1. Formulate and apply suitable methods to solve problems.
2. Identify and select procedures for various sequencing, assignment, transportation problems.
3. Identify and select suitable methods for various games .
4. To apply linear programming and find algebraic solution to games.

Unit-1 Network optimization models : **[16 hours]**

Introduction ,Formulation of Linear Programming Problems., Graphical methods for Linear Programming problems. General formulation of Linear Programming problems, Slack and surplus variables,Canonical form, Standard form of Linear Programmingproblems. Transportation problem:Introduction, Mathematical formulation ,Matrix form of Transportation problem.Feasible solution, Basic feasible solution and optimal solution, Balanced and unbalanced transportation problems. Methods of Initial basic feasible solutions: North west corner rule [Stepping stone method], Lowest cost entry method [Matrix minima method], Vogel's Approximation method [Unit Cost Penalty method] .The optimality test.[MODI method], Assignment Models :Introduction ,Mathematical formulation of assignment problem, Hungarian method for assignment problem. Unbalanced assignment problem.Travelling salesman problem.

Unit-2Quantitative techniques: **[16 hours]**

Game theory: Basic definitions , Minimax [Maximin] Criterion and optimal strategy, Saddle point , optimal strategy and value of game. Solution of games with saddle point. Fundamental theorem of game theory [Minimax theorem] , Two by two (2 X 2) games without saddle point.Algebraic method of Two by two (2 X 2) games.Arithmetic method of Two by two (2 X 2) games.Graphical method for 2 x n games and m x 2 games.Principle of dominance, Job sequencing : Introduction. Terminology and notations.Principal assumptions.Solution of sequencing problems.Processing n jobs through 2 machines.Processing n jobs through 3 machines.Processing 2 jobs through m machines.Processing n jobs through m machines.

Recommended Book:

1. Sharma S.D., Operations Research - Theory Methods and Applications"Kedarnath, Ramnath Meerut, ...hi Reprint 2015.

Reference Books:

1. Mohan, C. and Deep, Kusum, Optimization Techniques, New Age,2009.
2. Mittal, K. V. and Mohan, C., Optimization Methods in Operations, Research and Systems Analysis, ...w Age. 2003.
3. Taha, H.A. :Operations Research – An Introduction, Prentice Hall, (7th Edition), 2002.
4. Ravindran, A. , Phillips, D. T and Solberg, J. J., Operations Research: Principles and Practice, ...n Willey and Sons, 2nd Edition, 2009.
5.J.K.Sharma : Operation Research: Theory and Applications, Laxmi Publications, 2017.
6.KantiSwarup,P.K.Gupta and Manmohan,Operation Research, S.Chand& Co.
7. G.Hadley: Linear programming , Oxford and IBH Publishing Co.

B.Sc. (Mathematics) (Part-III) (Semester–V)
(Choice Based Credit System)
(Introduced from June 2020)

Code: DSE – E10

Hrs. (40 Lectures of 48 minutes)

Title of Course: Abstract Algebra

Marks : 100 Credits: 02

Course Objectives: After successful completion of this course the students will able to

- Basic concepts of group and rings with examples
- Identify whether the given set with the compositions form Ring, Integral domain or field.
- Understand the difference between the concepts Group and Ring.
- Apply fundamental theorem, Isomorphism theorems of groups to prove these theorems for Ring.
- Understand the concepts of polynomial rings, unique factorization domain.

Unit -1:Groups and Rings

16 hours

Groups: Definition and examples of groups, group S_3 and Dihedral group D_4,Commutator subgroups and its properties, Conjugacy in group and class equation.

Rings: Definition and example of Rings, Ring with unity. Zero divisor, Integral Domain, Division Ring, Field. Boolean ring, Subring, Characteristic of a ring: Nilpotent and Idempotent elements. Ideals, Sum of two ideals, Examples. Simple Ring.

Unit-2: Homomorphism and Imbedding of Ring , Polynomial Ring and Unique Factorization Domain.

16 hours

Quotient Rings, Homomorphism, Kernel of Homomorphism ,Isomorphism theorems,imbedding of Ring. Maximal Ideals, Polynomial Rings, degree of Polynomial, addition and multiplication of Polynomials and their properties, UFD, Gauss' Lemma.

Recommended Books:

1) Vijay K. Khanna, S.K. Bhambri, A Course In Abstract Algebra, Vikas publishing House Pvt.Ltd., New –Delhi-110014, Fifth Edition 2016.
(Chap. 3 Art. The Dihedral Group, commutator, Chap. 4 Art. Conjugate elements, Chap.7 Art. Subrings, characteristic of a ring, Ideals, Sum of Ideals, Chap. 8 Art. Quotient rings, Homomorphisms, Embedding of Rings, More on Ideals, Maximal Ideals, Chap 9 Polynomial Rings, Unique Factorization Domain.)

Reference Books:

1.Jonh B. Fraleigh, A First Course in Abstract Algebra Pearson Education, Seventh Edition(2014).
2. Herstein I. N, Topics in Algebra, Vikas publishing House,1979.
3.Malik D. S. Moderson J. N. and Sen M. K., Fundamentals of Abstract Algebra, Grew Hill,1997.
4.Surjeet Sing and QuaziZameeruddin, Modern Algebra, Vikas Publishing House,1991.
5.N.Jacobson, Basic Algebra Vol. I&II, Freeman and Company, New York 1980.

B.Sc. (Mathematics) (Part-II) (Semester–III)

(Choice Based Credit System)

(Introduced from June 2019)

Course Code: DSC – 5C

Title of Course: Real Analysis–I

Theory: 32Hrs. (40 Lectures of 48 minutes) Marks – 50 (Credits: 02)

Course Objectives: Upon successful completion of this course, the student will be able to:

(1) understand types of functions and how to identify them.

(2) use mathematical induction to prove various properties.

(3) understand the basic ideas of Real Analysis.

(4) prove order properties of real numbers, completeness property and the Archimedean property.

Unit1:Functions and Countable sets **(16 hours)**

1.1. **Sets.**

1.1.1. Revision of basic notions in sets.

1.1.2. Operations on sets:-Union, Intersection, Complement, Relative complement, Cartesian product of sets, Relation.

1.2. **Functions**

1.2.1. Definitions: Function, Domain, Co-domain, Range, Graph of a function, Direct image and Inverse image of a subset under a function. Examples of direct image and inverse image of a subset.

1.2.2. **Theorem:** If $f: A \to B$ and if $X \subseteq B, Y \subseteq B$, then

$$f^{-1}(X \cup Y) = f^{-1}(X) \cup f^{-1}(Y)$$

1.2.3. **Theorem:** If $f: A \to B$ and if $X \subseteq B, Y \subseteq B$, then

$$f^{-1}(X \cap Y) = f^{-1}(X) \cap f^{-1}(Y)$$

1.2.4. **Theorem:** If $f: A \to B$ and if $X \subseteq A, Y \subseteq A$, then $f(X \cup Y) = f(X) \cup f(Y)$

1.2.5. **Theorem:** If $f: A \to B$ and if $X \subseteq A, Y \subseteq A$, then $f(X \cap Y) \subseteq f(X) \cap f(Y)$

1.2.6. **Definitions:** Injective, Surjective and Bijective functions (1-1 correspondance) Inverse function.

1.2.7. **Proposition:** If $f: A \to B$ is injective and $E \subseteq A$, then $f^{-1}(f(E)) = E$.

B.Sc. (Mathematics) (Part-III) (Semester–VI)
(Choice Based Credit System)
(Introduced from June 2020)

Course: DSE – F12 **Title of Course: Discrete Mathematics**

Hrs. (40 Lectures of 48 minutes) Marks – 50 (Credits: 02)

Objectives: Upon successful completion of this course, Students will be able to

use classical notions of logic: implications, equivalence, negation, proof by contradiction, proof by induction, and quantifiers.

apply notions in logic in other branches of Mathematics.

know elementary algorithms : searching algorithms, sorting, greedy algorithms, and their complexity.

apply concepts of graph and trees to tackle real situations.

appreciate applications of shortest path algorithms in computer science.

Unit 1 : Mathematical Logic **[16 hours]**

The logic of compound statements: Statements, compound statements, truth values, logical equivalence, tautologies and contradictions, Conditional statements: Logical equivalences involving implication, negation.The contrapositive of a conditional statements, converse, inverse of a conditional statements, conditional statements.Valid and invalid arguments: Modus Ponens and modus Tollens, Additional valid argument forms, rules of inferences, contradictions and valid arguments, Number system: Addition and subtraction of Binary, decimal, quintal, octal, hexadecimal number systems and their conversions.

Unit 2:Graphs and trees **[16 hours]**

Graphs :Definitions, basic properties,examples, special graphs, directed and undirected graphs, concept of degree, Trails, Paths and Circuits: connectedness, Euler circuits, Hamiltoniancircuits, Matrixrepresentation of graphs,Isomorphism of graphs,isomorphicinvariants,graph isomorphism for simple graphs.

Trees: Definitions and examples of trees, rooted trees, binary trees and their properties. spanning trees , minimal spanning trees, Kruskal'salgorithm , Prim's algorithm, Dijkstra's shortest path algorithm.

Recommended Book:

Susanna S. Epp, Discrete Mathematics with Applications,PWS Publishing Company, 1995. (Brooks/Cole, Cengage learning, 2011)

ReferencesBooks :

1. Kenneth H. Rosen, Discrete Mathematics and its Applications, McGraw Hill, 2002.
2. J.P.Tremblay and R. Manohar, Discrete Mathematical Structure with Applications, McGraw– Hill.
3. V. Krishnamurthy, Combinatories:Theory and Applications", East-West Press.
4. Kolman, Busby Ross, Discrete Mathematical Structures, Prentice Hall International.
5. R M Somasundaram, Discrete Mathematical Structures, (PHI) EEE Edition 7.
6. A.B.P.Rao and R.V.Inamdar, A Graduate Text in Computer Mathematics,SUMS [1991]
7. Seymour Lipschutz and Marc Lipson,Discrete Mathematics, Schaum's Outlines Series, Tata McGraw - Hill.
8. Mathematical Foundations of Computer Science: professional publications, JNTU Hyderabad.
9. Liu C. L, Elements of Discrete Mathematics, McGraw – Hill.

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B.Sc. (Mathematics) (Part-III) (Semester–VI)
(Choice Based Credit System)
(Introduced from June 2020)

rse Code: DSE – F11 **Title of Course: Complex Analysis**

ory: 3 Hrs. (40 Lectures of 48 minutes) **Marks: 50 (Credits: 02)**

rse objectives: Upon successful completion of this course, Students will
1. learn basic concepts of functions of complex variable.
2. be introduced to concept of analytic functions.
3. learn concept of complex integration and basic results thereof.
4. be introduced to concept of sequence and series of complex variable.
5. learn to apply concept of residues to evaluate certain real integrals.

1 :Analytic functions and Complex Integration **16 hours**

Basic algebraic and geometric properties of complex numbers, Function of complex variable, Limits, inuity and differentiation, Cauchy Riemann equations, Analytic functions and examples of analytic tions. Exponential function, Logarithmic function, Trigonometric function, Definite integrals of functions, tours, Contour integrals and its examples, upper bounds for moduli of contour integrals, Cauchy-Goursat rem and examples, Cauchy integral formula and examples, Liouville's theorem and the fundamental rem of algebra.

2 : Sequences, Series and Residue Calculus **16 hours**

Convergence of sequences and series of complex variables, Taylor series and its examples, Laurent series and its examples, absolute and uniform convergence of power series, Isolated singular points, Residues, Cauchy's residue theorem, Residue at infinity, The three types of isolated singularities, Residues at poles and examples, Zeros of analytic functions, Zeros and poles, Application of residue theorem to evaluate real integrals.

Recommended book:

1. James Ward Brown and Ruel V. Churchill, *Complex Variables and Applications,* 8th Ed., McGraw – Hill Education (India) Edition, 2014. Eleventh reprint 2018.

Reference books:

1. S.Ponnusamy, Foundations of Complex Analysis, Narosa Publishing House, Second Edition , 2005, Ninth reprint 2013.
2. Lars V Ahlfors, Complex Analysis, McGraw-Hill Education; 3 edition (January 1, 1979).
3. S.B.Joshi, T.Bulboaca and P.Goswamy, Complex Analysis, Theory and Applications, DeGruyter, Germany(2019).

B.Sc. (Mathematics) (Part-III) (Semester-VI)
(Choice Based Credit System)
(Introduced from June 2020)

Code: DSE – F10
Course: Linear Algebra
32 Hrs. (40 Lectures of 48 minutes) Marks – 40 (Credits: 02)

Objectives: Upon successful completion of this course, the student will be able to:
1. understandnotion of vector space, subspace, basis.
2.understand concept of linear transformation and its application to real life situation.
3. work out algebra of linear transformations.
4. appreciate connection between linear transformation and matrices.
5. work out eigen values, eigen vectors and its connection with real life situation.

Vector Spaces and Linear Transformations **(16 hours)**

Vector space: Subspace, Sum of subspaces, direct sum, Quotient space, Homomorphism or Linear sformation. Kernel and Range of homomorphism, Fundamental Theorem of homomorphism, morphism theorems, Linear Span, Finite dimensional vector space, Linear dependence and pendence, basis, dimension of vector space and subspaces.
ear Transformation: Rank and nullity of a linear transformation, Sylvester's Law, Algebra of Linear nsformations , Sum and scalar multiple of Linear Transformations. The vector space of momorphisms, Product (composition) of Linear Transformations, Linear operator, Linear functional, ertible and non-singular Linear Transformation, Matrix of Linear Transformations and its examples.

it 2: Inner Product Spaces, Eigen values and Eigen vectors **(16 hours)**

Inner product spaces: Norm of a vector, Cauchy- Schwarz inequality, Orthogonality, Generalized Pythagoras Theorem, orthonormal set, Gram-Schmidt orthogonalization process, Bessel's inequality.
Eigen values and Eigen vectors: Eigen space, Characteristic Polynomial of a matrix and remarks on it, similar matrices, Characteristic Polynomial of a Linear operator, Examples and real life (Predatory – Prey problem), examples on eigen values and eigen vectors.

Recommended Book:

1. Khanna V. K. and Bhambri S. K., **ACourseinAbstractAlgebra,**Vikas Publishing House PVT Ltd., New Delhi , 2016, 5th edition,

Reference Books:

H. Anton & C. Rorres, **Elementary Linear Algebra** (with Supplemental Applications), Wiley India Pvt. Ltd (Wiley Student Edition), New Delhi , 2016, 11th Edition.
riedberg, A. Insel and L. Spence, **Linear Algebra**, Prentice Hall of India, 2014, 4th Edition.
Holfman K. and Kunze R., **Linear Algebra,** Prentice Hall of India, 1978.
Lipschutz S., **LinearAlgebra,**Schaum's Outline Series, McGraw Hill, Singapore, 1981.
David Lay, Steven Lay, Judi McDonald, **LinearAlgebra and its Applications,** Pearson Education Asia, IndianReprint, 2016, 5th Edition.

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2.4.10. **Theorem:** A cyclic group of order d has $\phi(d)$ generators.

2.5. **Cosets**

2.5.1. **Definition** of Left and Right Cosets in group G and examples.

2.5.2. **Theorem:** If H is a subgroup of G, then

(i) Ha = H if and only if $a \in H$

(ii) Ha = Hb if and only if $ab^{-1} \in H$

(iii) Ha is a subgroup of G if and only if $a \in H$

2.5.3. **Theorem:** If H is a subgroup of G, then for all $a \in G$ Ha = $\{x \in G \mid x \equiv a \pmod{H}\}$.

2.5.4. **Theorem:** If H is a subgroup of G then there exists a one to one correspondence between any two right (left) cosets of H in G.

Recommended Books

1. Howard Anton—Elementary Linear Algebra, Fifth Edition John Wiley & Sons.
2. J.B.Fraleigh, A First Course in Abstract Algebra, Narosa Publishing House New Delhi.

Reference Books---

1. Kenneth Hoffman,Raykunze---Linear Algebra, Second Edition, PHI Learning Private LTD.New Delhi-110001-2010.
2. Vivek Sahai, Vikas Bist—Linear Algebra, Alpha Science International LTD. Pangboume.
3. I. N. Herstein-- Topics in Algebra, Wiley India Pvt. Ltd.
4. S. kumaresan—Linear Algebra,A Geometric Approach

(16 hours)

Unit2: Groups

2.1 Definition of Binary Operations and examples

2.2 Groups and its Properties

2.2.1. Definition of Group, Semigroup, Abelian group, finite and infinite group, Quaternion group and Order of the group and examples

2.2.2. **Theorem:** In a group G

(i) Identity element is unique

(ii) Inverses of each elements in G is unique

(iii) $(a^{-1})^{-1} = a$ for all $a \in G$

(iv) $(ab)^{-1} = b^{-1}a^{-1}$ for all $a, b \in G$.

2.2.3. **Theorem:** If G is a group with binary operation $*$, then the left and right cancellation laws hold in G, that is $a * b = a * c$ implies $b = c$, and $b * a = c * a$ implies $b = c$ for $a, b, c \in G$.

2.2.4. **Theorem:** If G is a group with binary operation $*$, and if a and b are any elements of G, then linear equations $a * x = b$ and $y * a = b$ have unique solutions in G.

2.3. **Subgroups**

2.3.1. **Definition** of Subgroup, Improper and Proper subgroups, Trivial subgroup and examples

2.3.2. **Theorem:** A subset H of a group G is a subgroup of G if and only if

(i) H is closed under the binary operation of G.

(ii) The identity e of G is in H,

(iii) For all $a \in H$ it is true that $a^{-1} \in H$ also.

2.3.3. **Theorem:** A non empty subset H of a group G is a subgroup of G if and only if for all $a, b \in H$, $a * b^{-1} \in H$.

2.3.4. **Theorem:** Intersection of any two subgroups of a group is again a subgroup.

2.3.5. **Definition** of Normalizer of an element in group G, Center of group G.

2.3.6. **Theorem:** If G is a group and $a \in G$, then the set $N(a) = \{ x \in G \mid xa = ax \}$ is a subgroup of G.

2.3.7. **Theorem:** If G is a group, then the set $C = \{ x \in G \mid xa = ax$, for all $a \in G \}$ is the set of all the elements of G which commutes with every elements of G.

2.4. **Cyclic Groups and its Properties**

2.4.1. **Definition** of Cyclic group generated by an element, Cyclic subgroup of a group and examples

2.4.2. **Theorem:** If G is a group and $a \in G$ is a fixed element of G, then the set $H = \{ a^n \mid n \in Z \}$ is a subgroup of G.

2.4.3. **Definition** of Order of an element of a group and its properties.

2.4.4. **Theorem:** Every cyclic group is abelian.

2.4.5. **Theorem:** If a is a generator of a cyclic group G, so is a^{-1}.

2.4.6. **Theorem:** If a is a generator of a cyclic group G, then O(a) = O(G).

2.4.7. **Theorem:** If G is a finite group of order n containing an element of order n, then G is cyclic.

2.4.8. **Theorem:** If in a cyclic group $\langle a \rangle$ of order k, $a^m = a^n$ $(m \neq n)$, then $m \equiv n \pmod{k}$.

2.4.9. **Theorem:** Every subgroup of a cyclic group is cyclic.

(Introduced from June 2019 onwards)

Course Code: DSC – 6C

Title of Course: Algebra–I

Theory: 32Hrs. (40 Lectures of 48 minutes)

Marks: 50 (Credits: 02)

Course Objectives : Upon successful completion of this course, the student will be able to:

1. understand properties of matrices
2. solve System of linear homogeneous equations and linear non-homogeneous equations.
3. find Eigen values and Eigen vectors.
4. construct permutation group and relate it to other groups.
5. classify the various types of groups and subgroups.

Unit1: Matrices and Relations (16 hours)

1.1. **Definitions:** Hermitian and Skew Hermitian matrices.

1.2. **Properties** of Hermitian and Skew Hermitian matrices.

1.3. Rank of a matrix, Row-echelon form and reduced row echelon form.

1.4. System of linear homogeneous equations and linear non-homogeneous equations.

1.4..1. Condition for consistency

1.4..2. Nature of the general solution

1.4..3. Gaussian elimination and Gauss Jordon method (Using row-echelon form and reduced row echelon form).

1.4..4. Examples on 1.4.1 and 1.4.3

1.5. The characteristic equation of a matrix, Eigen values, Eigen vectors of a matrix.

1.6. **Cayley Hamilton theorem**

1.7. Applications of Cayley Hamilton theorem (Examples).

1.8. **Relations**: Definition, Types of relations, Equivalence relation, Partial ordering relation

1.9. **Examples** of equivalence relations and Partial ordering relations.

1.10. Digraphs of relations, matrix representation.

1.11. Composition of relations

1.12. Transitive closure, Warshall's algorithm

1.13. Equivalence classes, Partition of a set

1.13.1. **Theorem:** Let $\sim$ be an equivalence relation on a set X. Then

(a) For every $x \in X$, $x \in \overline{X}$

(b) For every $x, y \in X$, $x \in \overline{Y}$ if and only if $\overline{X} = \overline{Y}$.

(c) For every $x, y \in X$, either $\overline{x} = \overline{y}$ or $\overline{x} \cap \overline{y} = \emptyset$.

1.13.2. **Equivalence class Theorem**

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1.2.8. **Proposition:** If $f: A \to B$ is surjective and $H \subset B$, then $f(f^{-1}(H)) = H$.

1.2.9. **Definition:** Composite function, Restriction and Extension of a function.

1.2.10. **Theorem:** Let $f: A \to B$ and $g: B \to C$ be functions and let H be a subset of C. Then $(g \circ f)^{-1}(H) = f^{-1}(g^{-1}(H))$.

1.2.11. **Theorem:** Composition of two bijective functions is a bijective function.

1.2.12. **Examples**

1.3. **Mathematical Induction**

1.3.1. **Principle of Mathematical Induction** (without proof), Well ordering property of natural numbers

1.3.2. **Principle of Mathematical Induction** (second version: Statement only), Principle of strong induction (Statement only).

1.3.3. Examples based on 1.3.1 and 1.3.2

1.4. **Countable Sets**

1.4.1. **Definitions:** Denumerable sets, Countable sets, uncountable sets.

1.4.2. **Examples of denumerable sets:** Set of Natural numbers, Set of Integers, Set of even natural numbers and odd natural numbers.

1.4.3. **Proposition:** Union of two disjoint denumerable sets is denumerable.

1.4.4. **Theorem:** If A_m is a countable set for each $m \in \mathbb{N}$, then the union $A = \bigcup_{m=1}^{\infty} A_m$ is countable. (Countable union of countable sets is countable)

1.4.5. **Theorem:**The set of Rational numbers is denumerable.

1.4.6. **Theorem:** Any subset of countable set is countable.

1.4.7. **Theorem:** The closed interval [0,1] is uncountable.

1.4.8. **Corollary:** The set of all real numbers is uncountable.

1.4.9. **Examples**

(16 hours)

Unit2:The Real numbers

2.1. **Algebraic and Order Properties of $\mathbb{R}$.**

2.1.1. Algebraic properties of real numbers.

2.1.2. **Theorem:**Let $a, b, c \in \mathbb{R}$.

(a) If $a > b$ and $b > c$, then $a > c$

(b) If $a > b$, then $a + c > b + c$

1.6 Geometrical Relation between Total Differential equations and Simultaneous Differential Equations

Unit 2 : Partial Differential Equations

2.1 Partial Differential Equations

2.1.1: Introduction

2.1.2: Order and Degree of Partial Differential Equations

2.1.3: Linear and non-linear Partial Differential Equations

2.1.4: Classification of first order Partial Differential Equations

2.1.5: Formation of Partial Differential Equations by the elimination of arbitrary constants

2.1.6: Formation of Partial Differential Equations by the elimination of arbitrary functions Ø from the equation Ø(u,v) = 0 where u and v are functions of x, y and z.

2.1.7: Examples.

2.2: First Order Partial Differential Equations

2.2.1: First Order Linear Partial Differential Equations

2.2.2: Lagrange's equations Pp + Qq = R

2.2.3: Lagrange's methods of solving Pp + Qq = R

2.2.4: Examples

2.3: Charpit's method

2.3.1: Special methods of solutions applicable to certain standard forms

2.3.2: Only p and q present

2.3.3: Clairaut's equations

2.3.4: Only p, q and z present

2.3.5: f(x,p) = g(y,q)

2.3.6: Examples

Recommended Books:

(1) M. D. Raisinghania, Ordinary and Partial Differential Equations, Eighteenth Revised

B. Sc. Part – I Semester – II

SUBJECT: MATHEMATICS

BSC – 5B (DIFFERENTIAL EQUATIONS)

(Theory: 32 hrs. (40 lectures of 48 minutes)

Marks -50 (Credits: 02)

Unit 1: Differential Equations of First Order (16 hrs.)

1.1: Differential Equations of First Order and First Degree.

1.1.1: Exact Differential Equations.

1.1.2: Necessary and Sufficient condition for exactness.

1.1.3: Working Rule for solving an Exact Differential Equation.

1.1.4: Integrating Factor.

1.1.5: Integrating Factor by Inspection and examples.

1.1.6: Integrating Factor by using Rules (Without Proof) and Examples.

1.1.7: Linear Differential Equations: Definition, Method of Solution and examples.

1.1.8: Bernoulli's Equation: Definition, Method of Solution and Examples.

1.2: Differential Equations of First Order but Not of First Degree:

1.2.1: Introduction.

1.2.2: Equations solvable for p: Method and Problems.

1.2.3: Equations solvable for x: Method and Problems.

1.2.4: Equations solvable for y: Method and Problems.

1.2.5: Clairaut's Form: Method and Problems.

1.2.6: Equations Reducible to Clairaut's Form.

Unit 2: Linear Differential Equations (16 hrs.)

2.1: Linear Differential Equations with Constant Coefficients

6. Dr. Hari Kishan, Real Analysis, Pragati Prakashan, Meerut, Fourth Edition, 2012

B.Sc. Part II (Mathematics) (Semester IV)
(Choice Based Credit System)
(Introduced from June 2019 onwards)

Course Code: DSC – 6D
Title of Course: Algebra-II
Theory: 32 hrs. (40 lectures of 48 minutes) Marks – 50 (Credits: 02)

Course Objectives : Upon successful completion of this course, the student will be able to:

1. prove Lagrange's theorem.
2. derive Fermat's theorem.
3. understand properties of normal subgroups, factor group.
4. define homomorphism and isomorphism's in group and rings.
5. derive basic properties of rings and subrings.

Unit - 1 Groups **(16 hours)**

1.1 **Lagrange's theorem and its Consequences**

1.1.1 **Definition**of index of a subgroup

1.1.2 **Theorem(Lagrange):** If G is any finite group and H is any subgroup of G, then O(H) divides O(G).

1.1.3 **Corollary:** The index of any subgroup of a finite group is a divisor of the order of the group.

1.1.4 **Corollary:** If G is a finite group and $a \in G$, then O(a) divides O(G).

1.1.5 **Corollary:** If G is a finite group of order n then for all $a \in G$, $a^n = e$, where e is the identity element of G.

1.1.6 **Theorem(Euler's theorem):** If n is any positive integer and a is relatively prime to n, then $a^{\phi(n)} \equiv 1 (\text{mod } n)$

1.1.7 **Theorem(Fermat's theorem):** If a is any integer and p is any positive prime, then $a^p \equiv a (\text{mod } p)$.

1.2 **Normal subgroups and its Properties**

1.2.1 **Definition** of Normal subgroup and examples

1.2.2 **Theorem:** A subgroup H of a group G is normal if and only if $gHg^{-1} = H$ for all $g \in G$.

1.2.3 **Theorem:** A subgroup H of a group G is normal if and only if every right coset of H in G is a left coset of H in G.

1.2.4 **Corollary:** Every subgroup of an Abelian group is a normal subgroup.

1.2.5 **Theorem:** A subgroup H of a group G is normal in G if and only if the product of any two right (or left) cosets H in G is again a right (or left) coset of H in G.

B.Sc. Part II (Mathematics) (Semester IV)
(Choice Based Credit System)
(Introduced from June 2019 onwards)

Course Code: USC – 5D
Title of Course: Real Analysis – II
Marks – 50 (Credits: 02)
Theory: 3 Hrs. (40 Lectures of 48 minutes)

Course Objectives: Upon successful completion of this course, the student will be able to:

1. Understand sequence and subsequence.
2. Prove The Bolzano-Weierstrass Theorem.
3. derive Cauchy Convergence Criterion.
4. find convergence of series.
5. apply Leibnitz Test.

1 Sequences (16 hours)

1.1 Monotone Sequences

1.1.1 **Definition**: Monotone sequences and examples

1.1.2 **Theorem**: A monotonic increasing and bounded above sequence converges to its supremum.

1.1.3 **Theorem**: A monotonic decreasing and bounded below sequence converges to its infimum.

1.1.4 **Monotone Convergence Theorem(without proof)**: A monotone sequence of real numbers is convergent if and only if it is bounded.

1.1.5 **Theorem**: The sequence $\{(1 + 1/n)^n\}$ is convergent.

1.1.6 Examples

1.1.7 **Theorem**: Every monotonic increasing sequence which is not bounded above, diverges to $+\infty$

1.1.8 **Theorem**: Every monotonic decreasing sequence which is not bounded below, diverges to $-\infty$.

1.1.9 Examples

1.2 Subsequences

1.2.1 **Definition**: Subsequence and examples

1.2.2 **Theorem**: If a sequence $X = (x_n)$ of real numbers converges to a real number x, then any subsequence $X' = (x_{n_k})$ of X also converges to x.

1.2.3 **Theorem**: All subsequences of real numbers converges to same limit.

1.2.4 **Monotone Subsequence Theorem**: If $X = (x_n)$ is a sequence of real numbers, then there is subsequence of X that is monotone.

1.2.5 **The Bolzano-Weierstrass Theorem**: A bounded sequence of real numbers has convergent subsequence.

1.3 Limit Superior and Limit Inferior of Sequences

1.3.1 **Definition**: Limit Superior and Limit Inferior of Sequences and examples

1.3.2 **Theorem**: If (x_n) be a bounded sequence of real number R and $L \in R$ Then $\lim(x_n) = L$ if and only if $\limsup(x_n) = L = \liminf(x_n)$

1.3.3 **Theorem**: Let (x_n) and (y_n) be bounded sequences of real numbers and suppose that $x_n \leq y_n$ for all $n \in N$ Then

B. Sc. Part – I

ZOOLOGY PRACTICALS

Marks -50 (Credits: 02)

(DSC– 15A, Practical)

LAB)

1. **Study of the followingspecimens:**

i Study of *Amoeba, Euglena, Plasmodium, Paramecium, Sycon, Hydra, Obelia, Physalia, Fasciola, Taenia solium, Ascaris lumbricoides, Aphrodite, Nereis, Pheretima, Hirudinaria, Palaemon, Cancer, Limulus, Palamnaeus, Scolopendra, Julus, Periplaneta, Apis, Chiton, Dentalium, Pila, Unio, Loligo, Sepia, Octopus, Pentaceros, Ophiura, Echinus, Cucumaria* and *Antedon*, with classification and morphological peculiarities.

ii Study of Sycon, *Hydra*, and *Euplectella*, *Obelia*, *Physalia*, *Fasciola*, *Pulchella*, *Metridium*, *Taenia solium*, Male and female *Ascaris lumbricoides*, *Aphrodite*, *Nereis*, *Pheretima*, *Hirudinaria*, *Palaemon*, *Cancer*, *Limulus*, *Palamnaeus*, *Scolopendra*, *Julus*, *Periplaneta*, *Apis*, *Chiton*, *Dentalium*, *Pila*, *Unio*, *Loligo*, *Sepia*, *Octopus*, *Pentaceros*, *Ophiura*, *Echinus*, *Cucumaria* and *Antedon*, with classification and morphological peculiarities.

2. **Study of thefollowing:**

i T.S. or L.S. of*Sycon*,

ii Lifehistory*Taenia*and*Ascaris*andtheirparasiticadaptations.

3. **Preparation of haemincrystals**

4. **Study Tour: Visit to any suitable place to study animal diversity or any place related to theory syllabus and submission ofreport.**

5. **Preparation of blood smear and identification of ABO and Rh bloodgroups**

6. **CytologicalPreparations:**

Mitochondria – Stained preparation of mitochondria from onion peeling / Hydrilla leaf / Oralmucosa by using Janus Green -B.

Polytene Chromosomes – Stained preparation of polytene chromosome in Chironomous larva/Drosophila larva.

7. **Studyoffossilevidencesfromplastercastmodelsandpictures.**

8. **Demonstration of Rat tostudy,**

- Digestive system, Lungs, Heart, Kidney, Testis, Ovary and Brain ofRat

9. **Study of Mendelian Inheritance and gene interactions (Non-Mendelian Inheritance) using suitable examples.** Minimum 10 Examples on: Monohybrid & Dihybrid ratio, Incomplete dominance, Co-dominance, Multiple alleles, Sex linked inheritance, Linkage, Crossing over andGene interaction.

10. **Study of following insect vectors through permanent slides orphotographs**

1. Mosquito born diseases (Causal organism, symptoms and controlmeasures)
a. Malaria b. Dengue c.Chikungunya
2. Housefly born diseases (Causal organism, symptoms and controlmeasures)
a. Myiasis
3. Flea born diseases (Causal organism, symptoms and controlmeasures)
a. Plague b. Typhusfever

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Sem II Paper Code - F2846

B. Sc. Part – I Semester
ZOOLOGY
DSC – 16 B (Genetics)
Theory: 30 hrs. (37.5 lectures of 48 minutes)
Marks-50 (Credits: 02)

Genetics

1

troductiontoGenetics

endel's work on transmission of traits, Genetic Variations, Molecular basis of Genetic formation (3hrs.)

endelian and postMendelianGenetics

inciples of Inheritance, Incomplete dominance and co-dominance, gene interaction, ultiplealleles w.r.t. ABO, Rh blood groups and coat colour in rabbit, sex linked inheritance. (8hrs.)

nkage, CrossingOver

nkage and process of crossing over, Coupling and repulsion theory, Cytological evidence crossing over. (4hrs.)

2:

lutations

hromosomal Mutations: Deletion, Duplication, Inversion, Translocation, Aneuploidy and olyploidy, induced gene mutation. (8hrs.)

exDetermination

hromosomal theory, Genic balance theory, Haploidy-Diploidy mechanism, Environmental heory (7hrs.)

Total Periods – 30 hrs

SHIVAJI UNIVERSITY, KOLHAPUR.

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CHOICE BASED CREDIT SYSTEM

Syllabus For

B.Sc. Part - I
ZOOLOGY

SEMESTER I AND II

(Syllabus to be implemented from June, 2022onwards.)

Orthogonal trajectories (Cartesian form)

Simultaneous Differential Equations

Total differential Equations

Examples on Linear Differential Equations with Constant Coefficients

Examples on Exact Differential Equations

Examples on Charpit's method.

Examples on Clairaut's Forms.

Plotting family of solutions of second order differential equations (Using software)

Plotting of Curves. (Using software)

extreme value (n — sem 1)

SEMESTER –II

tany Paper III: DSC-13B: Mycology, Phytopathology and Mushroom cultivation

DIT: 2. LECTURE PERIODS: 2.5 PER WEEK- LECTURE HOURS; 2 PER WEEK
MARKS: 50

LE	SUB-MODULE	TOPICS	LECTURE PERIOD
		Mycology	
	1.1Fungi – A)	i) General characters of fungi ii) Classification as per Ainsworth (1973) - upto class iii) Economic importance	06
	B)	Life cycle (excluding developmental stages of sex organs) of the following types- **a) Zygomycotina: *Mucor*** **b) Ascomycotina: *Penicillium***	07
	1.2Lichens	i) Occurrence and General characters ii) Nature of association iii) Types of lichens iv) Economic importance	04
		Phytopathology and Mushroom cultivation	
	2.1Phytopathology	i) Introduction and General symptoms. ii) Study of following plant diseases with respect to symptoms and control measures- **a) Viral** – Yellow vein mosaic of Bhendi **b) Bacterial** – Blight of Pomegranate **c) Fungal** – White rust of crucifers **d) Mycoplasma (MLO)-** Grassy shoot of sugarcane	06
	2.2Mushroom cultivation	i) Introduction and History ii) Steps in cultivation of *Pleurotus sajor-kaju* iii) Commercial importance.	07
	Total Lectures		30

SEMESTER –I

Botany Paper II: DSC-14 A: Cell biology and Analytical techniques

2. LECTURE PERIODS: 2.5 PER WEEK- LECTURE HOURS; 2 PER WEEK
MARKS: 50

SUB-MODULE	TOPICS	LECTURE PERIOD
	Cell biology	
1.1 Cell as a structural and functional unit of life	i) Introduction, Definition ii) Cell as biochemical entity iii)Structure and difference between Prokaryotic and Eukaryotic cell iv) Plant cell wall- structure and functions	**04**
1.2 Cell organelles and cell membrane	**i)** Ultrastructure and functions of a) Chloroplasts b) Mitochondria c) Ribosomes d) Endoplasmic reticulum e) Lysosomes f) Peroxisomes **ii) Cell membrane-** Structure, Fluid Mosaic model, role of cell membrane	**09**
1.3 Cell division	i) Cell cycle and its importants. ii) **Mitosis-** Introduction, definition, stages and Significance iii) **Meiosis-** Introduction, definition, stages and Significance	**07**
	Analytical techniques	
2.1 Microscopy	i) Principles of microscopy ii) Light microscopy iii) Fluorescence microscopy iv) Electron microscopy (SEM)	**05**
2.2 Chromatography	i) Principles and applications of chromatography ii) Paper Chromatography- Ascending iii) Thin Layer Chromatography.(TLC)	**05**
Total Lectures		**30**

T: 2. LECTURE PERIODS: 2.5 PER WEEK- LECTURE HOURS; 2 PER WEEK

MARKS: 50

ULE	SUB-MODULE	TOPICS	LECTURE PERIOD
		Microbes	
	1.1 Viruses	i) Discovery, General characteristics, ii) Structure of viruses iii) Types of viruses- DNA viruses (T-Phage), RNA viruses (TMV) iv) Economic importance	06
	1.2 Bacteria	i) Discovery, General characteristics ii) Cell structure iii) Forms of bacteria iv) Nutrition, v) Reproduction- vegetative, asexual and sexual (Conjugation) vi) Economic importance	06
		Algae and Biofertilizers	
	2.1 Algae	i) General outline of plant kingdom (Cryptogams and Phanerogams), ii) General characteristics of algae Classification (as per G. M. Smith, 1955) up to classes iii) Economic importance iv) Life cycle (excluding developmental stages of sex organs) of the following types- **a) Cyanophyceae**: *Nostoc* **b) Chlorophyceae**: *Spirogyra*	09
	2.2 Biofertilizers	i) Introduction, Microbes used as Biofertilizers, ii) Study of following Biofertilizers with respect to characters, association and uses of **a)Bacteria:***Rhizobium* **b) Blue-green algae:** *Nostoc* **c) Fungi:** *Trichoderma* **c) Pteridophytes:** *Azolla*	09

A++

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(2021)

Revised Syllabus For

B. Sc. I Botany

(Faculty of Science & Technology)

Paper –I, II - (Semester- I)

and

Paper -III, IV - (Semester-II)

(NEP-2020) Syllabus to be implemented from August 2022 onwards.

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SEMESTER-IV

Botany Paper VII: DSC D13: PLANT ECOLOGY AND ECONOMIC BOTANY

CREDITS: 2, LECTURE PERIOD: 3 PER WEEK

LECTURE HOURS: 3 PER WEEK, MARKS: 50

Module	Sub-Module	Topics	Lecture Period
1	**PLANT ECOLOGY**		15
	1a. Introduction to Plant Ecology	1.1 Basic Concept, Levels of organization 1.2 Concept and Types of ecosystems: a. Terrestrial-Grassland b. Aquatic-Lake 1.3 Trophic organization, Food Chains and Webs and Ecological pyramids 1.4 Phytogeography: Principles, Phytogeographical regions of India (Chattarjee, 1962)	9
	1b. Abiotic factors: Soil and Water	1.5 Soil: Importance, Origin, Formation, Composition and Soil profile. 1.6 Water: Introduction and importance, States of water in the soil and environment, Water Table; plant indicators of water table.	6
2	**ECONOMIC BOTANY**		15
	2a. Origin of Cultivated Plants	2.1 Concept of Centers of Origin, their importance with reference to Vavilov's work, 2.2 Importance of Germplasm diversity- Seed bank; Contribution of Padmashree Rahibai Soma Popere (Bijmata)	4
F	2b. Utilization of plants	2.3 Botanical name, Origin (Native place), Morphology, Plant parts used and Economic importance of a. Millets: Finger millet b. Spices: Clove c. Condiment: Bay leaf (Tamalpatra) d. Beverages: Coffee e. Oil yielding: Soybean f. Medicinal: Neem g. Dyes: Heena h. Cosmetics: *Aloe* i. Timber: Teak j. Fibers: Cotton k. Rubber: Rubber fig	11

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		2.7 Secondary structure (Normal) of root and stem (Dicot and Monocot)	

SEMESTER-III

Botany Paper VI: DSC C14: GENETICS AND MOLECULAR BIOLOGY
CREDITS: 2, LECTURE PERIOD: 3 PER WEEK
LECTURE HOURS: 3 PER WEEK, MARKS: 50

UNIT	SUBUNIT	TOPIC	LECTURE PERIOD
1.	GENETICS		15
	1a. Mendelian inheritance	1.1 Introduction and terminologies 1.2 Principles of inheritance-Mendel's Laws 1.3 Chromosome theory of inheritance 1.4 Linkage: Introduction, types and significance 1.5 Crossing over : Introduction and significance	8
	1b. Variation in Chromosome Number and Structure	1.6 Structure of chromosome and types of chromosome based on position of centromere 1.7 Structural variations: Deletion, Duplication, Inversion and Translocation 1.8 Numerical variations: Euploidy and Aneuploidy	7
2.	MOLECULAR BIOLOGY		15
	2a. Nucleic Acids: Carriers of Genetic Information	2.1 Nucleic acids – DNA and RNA a. DNA structure: Watson and Crick's Model, Forms of DNA – A, B, Z. b. RNA structure, Types- mRNA, tRNA and rRNA c. Significance of nucleic acids 2.2 DNA as a genetic material: Griffith's experiment.	9
	2b. DNA Replication	2.3 Concept of Central Dogma of molecular biology 2.4 DNA replication and Enzymes involved 2.5 Concept of genetic code	6

SEMESTER-III

Botany Paper V: DSC C13: PLANT SYSTEMATICS AND ANATOMY

CREDITS: 2, LECTURE PERIOD: 3 PER WEEK

LECTURE HOURS: 3 PER WEEK, MARKS: 50

UNIT	SUBUNIT	TOPIC	LECTURE PERIOD
1.	**PLANT SYSTEMATICS**		15
	1a. Plant systematics	1.1 Introduction to systematics, Functions of Taxonomy: Plant Identification, Classification, Nomenclature. 1.2 Principle and Rules of ICN 1.3 Morphology of flowering plants: a. Root: Definition, Types and Modifications (Conical, Fusiform, Napiform, Prop, Pneumatophore) b. Stem: Definition and Modifications (Phylloclade, Rhizome, Corm, Tuber) c. Leaf: Definition and (Simple and Compound, Phyllotaxy) d. Flower: Definition, Typical flower and Types (Actinomorphic, Zygomorphic) e. Inflorescence: Definition and Types f. Fruits: Definition and types 1.4 Bentham and Hooker's Classification (outline up to subclasses mentioning the numbers of series, orders), Merits and demerits.	13
	1b. Herbaria and Botanic gardens	1.5 Herbaria: Introduction and functions, examples with salient features: a. 'CAL' b. 'K' (Virtual herbarium) 1.6 Botanic gardens: Introduction and functions, example with salient features: Lead Botanic Garden (SUK)	2
2.	**PLANT ANATOMY**		15
	2a. Structure and development of plant body	2.1 Anatomy: Introduction to internal organization of plant body 2.2 Organization of shoot apex: Apical cell theory 2.3 Organization of root apex: Quiescent centre concept 2.4 Types of tissues: a. Meristematic tissue types based on position (Apical, intercalary and lateral) b. Permanent tissue types [Simple tissue: Parenchyma, Collenchyma, Sclerenchyma and Complex tissue: Xylem, Phloem]	9
	2b. Primary and secondary structure	2.6 Primary structure of root, stem and leaf (Dicot and Monocot)	6

SEMESTER –II

per IV: DSC-14B: **Archegoniate (Bryophytes, Pteridophytes and Gymnosperms)**

: 2. LECTURE PERIODS: 2.5 PER WEEK- LECTURE HOURS; 2 PER WEEK
MARKS: 50

SUB-MODULE	TOPICS	LECTURE PERIOD
	Archegoniate and Bryophytes	
1.1 Archegoniate	i) Introduction, ii) Diagnostic features of archegoniate iii) Transition to land habit iv) Alternation of generation	04
1.2 Bryophytes	i) General characters ii) Classification as per G.M. Smith (1955) upto classes iii) Ecological & Economic importance. iv) Morphology, Anatomyand life cycle (excluding developmental stages of sex organs) of **Anthocerotopsida**- *Anthoceros*	08
	Pteridophytes and Gymnosperms	
2.1 Pteridophytes	i) General characters ii) Classification as per G.M. Smith (1955) upto classes iii) Ecological and Economic importance iv) Morphology, anatomy (leaf and stem) and life cycle (excluding developmental stages of sex organs of a) **Lycophyta** – *Selaginella* b) Heterospory& Seed habitat	08
2.2 Gymnosperms	i) General characters ii) Classification as per Sporne (1965) upto classes iii) Ecological and Economic importance. iv) Morphology, Anatomy(leaf and stem) and life cycle (excluding developmental stages of sex organs) of **Gnetopsida** – *Gnetum* v) Connecting link between Pteridophytes and Angiosperms	10
	Total Lectures	30

Practical's of B. Sc. Part – I Botany (CBCS)

B.Sc. Part- III Botany
CREDITS: 2, LECTURE PERIOD: 3 PER WEEK , MARKS: 40+10
Paper- XI DSE –E27

Cytology and Research Techniques in Biology

Unit 1: Cell as a unit of life 10

1.1 Introduction, The Cell Theory, Prokaryotic and Eukaryotic cells,

1.2 Cell cycle and Apoptosis.

1.3 Cell division: Mitosis and Meiosis with their significance.

Unit 2: Cell Organelles 12

2.1 Nucleus: Ultra structure, Nuclear envelope, Nuclear pore complex, DNA packaging in Eukaryotes.

2.2 Mitochondria: Ultrastructure, semiautonomous body and Role.

2.3 Chloroplasts: Ultrastructure, semiautonomous body and Role.

2.4 Ribosomes: Structure and Functions of Prokaryotic and Eukaryotic ribosome.

Unit 3: Sub Cellular Structures and Cell Membrane 10

3.1. ER, Golgi body and Lysosomes: Structure and Role,

3.2 Peroxisomes and Glyoxysomes: Structure and Role.

3.3 Cell membrane: Structure, Fluid Mosaic Model, Role.

3.4Types of membranes as per permeability.

Unit 4: Research Techniques in Biology 13

4.1 Principles of microscopy, Light, Fluorescence and Electron microscopy (EM)- Scanning EM.

4.2 Colorimetry, Spectrophotometry, Micrometry, Photomicrography,

4.3 Intellectual property right (IPR) – Concept and Importance.

4.4 Patents – Objectives, Procedure and Working

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B.Sc. Part- III Botany
CREDITS: 2, LECTURE PERIOD: 3 PER WEEK , MARKS: 40+10
Paper- XDSE –E26

Microbiology, Plant Pathology and Mushroom Culture Technology

Unit 1: Microbiology 10

1.1 Micro organisms in biological world, characteristic features of different groups: Phytoplasma and Actinomycetes

1.2 Methods in Microbiology: Staining for microbes: Bacteria, Sterilization Methods. Culture Media, Pure Culture Techniques

1.3 Recombination in Bacteria: Transformation and Transduction

Unit 2: Industrial Microbiology 10

2.1 Applications of micro-organisms with reference to Synthesis of Antibiotics (Penicillin), Organic Acids (Lactic Acid), Alcohol (Ethyl Alcohol)

2.2 Bio-pesticides- Concept, Types and Significance

Unit 3: Plant Pathology 15

3.1 Classification of Plant Diseases: on the basis of Pathogens and Symptoms

3.2 Transmission of Pathogen- Air borne, Seed borne and Soil borne

3.3 Prevention and Control: Physical, Chemical and Biological Control, Role of Quarantine

3.4 Study of Plant Diseases-

i) Grassy Shoot of Sugarcane (Phytoplasma),
ii) Citrus Canker (Bacterial),
iii) Yellow Vein Mosaic of Bhendi (Viral),
iv) White Rust of Crucifers and Tikka Disease of ground nut (Fungal)

Unit 4: Mushroom Technology 10

4.1 History; Types of Mushrooms: Edible (Non poisonous) and inedible (Poisonous).

4.2 Cultivation Technology:

Pure culture: Medium, Sterilization, Preparation of spawn, Multiplication, Mushroom bed preparation, factors affecting the mushroom bed preparation and composting technology in mushroom production.

4.3 Storage: Short Term (Refrigeration), Long Term Storage (Canning, Pickles, Papads), Drying in Salt Solutions

4.4 Values of Mushroom: Nutrition - Proteins - amino acids, mineral elements nutrition - Carbohydrates, Crude fibre content - Vitamins.

SEMESTER V
B.Sc. Part- III Botany
CREDITS: 2, LECTURE PERIOD: 3 PER WEEK, MARKS: 40+10
Paper- IX DSE –E25
Genetics and Plant Breeding

Unit 1: Mendelism: 10

1.1 Introduction, Definition and Basic terminologies in genetics.

1.2 Principles of inheritance a) Law of Dominance b) Law of Segregation c) Law of independent assortment.

1.3 Gene Interaction-a) Complementary gene interaction b) Supplementary gene interaction.

Unit 2 : Linkage and Recombination 10

2.1 Linkage: Definition, Linkage group, Types, Coupling and Repulsion phase, Significance.

2.2 Recombination (Crossing over): Definition, Types , Mechanism of crossing over, Significance

2.3 Mutation – Definition, Spontaneous and Induced mutation. Types of mutagen Physical and Chemical, significance.

Unit 3: Chromosomes structure and Variation

3.1 Chromosome structure - Introduction, types (based on position of centromere) 13

3.2 Multiple allelism: Introduction, Definition, Self-incompatibility in plants

3.3 Quantitative inheritance: a) Polygene inheritance- Concept, examples- Kernel colour in wheat,
b) Population genetics- Hardy-Weinberg's law.

3.4 Maternal inheritance- Mendelian versus cytoplasmic inheritance, Plastid inheritance in *Mirabilis jalappa.*

3.5 Alternation in genetic make-up and its significance-
a) Change in chromosome structure- Deletion, Duplication, Inversion and Translocation.
b) Change in chromosome number- Euploidy and Aneuploidy.

Unit 4: Plant Breeding 12

4.1 Introduction, Definition of plant breeding.

4.2 Aims and objectives of plant breeding

4.3 Methods of plant breeding-
a) Introduction and acclimatization
b) Selection- i) Mass selection ii) Pure line selection iii) Clonal selection
c) Hybridization techniques in self and cross pollinated crops.
d) Male sterility and its significance
e) Mutation breeding- Gamma garden

SEMESTER-IV

Botany Paper VIII: DSC D14: PLANT PHYSIOLOGY, NURSERY AND GARDENING TECHNIQUES

CREDITS: 2, LECTURE PERIOD: 3 PER WEEK

LECTURE HOURS: 3 PER WEEK, MARKS: 50

Module	Sub-Module	Topics	Lecture Period
1	**PLANT PHYSIOLOGY**		15
	1a. Fundamentals of Plant Physiology and Photosynthesis	1.1 Introduction to Plant Physiology. 1.2 Photosynthesis-Introduction and significance 1.3 Photosynthetic pigments(Chlorophyll a, b, xanthophylls, carotene) and Photosystems 1.4 Mechanism of Photosynthesis- a) Light reaction: Photolysis of water, Photophosphorylation (cyclic and non-cyclic) b) Dark Reaction: C_3, C_4 and CAM pathways	8
	1b. Respiration	1.5 Respiration: Introduction and significance 1.6 Types of Respiration: Aerobic and Anaerobic 1.7 Mechanism of Aerobic respiration a) Glycolysis b) Formation of Acetyl- CoA c) TCA / Krebs cycle d) Electron transport system in mitochondria	7
2	**NURSERY AND GARDENING TECHNIQUES**		15
	2a. Nursery techniques	2.1 Nursery: Definition, objectives, types and scope 2.2 Infrastructure and planning for nursery, poly house. 2.3 Propagation practices a. Seed propagation - Planting-direct seedling and transplants. b. Vegetative propagation – cutting (Soft wood and hard wood), layering (air), grafting (Whip and Tongue) and budding ('T' and Patch).	07
	2b. Gardening Techniques	2.4 Introduction, objectives, scope and advanced gardening 2.5 Types of gardening-landscape and home gardening, Terrarium, Floating garden, Bottle garden, Hanging garden, Vertical garden. 2.6 Bonsai technique 2.7: Important gardens in India: Lalbagh (Bangalore) and Mughal Garden (New Delhi)	08

B.Sc. Part- III Botany

CREDITS: 2, 1 Hr Th per week, 1 Hr P per week, Marks- 50

Paper- XV DSE E27

Plant Biotechnology and Paleobotany

Unit 1: Plant Biotechnology 03

1.1 History, Definition, Scope and Importance (Areas of application)

1.2 Biotechnology in India

Unit 2: Recombinant DNA Technology 15

2.1 Introduction, Principles and enzymes involved in DNA technology

2.2 Cloning Vectors: a) Prokaryotic- Plasmid, Lambda phage and Cosmid

(Brief idea) b) Eukaryotic-YAC (Yeast Artificial Chromosomes)

2.3 Southern blotting and Northern blotting techniques and its applications, Molecular Probes

2.4 DNA Fingerprinting, Molecular DNA Markers (RAPD, RFLP)

2.5 PCR, DNA sequencing and Concept of Gene bank.

Unit 3: Plant Tissue Culture 15

3.1 Principles and Terminologies, Laboratory Requirement (Conditions and Instruments), Culture Media, Totipotency and Cellular Differentiation,

3.2 Micro propagation: Stages of Micro propagation- Callus formation, Root Initiation, Shoot Initiation, Primary and Secondary Hardening, Advantages and disadvantages

3.3 Embryogenesis: Protoplast culture, Cybrid

3.4 Somaclonal Variations

Unit 4: Paleobotany 12

4.1 General account, Geological time scale, process of fossilization, Types of fossils.

4.2 Study of following form genera with reference to systematic position, external morphology and affinities: a) *Lyginopteris* b) *Enigmocarpon*.

4.3 Application of paleobotany: Role of microfossil in oil and coal exploration.

B.Sc. Part- III Botany
CREDITS: 2, LECTURE PERIOD: 3 PER WEEK, MARKS: 40+10
Paper- XIV DSE –F26
Bioinformatics, Biostatistics and Economic Botany

Unit 1: Bioinformatics 14

1.1 Introduction, Aim, Scope and Branches of Bioinformatics

1.2 Biological Databases: Classification Format and Retrieval system of Biological Database, National Center for Biotechnological Information (NCBI), Basic Local Alignment Search Tool (BLAST)

1.3Protein Information Resource (PIR) - Concept, Resources, Databases and Data Retrieval

1.5 Applications of Bioinformatics- Molecular Phylogeny (Concept, Methods, Analysis and Consistency)

Unit 2: Biostatistics 11

2.1 Introduction, definition, terminology.

2.2 Collection and presentation of data: Types of data, techniques of data collection- Census method, sampling method- simple random, stratified and systematic sampling.

Classification, tabulation, graphical representation- Histogram and polygon.

2.3 Measures of central tendency and Dispersion: Arithmetic mean, Mode, Median, Range, Deviation, Mean deviation, Standard Deviation, Coefficient of Variation.

2.4 Statistical methods for testing the hypothesis') Students' T-test ii) Chi-square test.

Unit 3: Economic Botany: Cereals, Legumes and Oils 10

3.1 Origin of Cultivated Plants - Concept of centers of origin, their importance with reference to Vavilov's work.

3.2 Cereals: Origin, Botanical Name, Morphology, Sources and Economic importance of Wheat.

3.3 Legumes: Origin, Botanical Name, Morphology, Sources and Economic importance of Gram and Soybean.

3.4 Oils and Fats: Origin, Botanical Name, Morphology, Parts used and uses of Ground nut.

Unit 4: Economic Botany: Spices, Beverages and Fibers 10

4.1 Spices and Condiments - Origin, Botanical Name, Morphology, Parts used and Uses of Clove and Black pepper.

4.2 Beverages -- Origin, Botanical Name, Morphology, Parts used and uses of Tea.

4.3 Fibre yielding Plants - Origin, Botanical Name, Morphology, Parts used and uses of Cotton.

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SEMESTER- VI
B.Sc. Part- III Botany
CREDITS: 2, LECTURE PERIOD: 3 PER WEEK, MARKS: 40+10
Paper- XIII DSE –F25
Plant Biochemistry and Molecular Biology

Unit 1: Carbohydrates 12

1.1 Introduction and Classification of carbohydrates.

1.2 Structure and Properties of- a) Monosaccharides (Pentose: Ribose, Hexose: Glucose), b) Oligosaccharides (Sucrose), c) Polysaccharides (starch).

1.3 Isomerism: Types of Isomers (Structural and Stereoisomer)

1.4 Significance of carbohydrates

Unit 2 : Lipids 12

2.1 Introduction, General Structure, properties and classification of Lipids

2.2 Structure and properties of Saturated Fatty Acids (Stearic and Palmitic acid) and Unsaturated Fatty Acids (Oleic acid, Linoleic and)

2.3 Significance of Lipids

Unit 3: Proteins 11

3.1. Introduction, ructure, Properties, Characteristics and classification of Amino acids

3.2. Brief Outline of biosynthesis of Amino acid: Proline

3.3. General Structure, Classification of Protein

3.4. Protein Biosynthesis in Eukaryotes: Transcription and translation

Unit 4: Nucleic Acids 10

4.1 Introduction, Composition and Structure

4.2 DNA: Watson and Crick Model, Forms of DNA (A, B and Z)

4.3 DNA Replication in Eukaryotes

4.4 RNA: Types, structure and role of RNA's

4.5 Regulation of Gene expression- Lac Operon, Tryptophan Operon

B.Sc. Part- III Botany

CREDITS: 2, LECTURE PERIOD: 3 PER WEEK, MARKS: 40+10

Paper- XII DSE–E28

Horticulture and Gardening

Unit 1: Importance and divisions of Horticulture 5

1.1: Introduction and importance of horticulture

1.2: Divisions of Horticulture – Pomology, Olericulture, Floriculture, Landscape gardening.

Unit 2: Horticultural Produce and Management of Pest and diseases 10

2.1: Floriculture: a) Introduction, Cultivation of important cut flowers and management of important pests and diseases: Rose, Gerbera and Marigold.

b) Flower arrangements, Packing and Marketing of cut flowers.

2.2: Fruit preservation technology:

a) Physical - Drying, freezing, heat,

b) Chemical - sugar, salt, chemical preservatives.

Unit 3: Nursery 15

3.1: Definition, objectives and scope, Infrastructure for nursery

3.2: Propagation Practices: Sexual and Asexual

a) Sexual: Seed: Sowing of seed, Transplanting of seedling, Advantages and Disadvantages.

b) Vegetative: i) Cutting – Definition, Stem cutting (Hard wood stem and soft wood stem),Use of PGR's for rooting

ii) Layering –Definition, Simple layering, Air layering

iii) Grafting – Definition, Whip grafting, Approach grafting

iv) Budding: Definition, T-budding, Patch budding

c) By specialized vegetative structure – Bulbs, Corms, Tubers, Rhizomes

Unit 4: Landscape Gardening 15

4.1 Definition, scope and objectives

4.2 Indoor Garden – Indoor plants, bottle garden, dish garden, hanging basket, Bonsai, Vertical Garden

4.3 Outdoor Garden – Lawns, Preparation of lawn, lawn types, Rockery, Terrace garden, Water garden, green house and polyhouse

4.4 Important acsthetic Gardens of India: i) Mughal garden, Delhi

ii) Brindavan garden, Mysore.

Junction Transistor, Types, Construction of PNP and NPN Transistor, Configurations - CB, CE and CC, I-V characteristics of CB and CE configuration, Relation between α and β, Leakage current in CB and CE, Relation between I_C, I_B and I_E.

UNIT:3 Transistor Biasing and Thermal Stabilization: -

10

AC and DC Operating point, DC and AC load line, Need of transistor biasing and stability of Q point, Thermal instability. Biasing methods: Stability factor in potential divider biasing. Temperature compensation using single diode and two diodes. Transistor Rating and specifications forTypical transistor SL100, BC148 orBC 548.

UNIT:4Special Semiconductor Devices : -

10

Field Effect Transistor: - JFET: -Structure and operation of n-channel FET. The volt-ampere characteristics ofFET. FET parameters & Applications. MOSFETs: - Structure, operation and characteristics of MOSFETs & Applications. UJT and SCR: - Structure, operation, characteristics and Applications. TRIAC, DIAC- construction and applications.

Books for Section II

- Electronic Devices and Circuits — J.Millman& C.C. Halkias (TMH)
- Electronic Devices and Circuits — Allen Mottershead (PHI)
- A text book of Applied Electronics — R.S.Sedha (S.Chand& Company)
- Basic Electronics and Linear circuits — N.N.Bharagava, D.C.Kulshreshtha and S.C.Gupta (TMH)
- Semiconductor Approximation — Malvino
- Principles of Electronics — V.K. Mehta (New Edn.)
- Electronic Devices and Circuit Theory — R.Boylested& Louis Nashlsky.
- Electronic Devices — Floyd

B.Sc. I – Electronics

Semester II

Paper III – Basic Digital Electronics **(Total Marks 50)**

UNIT:1 Number systems: -

10

Number Systems: - Decimal, Binary,Octal, Hexadecimal number system and their inter-conversions.

1's and 2's complement of Binary Numbers, 9's and 10's complement.

Binary Arithmetic: - Addition, Subtraction, Multiplication and Division.

Binary codes: - 8421 code, Excess- 3 code, Gray code, Alphanumeric codes ASCII and EBCDIC code. The parity Bit, bar code.

UNIT 2: Logic Gates

10

Introduction to logic gates with IC's, Positive and Negative Logic.

DeMorgan's Theorems, The universality of NAND & NORgate, TTL NAND gate, Specification of TTL logic family, current sinking & current sourcing , open collector TTL, CMOS Familyand specifications, TTL-CMOS interface.

UNIT: 3 Boolean algebra: -

10

Rules and Laws of Boolean Algebra, Boolean expressions for gate networks, Simplification of Boolean expressions,Sum of product and Product of sum method by using K-maps.

UNIT:4 Arithmetic Circuit and Computer Organization: -

10

Ba[illegible] laws and rules: - Ohm's law, Kirchhoff's laws, voltage and current divider rules, power in series and parallel circuits. Mesh-analysis method and Nodal analysis method (only for dc resistive circuit)

Network Theorems: - (only for dc resistive circuit) Thevenin's Theorem, Norton Theorem, Superposition Theorem, Maximum power transfer

The[illegible] and Millman's Theorem.

Un[illegible] Principle of electrical machines

10

Ma[illegible]et Magnetism and its properties, Coulomb's law, magnetic line of force, Ele[illegible]omagnets, Right hand thumb rule, Dot and cross Convention, Magnetic field due to sol[illegible]oid. Right hand thumb rule applied to a solenoid, Principle of operation of DC ge[illegible], Fleming's right hand rule, Flemings Right rule under Various operating co[illegible]s. Magnitude of induced e.m.f. single turn alternator, Principle and operation of a [illegible]otor. Magnitude of force, Direction of rotation of motor, Back e.m.f. and its sig[illegible]ance, Armature Friction and voltage equation, Windings in DC motor, Principle of [illegible]ction motor, Torque production in induction motor, Rotor slip and rotor effi[illegible]cy.

Books for Section I

- Ba[illegible] Electronics — Bernard Grob
- Be[illegible] Electronics solid state — B.L.Theraja(S.Chand& Company)
- Te[illegible]book of Electrical technology vol- II — B.L.Theraja(S.Chand& Company)
- Bu[illegible] Electrical Engineering Vol. –II — P. S. Dhogal (Tata McGrath-Hill Pub.)
- A [illegible] book of Applied Electronics — R.S.Sedha (S.Chand& Company)
- B[illegible] Electronics and Linear circuits — N.N.Bharagava, D.C.Kulshreshtha and S.C.Gupta (TMH)
- Circuits and Networks: Analysis and synthesis. — A.Sudhakar Shyammohan (Tata McGrath-Hill Pub.)
- A course in Circuit Analysis — Soni and Gupta.
- Linear Circuits. — M.E. Valkenberg&Kinariwala.
- Electronics materials and components — Madhuri Joshi.

B. Sc. I – Electronics
SEMESTER-I
Paper II – Semiconductor Devices (Total Marks 50)

UNIT:1 Semiconductor diode: -

10

PN junction, unbiased junction, formation of depletion layer and internal potential barrier, I-V characteristics of PN junction diode. Diode application, power and current rating of diode, effect of temperature on PN junction diode. Zener diode: - Breakdown mechanism, Zener and Avalanche Break down,Zener Diode as Voltage regulator. Specification of Zener diode, point contact diode, applications, effect of temperature on Zener diode. Photo diode, Varactor diode, LED [Construction and applications of Seven segment display, LCD].

UNIT:2 BJT (Bipolar Junction Transistor): -

10

B. Sc. I – Electronics
SEMESTER-I

Paper I – Basic Electronics (Total Marks 50)

Unit: 1 Passive Circuit Elements
10

Definition of active and passive elements

Resistors: - Definition, symbol and color code method.

Types of resistors: -

Linear Resistors (Fixed): -Carbon composition, carbon ceramic, carbon film,wire wound.

Linear resistors (Variable): -Wire wound, Potentiometer, Preset.

Non-Linear resistors: - Thermistors, photo resistors and Varistors. [Specification and application]

Capacitors: - Definition, Capacitance, capacitive reactance (X_C), Energy stored in a capacitor,

Charging and discharging of a capacitor, leakage current in capacitor, stray capacitance.

Types of capacitors: -

Fixed electrostatic capacitors: -ceramic, mica, plastic and paper

[Construction of ceramic capacitor only]

Fixed electrolytic capacitors: - Aluminum and Tantalum polycarbonate polyethylene.

Variable capacitors: -Air dielectric capacitor and Trimmers.

Inductors &Transformers:

Inductors: - Definition, symbol, Inductance, Inductive reactance (X_L), Energy stored in an inductorQ-Factor.

Types of Inductors: - Air core, Iron core and ferrite core inductors.

Use of Inductors: - Filter chokes AFC & RFC and Variable inductor.

Transformers: - Principle and construction of transformer, Specification of transformer.

Types of Transformer: - Step-up, step-down transformer

Relays: - Principle, construction and working of electromagnetic relays

Types of Switches: (Explanation using Symbols)

Unit: 2 Circuit Fundamental
10

AC/DC Fundamentals:
Energy sources: - AC and DC sources, constant voltage and constant current source, and their inter-conversions, Reference direction for voltage and current.
Sources of DC voltage: Lead-Acid and Ni-Cd Battery:Construction,Chemical action, Current rating. Other DC sources (only names),Solar cell
A.C.Fundamentals:Types of AC, Important terms of AC: Cycle,Time period,Frequency, Amplitude, peak, Peak to peak value, R.M.S. value ,Phase,Phase Difference.
Electric circuit, Active and Passive elements, Bilateral and unilateral element, Linear and non Linear element, Lumped and distributed element.
Basic Voltage and Current relations for R, L and C.

UNIT:3 Network Theorems
10

B.Sc. Part- III Botany
CREDITS: 2, LECTURE PERIOD: 3 PER WEEK, MARKS: 40+10
Paper- XVI DSE –F28
Bio fertilizers and Herbal Drug Technology

Unit 1: Biofertilizers 11

1.1 Introduction, Importance, types and study of –

a) Bacterial fertilizers: *Rhizobium*, *Azotobacter*, *Azospirillum*

b) Blue green Algal:, Cyanobacteria (BGA): *Nostoc*, *Anabaena*.

c) Mycorrhizal association: VAM

d) Fungal: *Trichoderma*

1.2 Organic manures –

a) Farm Yard Manure, Green manure, Compost

b) Vermicomposting and Vermi-wash

Unit 2: Herbal Medicines 11

2.1 Definition, Importance of herbal medicines

2.2 Classification of crude drugs: Taxonomical, Morphological and Chemical

2.3 Identification, authentication, collection, processing and storage of medicinal plants.

2.4 Introduction to general methods of extraction, isolation and purification of Phyto constituents.

Unit 3: Herbal cosmetology 11

3.1 Applications of herbs in cosmetics: Shampoo (*Sapindus laurifolius, Acacia concinna*), hair dye (*Lawsonia inermis*)

3.2 Facemask (*Santalum album*), bath oil (*Rosa indica*), perfume (*Jasminum sambac*).

Unit 4: Pharmacognosy 12

4.1 Pharmacognosy: Introduction And, Definition

4.2 Medicinal uses of Tulsi, Ginger, Methi, Avala.

4.3 Adulteration of drugs of natural origin: Evaluation by morphological, Microscopic, Chemical, Physical, Chromatographical, Spectrophotometric.

4.4 Plant antioxidants: Properties of Antioxidants, Vitamins (C and E)

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2.	**Actuation Systems** **Mechanical Systems**: uses of kinetic chains, cams, linkages, ratchet and pawl, Gears, gears trains, rotational to translational motion, belt and chain drive, types of the belt, and mechanical aspects of motor selection **Electrical Systems:** mechanical switch(relays), solid state switches (diodes, thyristors and TRIAC, bipolar transistor, MOSFET's, solenoids, DC motors : brushless permanent magnet DC motor, AC motors, advantages of AC motor over DC, stepper motors (VR, PM and hybrid), stepper motor specifications,	12
3.	**Robotics - I** Definition and advantages of robotics, laws of robotics, robot: definition, applications, functions, advantages, disadvantages, types, robotics systems, basic motions of robotics, microprocessor based robotic system, robot classifications (names only), selection, control systems: non servo control and servo control, drives, comparison of drive system	08
4	**Robotics - II** Case studies : digital camera and autofocus, the engine management system, the automatic control of the water, shaft speed control , copy machine, solar tracker, satellite tracker (Block diagram and explanation of each Application)	06

Reference Books

1. Mechatronics Electronic Control Systems in Mechanical and Electrical Engineering- W Bolton Pearson Publication
2. Instrumentation, Measurements and Analysis- B.S. Nakara and K K Chaudhry (TMH)
3. A text book of Mechatronics : R. K. Rajput (S. Chand)
4. Electronic instruments and measurement techniques- W. D. Cooper and A.D.Helfrick (PHI)
5. Electronic Instruments- K.S. Kalsi (Tata Mc-Graw Hill)
6. Op-Amps and Linear circuits - Ramakant Gaikwad (PHI)
7. Operational Amplifiers and Linear ICs - Caughlin and Driscoll (PHI)
8. Operational Amplifier with Linear Integrated Circuit – W. D. Stanley (CBS Publications)

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Choice Based Credit System
B.Sc. - II (2021-22)
Semester- III Paper-VI
DSC 9D: Introduction to Microprocessor 8085
Credits: 02(Marks -50) Hours: 30 (37.5 Lectures of 48minutes)

Unit	Contents	Hours Allotted
1	**Microcomputer Organization:** Basic componants of microcomputer(CPU,Program memory,Data memory,input and output ports, idea of RAM (SDRAM,DRAM) Types of ROM Memory organization & addressing. Memory Interfacing.Memory Map.	06
2	**8085 Microprocessor Architecture:** Main features of 8085. Block diagram and Pin-out diagram of 8085. Data and address buses. Registers, ALU, Stack memory, Program counter,Flag registers	08
3	**Instruction set of 8085:** Instruction classification,Addressing modes of Instructions, Instruction set (Data transfer including stacks. Arithmetic, logical, branch, and control instructions). Subroutines, delay loops Instruction cycle in 8085 with example MVI instruction, concept of machine cycle and T-states	08
4	**8085 Programming :** Programs for:Addition,Substraction,Multiplication,Division,Block transfer. Subroutines, delay loops using single register and register pair. Program for 1's and 2's complement, masking of higher and lower nibbles.	08

Reference Books:

- Microprocessor Architecture Programming & applications with 8085, 2002, R.S. Gaonkar, Prentice Hall.
- Embedded Systems: Architecture, Programming & Design, Raj Kamal, 2008, Tata McGraw Hill
- Microprocessor and Microcontrollers, N. Senthil Kumar, 2010, Oxford University Press

Choice Based Credit System
B.Sc. - II (2013-24)
Semester- III Paper- V
DSC 9C: Electronic Communication System
Credits: 02 (Marks -50) Hours: 30 (37.5 Lectures of 48 minutes)

Unit	Contents	Hours Allotted
1	**Electronic Communication:** Introduction to communication- means and modes. Block diagram of an electronic communication system. Brief idea of frequency allocation for radio communication system in India (TRAI). Electromagnetic communication spectrum, band designations and usage. Channels and base band signals, concept of Noise, signal-to-noise (S/N) ratio. Concept of antenna and its working principal.	08
2	**Analog Modulation-Demodulation:** Need for modulation, Amplitude Modulation (AM) modulation index and frequency spectrum. Generation of AM (using Transistor), Concept of DSB & SSB and generation. Amplitude Demodulation (diode detector).	10
3	**Frequency Modulation:** Frequency Modulation (FM) and Phase Modulation (PM), modulation index and frequency spectrum, equivalence between FM and PM. Generation of FM using VCO, FM detector (Slope detector) and Block diagram and working of FM Super heterodyne radio receiver..	10
4.	**Introduction to Communication and Navigation System:** **Satellite communication** Introduction, Need, Geosynchronous satellite orbits, geostationary satellite, advantages of geostationary satellite. Satellite visibility, transponders (C- Band), path loss, ground station, simplified block diagram of earth station. Uplink and down link frequency.	10

Reference Books:

- Electronic Communications, D. Roddy and J. Coolen, Pearson Education India.
- Advanced Electronics Communication Systems- Tomasi, 6th edition, Prentice Hall.
- Electronic Communication systems, G. Kennedy, 3rd Edn., 1999, Tata McGraw Hill.
- Principles of Electronic communication systems – Frenzel, 3rd edition, McGraw Hill
- Wireless communications, Andrea Goldsmith, 2015, Cambridge University Press

Ex-OR gate and Controlled invertors, half adder, Full adder, Parallel binary adder, BCD Adder, Excess 3 adder, half and full sub tractor.
Computer I/O devices, Key board, Monitor, Types of Printers, Computer Specification(Mention only Processor,speed,size of HDD,Size of memory)

Reference books:

- Digital Fundamentals — Floyd.
- Digital Principles and Applications — A.P.Malvino&D.P.Leach(TMH).
- Modern digital Electronics (2nd Edn.) — R.P.Jain.
- Fundamentals of Computer — V.Rajaraman.

B.Sc. I – Electronics
Semester II
Paper-IV Electronic Circuits (Total Marks 50)

UNIT 1 10

Half wave, full wave, bridge rectifiers and their performance parameters, study of filters. Concept of dual power supply.

UNIT 2 10

Transistor as an amplifier, classification of amplifiers as CE, CB and CC.
Multistage amplifier:Different coupling schemes: RC coupling,transformer coupling,direct coupling
Concept of differential amplifier.

UNIT 3 10

Power Amplifiers:Class – A, B and C amplifiers, Class B Push-pull amplifier. Complementary symmetry push – pull amplifier. Types of distortions in power amplifiers.

UNIT 4 10

Feedback circuit and Oscillators: Theory of feedback circuit. Effects of negative feedback. Analysis of current series feedback and voltage series feedback.
Oscillators:Barkhausen's criterion, RC oscillators: phase – shift oscillator, Wien Bridge oscillator.
LC oscillators: Hartley oscillator, Colpitt's oscillator.Crystal oscillator.

Reference Books:

1. A Text Book of Applied Electronics By R. S. Sedha (S. Chand & Co)
2. Electronics Devices &Circuit : An Introduction By Allen Mottershead (PHI)
3. Electronics Devices & circuit By Jacob Millman& Christos, C. Halkias(TMH)
4. Principal of Electronics By V. K. Mehta
5. Electronics Design From concept to reality By Martin S. Roden Gordon L. Carpenter William R. Wicserman Fourth Edition SPD (Shroff Publishing and Distributors pvt.l.td.Colcata)

Practical for B.Sc. Part-I(Electronics)

GROUP A

1. Study of Components:

Shivaji University, Kolhapur
B.Sc. Part- III Electronics
Choice Based Credit System (June 2020 Onwards)
Semester- VI Paper- XVI
DSE-

F20: Industrial Automation and PLC Programming

Credits: 02 (Marks: 40 +10); 03 Lectures per week (Total 45 Lectures of 48 minutes) Hours: 36

Course Outcomes	
After successful completion of this course, the students will be able to :	
CO1	Understand basics of control system.
CO2	Understand components of control system.
CO3	Understand programming logic controller (PLC) basics.
CO4	Understand ladder programming basics.

Unit	Contents	Hours Allotted
1.	**Introduction to Control System** Basic building of automation systems, open loop control system, closed loop control system, control system terminology, manually controlled closed loop systems, automatic controlled closed loop systems, comparison closed-loop system and open-loop control, feed-forward control,cascade control, ratio control system, adaptive control system, classification of control system: **Discrete Control System**: ON-OFF controller, multi-position control systems, PWM control **continuous control systems**: proportional control, PI controller, PD controller and PID control.	06
2.	**Components of Control System** Op-amp as a zero-crossing detector, non-inverting comparator, inverting comparator, Two position control using op-amp, proportional controller, integral controller using Op-amp, derivative controller, PI controller, PID controller. **Basic components:** fuse, pushbutton, selector switches, limit switches, indicators, relay, time delay relays,proximity sensors inductive, hall effect and optical, optical and magnetic encoders.**Final controlling elements:** pneumatic actuation, pneumatic cylinders, single actuating cylinders, double actuating cylinders, double rod cylinders, Tenden cylinders, multi-position cylinders, rotary cylinders, telescope cylinders. **Electric actuation:**relay, reed relay, solenoid, Thyristor, Triac, DC motor, AC motor, servo motors, stepper motor, control valves.	12
3.	**Introduction to PLC** Programmable logic controller (PLC) basics: Definition, overview of PLC systems, block diagram of PLC, input/output modules, power supplies, isolators, features like scan time, system scale, user interface. Modular PLC and Redundant PLC and Applications, **communication protocols:** RS485, Profibus, Modbus, HART protocol, EtherCAT. PLC installation and panel	10

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3.	**Facilities in PIC18 Part-I** Programming timers 0: T0CON, PIR1 register, steps to programming (ALP/C)) timer 0 in 16 bit mode and 8-bit mode, delay calculation (Timer count calculation), comparison of T0CON, T1CON, T2CON and T3CON timers of PIC18(#314-359) ADC programming in the PIC18: features of ADC, programming, ADCON0, ADCON1 register, conversion time, steps for programming (ALP/C) the ADC using polling, (#483-492), use of PIC as a digital thermometer(Display on LED).	09
4.	**Facilities in PIC18 Part-II** PIC18 serial communication: serial port programming, SPBRG, TXREG, RCREG, TXSTA, RCSTA register, Interfacing MAX232 to PIC18, programming(ALP/C) PIC18 to transfer and receive data serially, importance of TXIF and RCIF flag, quadrupling baud rate (#375-387) PIC18 Interrupts: Interrupt vector table in PIC18, sources of interrupts, INTCON register, interrupts enabling, programming(ALP/C)of external hardware interrupts,setting interrupt priority(#402-406,417-422,427-428,432-434).	09

Reference Books

1. Muhammad Ali Mazadi et al. *"PIC microcontroller and Embedded Systems using assembly and C for PIC 18,"* Pearson Education publication,1st Edition, Fourth Impression 2011(Indian Edition).
2. PIC micro 18C MCU reference manual, ww1.microchip.com/downloads/en/DeviceDoc/39500a.pdf
3. PIC18FXX8 data sheet , ww1.microchip.com/downloads/en/devicedoc/41159d.pdf
4. Peatman, John B. Design with PIC microcontrollers. Simon & Schuster Trade, 1997.

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Reference Books

1. Optical Fiber Communication – G. Keiser - MGH
2. Fundamentals of Optics – Jenkins & White - MGH
3. Optical Fiber Communication – J.M. Senior - PHI
4. Optical Communication – Gagliardi & Karp - Wiley
5. Semiconductor Optoelectronics Devices-Bhattacharya &Pallab - Pearson Education
6. Optoelectronics an Introduction to Materials and Devices - Singh, &Jasprit - McGraw-Hill
7. Fiber Optics & Optoelectronics - Khare, R.P. - Oxford Univ. Press
8. Text Book of Optical Fiber Communication & Its Applications- Gupta & S.C. Pren

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Shivaji University, Kolhapur
B.Sc. Part- III Electronics
Choice Based Credit System (June 2020 Onwards)
Semester- VI Paper- XV
DSE-F19: Advanced Microcontroller: PIC S.m
Credits: 02 (Marks: 40 +10); 03 Lectures per week (Total 45 Lectures of 48 minutes) Hours: 36

Course Outcomes After successful completion of this course, the students will be able to :	
CO1	Understand basics if PIC families.
CO2	Understand instruction set and programming of PIC18.
CO3	Understand facilities in PIC18.
CO4	Understand serial communication, interfacing and different type of interrupts in PIC18.

Unit	Contents	Hours Allotted
1.	**Introduction** Comparison of PIC12XX, PIC16XX, PIC18XX, PIC24XX and PIC32XX PIC families, WREG register (#18), PIC file register, SFRs, GPR, GP RAM vs EEPROM, File register and access bank in the PIC18(#21-25), PIC status register (#35-36), Pindiagram (18F458) (S 2, 10-15), Minimum connection (Clock and reset circuit) (#280), uses of Configuration register and LIST directive(#282-292), stack and stack pointer in PIC18(#88-90), ROM width in the PIC18(#55-56),bank switching (#197-203),pipelining, instruction cycle time, branch penalty, loop inside a loop delay(#95-102).	09
2.	**Instruction set and programming of PIC18** Instruction set (#660-697), Addressing modes, I/O ports programming, I/O bit manipulation programming, program for square wave generation at port pin and port, reading and monitoring single bit (#109-129), BCD to ASCII, ASCII to BCD conversion(#162 to 164).	09

Shivaji University, Kolhapur
B.Sc. Part- III Electronics
Choice Based Credit System (June 2020 Onwards)
Semester- VI Paper- XIV
DSE- F18: Optoelectronics and IoT

Credits: 02 (Marks: 40 +10); 03 Lectures per week (Total 45 Lectures of 48 minutes) Hours: 36

Course Outcomes	
After successful completion of this course, the students will be able to	
CO1	Understand working of LASER diode, LED, Photodiodes, and Phototransistors.
CO2	Understand OFC communication and construction - working of different types of fibers.
CO3	Understand different types of losses in optical fibers.
CO4	Understand the concept, working and applications of IoT.

Unit	Contents	Hours Allotted
1.	**Photonic Devices** Optical Sources: LASER, Basic concepts of laser, Optical emission from semiconductors, Semiconductor Injection Laser (ILD), Injection laser characteristics. LED: power and efficiency, LED structures, LED characteristics. Optical detectors: p-n photodiodes, p-i-n photodiodes, Avalanche photodiodes, Phototransistor. Optical receiver: Receiver operation, digital receiver performance and noise.	09
2.	**Optical Communication** Principle of optical communication, total internal reflection, optical fiber modes and configuration, step index & graded index fiber, single mode fiber, fiber materials, basic structure of optical fiber. Optical Fiber Communication system, transmission link, fiber optic transmitter and receiver, advantages and applications of optical fiber communication.	09
3.	**Characters of Optical Fibers** Signal degradation in optical fiber, attenuation, intrinsic & extrinsic absorption losses, scattering losses, bending losses and joint loss linear & nonlinear scattering losses, distortion in optical wave guide, fiber to fiber joints, fiber splicing technique, fiber connectors.	08
4.	**Introduction to IoT** Basics of internet of things (IoT), Technological trends in IoT, impact of IoT on society, review of various IoT applications domain, agriculture, healthcare, manufacturing, device, smart cities management and vehicle to vehicle communication, wearable computing devices, Introduction to architectural layers of IoT, IoT smart devices, IoT components and technologies to secure systems and devices. IoT based smart home and Nano-grid monitoring system. Google assistance IoT.	10

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Shivaji University, Kolhapur
B.Sc. Part- III Electronics
Choice Based Credit System (June 2020 Onwards)
Semester- V Paper- IX
DSE-E17: Electronics Instrumentation-I and Mechatronics
Credits: 02 (Marks: 40 +10); 03 Lectures per week (Total 45 Lectures of 48 minutes) Hours: 36

Course Outcomes After successful completion of this course, the students will be able to :	
CO1	Understand the basics, advantages, disadvantages and applications of mechatronics.
CO2	Understand construction, working and applications of different types of transducers.
CO3	Understand different types of applications of Op-amp.
CO4	Understand basics of first order active filters.

Unit	Contents	Hours Allotted
1.	**Introduction** Mechatronics System: definition, advantages, disadvantages, features, applications, role of engineering discipline in mechatronics, components of mechatronics, design process (stages, modeling systems, traditional and mechatronics design), Performance terminology, Static Characteristics, Errors in measurement, Types of Errors, Sources of errors, Dynamic Characteristics and Response , Standard and International Standards,	09
2.	**Sensors and Transducers** Classification of sensors, basic requirement/characteristics of electric sensors, smart sensors, potentiometer sensor, capacitive element, pressure sensors (strain gauge, piezoelectric), LVDT(Linear Variable Differential Transformer), eddy current proximity sensor, optical encoders, pneumatic sensors, proximity switches, hall effect sensors, load cell (force sensor), pyroelectric sensor, IR and PIR sensors, temperature sensors (Bimetallic strips, RTD, Thermocouple, thermistor, IC sensor LM35), light sensors (photodiode & photovoltaic sensor)	09
3.	**Signal Conditioning -I** Introduction, Op-Amp applications: log amplifier, antilog amplifier, Schmitt Trigger, peak detector, sample and hold circuit, precision rectifier, clipping and clamping circuit, V to I and I to V converter, voltage follower, Instrumentation Amplifier, Strain Gauge, Bridge Amplifier	09
4.	**Signal Conditioning -II** Advantages of active filter over passive filter, types of active filter, design of first order low pass, band stop filter and band pass filter, block diagram of PLL, PLL applications (frequency multiplier, frequency synthesizer and FM), Grounding, Shielding and Isolation Techniques. Data Acquisition System (computer with plug in board, data Loggers)	09

Choice Based Credit System
B.Sc. - II (2023-24)
Semester- IV Paper- VIII
BSC-IID: 8051 Microcontroller and Embedded System
Credits: 02(Marks -50) Hours: 30 (37.5 Lectures of 48 minutes)

Unit	Contents	Hours Allotted
1	**Introduction to 8051Microcontroller:** Architecture of embedded system, Difference between microprocessor and microcontroller, overview of MCS51 family (89C51, 89C52, 89C2051, 8751, DS5000). Pin diagram of 8051 microcontroller, architecture of 8051, RAM structure of 8051, SFR'S in 8051., PSW register, ROM Memory.	08
2	**Instruction Set of 8051 Microcontroller:** Addressing modes of 8051 instructions, Instruction set of 8051: data transfer, arithmetic, Logical, Jump, call, Single bit instructions,	08
3	**Facilities in 8051:** Timers in 8051, Registers involved in 8051 timers. Time delay calculations in model and mode 2, Sources of interrupts in 8051, Registers involved in 8051 interrupts, External interrupts programming, interrupts priority.	08
4	**8051 Programming:** Assembly language programming: generate square wave on port pin, Interfacing of LED and Switch, Relay, Stepper motor, seven segment display (to display message "HELP")	06

Reference Books:

- Embedded Systems: Architecture, Programming & Design, Raj Kamal, 2008, Tata McGraw Hill
- The 8051 Microcontroller and Embedded Systems Using Assembly and C, M.A. Mazidi, J.G. Mazidi, and R.D. McKinlay, 2nd Ed., 2007, Pearson Education India.
- Microprocessor and Microcontrollers, N. Senthil Kumar, 2010, Oxford Universty

Choice Based Credit System
B.Sc. - II (2023-24)
Semester- IV Paper - VIII
DSC -D9: Digital Modulation and Mobile Telephone system

Credits: 02 (Marks -50)
Teaching Scheme: 3 Lectures/ week Hours: 36 (45 Lectures of 48 minutes)

Unit	Contents	Hours Allotted
1	**Analog Pulse Modulation:** Channel capacity, Sampling theorem, Basic Principles-PAM, PWM, PPM, modulation and detection technique for PAM only, Multiplexing techniques: FDM & TDM only	08
2	**Digital Pulse Modulation:** Need for digital transmission, Pulse Code Modulation, Digital Carrier Modulation Techniques, Sampling, Quantization and Encoding. Concept of Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK), Phase Shift Keying (PSK), and Binary Phase Shift Keying (BPSK).	10
3	**Mobile Telephony System** – Basic concept of mobile communication, frequency bands used in mobile communication, concept of cell sectoring and cell splitting, SIM number, IMEI number, need for data encryption, architecture (block diagram) of mobile communication network, simplified block diagram of mobile phone handset. Concepts of GSM.	10
4	**Multiple Access Techniques & Wireless Communication:** Concepts of SDMA, CDMA, TDMA and FDMA technologies, 2G, 3G and 4G, Bluetooth, Wi-Fi, RFID & GPS navigation system concepts only (qualitative idea only)	08

Reference Books:

- Electronic Communications, D. Roddy and J. Coolen, Pearson Education India.
- Advanced Electronics Communication Systems- Tomasi, 6th edition, Prentice Hall.
- Modern Digital and Analog Communication Systems, B.P. Lathi, 4th Edition, 2011, Oxford University Press.
- Electronic Communication systems, G. Kennedy, 3rd Edn., 1999, Tata McGraw Hill.
- Principles of Electronic communication systems – Frenzel, 3rd edition, McGraw Hill
- Communication Systems, S. Haykin, 2006, Wiley India
- Electronic Communication system, Blake, Cengage, 5th edition.

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	wiring diagrams. **Advance control Algorithm:** direct digital control, Distributed control system, DCS components/block diagram, system architecture, distributed vs centralized control systems, advantages of distributed control system, SCADA, adaptive controlsystem.	
4.	**Ladder Programming Basics** General PLC programming procedures, Ladder diagrams instructions: special functions, data transfer and manipulation instructions, flow control operations, Boolean memories, data transfer operations, arithmetic and logical operations, flow control operations. Register basics, timer functions, counter functions. **Ladder Programming:** Programs for Boolean logic and flip-flops, single shot (monostable), holding contacts, counters, timers, flasher. **Application Program:** Bottle filling plant, automatic color mixing tank, timed sequencer washing machine control, automatic car parking system. Automatic traffic light controller.	08

Reference Books

1. Control System Engineering- I.J. Nagrath and M.Gopal (New Age International Publication 5th Edition 2006)
2. Feedback Control System Principles And Control System R.A.Barapate (Techmax publication 10th edition)
3. Modern Control Engineering-Katsuhiko Ogata (Prentice Hall, 2010)
4. Computer Based Industrial Control- Krishna Kant (PHI Learning 2004)
5. Programmable Logic Control Programming And Applications - John R. Hackworth
6. Frederic D. Hackworth (Pearson Education India forth edition 2008)
7. 6. Introduction To Programmable Logic Controller- Gray and Dunning (2nd edition Thomson Education)

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Shivaji University, Kolhapur
B.Sc. Part- III Electronics
Choice Based Credit System (June 2020 Onwards)
Semester- V Paper- XII
DSE –E20 : Power Electronics Devices and Applications
Credits: 02 (Marks: 40 +10); 03 Lectures per week (Total 45 Lectures of 48 minutes) Hours: 36

Course Outcomes	
After successful completion of this course, the students will be able to:	
CO1	Understand construction, working and applications of semiconductor power devices.
CO2	Understand structure, characteristics operation of IGBT and thyristors.
CO3	Understand basics of uncontrolled and controlled rectifiers.
CO4	Understand applications of power devices.

Unit	Contents	Hours Allotted
1.	**Power Devices -I** Definition and application of Power electronics, Need for semiconductor power devices, **Power Diode:** Construction of the diode (drift layer), conductivity modulation, I-V characteristics, Reverse recovery effect (analysis), types of diode, series and parallel connection of diode. **Power Transistors**: Structure, operation, effect of drift layer.Switching characteristics, specifications, Base drive circuits. **Power MOSFET:** MOSFET structure, characteristics, operation and drive circuits.	09
2.	**Power Devices -II** **IGBT:** Structure, characteristics, Operation and drive circuits, Comparison of power transistor, MOSFET and IGBT (Insulated-Gate Bipolar Transistor). **Thyristors :** Structure, I-V Characteristics, two transistor analogy, Turn ON and turn Off process, Thyristor rating, concept of di/dt and dv/dt, TRIAC, different modes of operation, rating, MOS controlled Thyristors.	09
3	**Power Circuits** **Uncontrolled rectifier**:Basic and three phase supply, phase and line voltage waveforms, three phase half wave rectifier with resistive load, analysis with resistive load, three phase full wave rectifier with resistive and large inductive load, Three phase bridge rectifier with resistiveload, analysis with resistive load. Comparison of HWR, FWR, and FWBR. **Control Rectifiers:** Concept of firing angle, Half convertor with resistive load. Use of freewheeling diode, semi-converter with resistive load. Full converter with resistiveload(Analysis of all these circuits with resistive load only)	12
4	**Applications of Power Devices** Principle of ON/OFF control, Singlephase bidirectional controller with resistive load. (Analysis of these circuits). SMPS, UPS, Electronic Ballast, Power factor correction. Principle of induction and dielectric heating.	06

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Unit	Contents	Hours Allotted
1.	**Interrupts Programming in 8051** Interrupts vs polling, Sources of interrupts, vector table, enabling and disabling, TCON and IE registers, interrupt priority IP register, programming external interrupts (Level and edge triggering), programming serial communication interrupts (Mode1) and timer interrupts (mode1) (Use ALP and C during programming)	06
2.	**Real World Interfacing of 8051** Interfacing Relay, solenoid switch, opto-coupler, thumb wheel switch and seven segment display, seven segment (multiplexing mode), DAC0808 and ADC0804. Speed Control of DC motor by PWM technique, TRIAC drive circuit (Use ALP/C during programming)	10
3.	**Applications of 8051** Digital Voltmeter, Water level controller, Traffic Light controller, speed measurement of motor, Gate Emulator (Logic Gate study using microcontroller), Temperature measurement using LM35, ADC0804 & LCD, automatic basin control (using IR and solenoid switch), motion detection system using PIR sensor, Automatic Street light control System (Use ALP/C during programming)	10
4	**Modern Microcontroller Features and Development Tools** Features: Watch Dog Timer (WDT), Brownout detector, I^2C bus, SPI bus, analog comparator, low power devices, RTC, current sink and source capability, sleep mode, LCD and motor drivers, CAN and ZigBee interface. Architectures: Harvard vs.Von Neumann architecture, CISC and RISC, Software development tools: text editor, assembler/compiler, simulator, IDEs, high level language simulator. Hardware development tools: development boards, device programmer, in-circuit debugger, in-circuit emulators	10

Reference Books:

1. The 8051 Microcontroller -K. J. Ayala, (Penram International)
2. The 8051 Microcontroller and Embedded Systems, M. A. Mazadi,J. G. Mazadi, Pearson Education, Asia
3. Advanced PIC microcontroller projects in C from USB to ZigBee with the PIc18F series Dogan Ibrahim, Newnes
4. *PIC microcontroller and Embedded Systems using assembly and C for PIC 18*,Muhammad Ali Mazadi et al. Pearson Education publication,1st Edition, Fourth Impression 2011(Indian Edition).
5. C and the 8051: Programming and Multitasking, Schultz, P T R Prentice-Hall, Inc. Embedded C, Michael J. Pont,

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3.	**Radiating wire Structures** (Qualitative treatment only) Monopole, Dipole, Folded dipole, Loop antenna and Biconical broadband Antenna. Basics of Patch Antenna and its design. Examples of Patch antenna like bowtie, sectoral, fractal, etc.	06
4.	**Wave Propagation** Concepts of Propagation, frequency ranges and modes of propagations. *Ground Wave Propagation*: Characteristics, Parameters, Wave Tilt, Flat and Spherical Earth Considerations. *Sky Wave Propagation*: Formation of Ionospheric Layers and their characteristics, Mechanism of Reflection and Refraction, Critical Frequency & its expression, MUF & Skip Distance, Virtual Height. *Space Wave Propagation*: LOS & Radio Horizon, Effect of Earth's Curvature, Field Strength Calculations, Duct Propagation, and Tropospheric Scattering.	12

Reference Books:

1. Antenna and Wave propogation- K.D.Prasad (Pragati Prakashan, 2009)
2. Electromagnetic waves and radiating sytems- Jordan and Balmian (PHI)
3. Microwave Devices and Cricuits - Y. Liao, (PHI)
4. Foundation of Microwave Engineering – Collin -2nd cd. McGraw Hill, 1992
5. Reich, "Microwave principles", CBS, 1996.
6. Microwave Semiconductor Devices and Their Circuit Applications- Watson (McGraw Hill)
7. Antennas- J.D.Krauss (TMH)
8. Microwave Engineering - S.Kulkarni (Umesh Publication,2009).

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Shivaji University, Kolhapur
B.Sc. Part- III Electronics
Choice Based Credit System (June 2020 Onwards)
Semester- V Paper- XI

DSE- E19 : 8051 Microcontroller Interfacing and Applications

Credits: 02 (Marks: 40 +10); 03 Lectures per week. (Total 45 Lectures of 48 minutes) Hours: 36

Course Outcomes After successful completion of this course, the students will be able to :	
CO1	Understand different types of interrupts in 8051 programming
CO2	Understand real world interfacing of 8051 microcontrollers.
CO3	Understand different applications of 8051 microcontrollers.
CO4	Understand basics of modern microcontrollers and their applications.

Reference Books

1. Mechatronics Electronic Control Systems in Mechanical and Electrical Engineering- Bolton Pearson Publication
2. Instrumentation, Measurements and Analysis- B.S. Nakara and K.C. Chaudhry (TMH)
3. A text book of Mechatronics : R. K. Rajput (S. Chand)
4. Electronic instruments and measurement techniques- W. D. Cooper and A.D.Helfrick (PHI)
5. Electronic Instruments- K.S. Kalsi (Tata Mc-Graw Hill)
6. Op-Amps and Linear circuits - Ramakant Gaikwad (PHI)
7. Operational Amplifiers and Linear ICs - Caughlin and Driscoll (PHI)
8. Operational Amplifier with Linear Integrated Circuit – W. D. Stanley (CBS Publications)

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Shivaji University, Kolhapur
B.Sc. Part- III Electronics
Choice Based Credit System (June 2020 Onwards)
Semester- V Paper- X
DSE-E18: Antenna and Wave Propagation
Credits: 02 (Marks: 40 +10); 03 Lectures Per Week (Total 45 Lectures of 48 minutes) Hours: 36

Course Outcomes After successful completion of this course, the students will be able to :	
CO1	Understand basic antenna parameters.
CO2	Understand construction and working of HF, VHF, UHF and Microwave antennas.
CO3	Understand construction and working of monopole, dipole and patch antennas.
CO4	Understand different modes of propagation of radio waves, critical frequency, skip distance, virtual height etc.

Unit	Contents	Hours Allotted
1.	**Antenna Basics** Introduction, Radiation Mechanism, Antenna Parameters-Radiation Patterns, Main Lobe and Side Lobes, Beam widths, Beam Area, Radiation Intensity, Beam Efficiency, Directivity, Gain, Impedance, Antenna Apertures, Aperture Efficiency, Effective Height.	06
2.	**Antenna Types** **HF, VHF & UHF ANTENNAS**: Traveling wave radiators–basic concepts, Long wire antennas, V-antennas, Rhombic Antennas and Design Relations, Small Loop antennas-, Helical Antennas, Yagi-Uda Arrays, Log periodic antennas. **MICROWAVE ANTENNAS:** Reflector Antennas, Flat Sheet and Corner Reflectors, Paraboloidal Reflectors, Cassegrain Feeds. Slot antennas, Microstrip antennas, Horn antennas, Lens antennas (Qualitative treatment only)	12

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Unit – 2 Entity Relationship and Enhanced ER Modeling **(15 hrs.)**

Entity : Entities: Domain, Attributes, Tuples, Relations,Entity Relationships: one-one, one-many, many-one, many-many, SQL-99: Schema Definition, Constraints: Domain Integrity, Entity, Referential, And Concept of Object modeling.

Reference Books:

(For Unit-1 and Unit-2)

1. "C Programming in an Open Source Paradigm: A Hands on approach", K.S.Oza, S.R.Patil, R.K.Kamat River Publisher Series in Information Science and Technology, Netherland 978-87-93237-67-4 , 2015
2. ANSI C – E. Balgurusamy
3. Let us C – Y.C. Kanetkar
4. 'C' programming – Dennis Ritchie
5. Programming in 'C' - Venugopal

(For Unit-3 and Unit-4)

1. R. Elmasri, S.B. Navathe, Fundamentals of Database Systems 6th Edition, Pearson Education, 2010.
2. R. Ramakrishanan, J. Gehrke, Database Management Systems 3rd Edition, McGraw-Hill, 2002.
3. A. Silberschatz, H.F. Korth, S. Sudarshan, Database System Concepts 6th Edition, McGraw Hill, 2010.
4. R. Elmasri, S.B. Navathe Database Systems Models, Languages, Design and application Programming, 6th Edition, Pearson Education,2013.

B. Sc. Part – I Semester – I

COMPUTER SCIENCE

DSC-11A : PROBLEM SOLVING USING COMPUTERS

Theory: 30 hrs. (37 lectures of 48 minutes)

Marks-50 (Credits: 02)

Unit – 1 Problem Solving Using Computers (15 hrs.)

(A) Planning the Computer Program: Concept of problem solving, Problem definition, Program design, Debugging, Types of errors in programming, Documentation.

(B) Logical Continuum of Program of Programming : Linux Operating System and C Language, Introduction to GCC Compiler, Components of Compilation Process, Getting Used to the Data Types , Built-In Standard Library, Nitty-Gritty of Programming, structures, Algorithm, Pseudocode, Procedure, Program, C Program Structure, Vi Editor, Whittling the First 'C' Program, Checking Whether the Compiler Is Working, Execution of Make file, Variable Declaration , Input / Output Statement, Format Specifiers, Escape Sequences.

Unit – 2 Control Structures and Arrays (15 hrs.)

(A) Decision Making and Looping Constructs: Introduction, The if Statement, The if-else Statement, Nested if-else, The Switch Case Statement, The while Loop, The odd Loop(do while), the for Loop, Loop Control Statements, Infinite Loop.

(B) Arrays: Features, Definition, Types of Arrays, Single-Dimensional Array, Two-Dimensional Array, Multi-Dimensional Array.

DSC-12A Database Management System

Theory: 30 hrs. (37 lectures of 48 minutes)

Marks-50 (Credits: 02)

Unit – 1 Introduction to Database Management Systems (15 hrs.)

Characteristics of database approach. Data models: Hierarchical, Network, Relational, Schema and Instances, DBMS architecture: Three Schema Architecture, Internal, Conceptual, External, Data independence: Logical, Physical.

SHIVAJI UNIVERSITY, KOLHAPUR.

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Accredited By NAAC with 'A' Grade

CHOICE BASED CREDIT SYSTEM

Syllabus For

B.Sc. Part – I

Computer Science (Optional)

SEMESTER I AND II

(Syllabus to be implemented from June, 2018 onwards.)

Reference Books

1. Power Electronics – M.H. Rashid (PHI)
2. Power Electronics- Jamil Asghar(PHI)
3. Power Electronics-P.C. Sen
4. Power Electronics-Samir K. Datta(PHI)
5. Thyristor Engineering – M.S.Berde, Khanna Publications
6. Power Electronics Principles and Applications-S. Biswas(Dhanapat Rai Publications)
7. Power Electronics- I by J.S. Katre(Tech-Max)
8. Power Electronics- Dr. P.S. Bhimbhra (Khanna publications)
9. Power Electronics- by Jalnekar(Tecchnical Publications Pune)
10. Electronics in Industry- G.M. Chute and R.D. Chute(Mc-Graw Hill

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Shivaji University, Kolhapur
B.Sc. Part- III Electronics
Choice Based Credit System (June 2020 Onwards)
Semester- VI Paper- XIII
DSE- F17: Electronics Instrumentation-II and Robotics
Credits: 02 (Marks: 40 +10); 03 Lectures per week (Total 45 Lectures of 48 minutes) Hours: 36

Course Outcomes After successful completion of this course, the students will be able to :	
CO1	Understand construction and working of different types of modern lab instruments and meters.
CO2	Understand basics of mechanical and electrical actuation systems.
CO3	Understand basics of robotics.
CO4	Understand certain applications robots.

Unit	Contents	Hours Allotted
1.	**Data Presentation Elements** Analog and digital meters, CRO, VDU, printers, Magnetic recording, magnetic disc, optical recording, displays (LED, seven segment and LCD), instrument calibration and testing, Digital Tachometer, pH meter, spectrum analyzer (block diagram), Biomedical measurements (bioelectric potentials and blood pressure measurement), DSO, function generator basic elements, function generator using 8038	10

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Unit – 2: Introduction to PHP

2.1 Introduction PHP

- 2.1.1 Introduction and Features.
- 2.1.2 PHP basic syntax <?php...?>.
- 2.1.3 Comment(single and multiline).
- 2.1.4 Echo command, PHP script execution in web browser.
- 2.1.5 Variables: Basics, Variable naming rules, unset(), gettype(), isset(),
- 2.1.6 constants -define() and constant()
- 2.1.7 Operators: Arithmetic, Comparison, Relational, Assignment, Increment Decrement, Ternary, Other operators(., $, @, !!, ``, =>),
- 2.1.8 Strings: Single Quoted and Double Quoted, escape sequences,
- 2.1.9 Forms: HTML forms, action and get & post methods. PHP super global variable ($_GET, $_POST, $_REQUEST
- 2.1.10 Decision-Making Statements: if, if... else, if ... elseif...else, switch statement, iterative Statements: for, while, do... while, foreach, break and continue statement
- 2.1.11 Exit statements: exit, die
- 2.1.12 User-Defined Functions: Declaring functions, Function call
- 2.1.13 Arrays: Concept, Types(Numerical/List, Associative/Maps, Multidimensional), accessing array elements

2.2 Database Connection – Connection to MySQL

- 2.2.1 Establishing Connection - mysqli_connect()
- 2.2.2 Closing connection - mysqli_close()
- 2.2.3 Select a database - mysqli_select_db()
- 2.2.4 Execute MySQL commands- mysqli_query()
- 2.2.5 Fetch data from tables - mysqli_fetch_row(), mysqli_fetch_array(), mysqli_fetch_assoc()

Reference Books –

1. Web Programming – John Dean, John and Bartlett Learning
2. Internet Fundamentals & Concepts – Shubhra Garg, S.K.Kataria& Sons
3. Web Technologies HTML, JavaScript, PHP, Java, JSP, ASP.NET, XML, and AJAX Comprehensive Problem Solver, Black Book -Kogent Learning Solutions Inc, Dreamtech Press, Willey India Pvt Ltd.
4. Internet and World Wide Web How to Program – P. J. Deitel, H. M. Deitel,, Pearson
5. PHP and MySQL byDreamtech Publications
6. PHP Concepts Unleashed for Novice – Vol I - By Poornima Naik, Kavita G Evincepub Publishing
7. PHP A Beginner's Guide – Vikram Vaswami
8. Beginning PHP 6, Apache, MySQL Web Development- By Timothy Boronczy ElizabethNaramore, Jason Gerner, Yann Le Scouarnec, Zeremy Stolz, Michael K. Glass
9. PHP and MySQL by Rajendra Salokhe, Aruta Publications
10. Learning Laravel: The easiest way – Jack Vo, Lean Publishing
11. Beginning Laravel -Sanjib Sinha, Apress
12. Web application development with Laravel PHP Framework version 4 - Jamal Ahmad Metropolia

B.Sc. Part – II Computer Science (Optional) (Semester – III)
Course Code: DSC-C11 Computer Science Paper – V
Course Title: Web Technology
Total Contact Hours: 36 Hrs (45 Lectures of 48 Min.)
Teaching Scheme: Theory – 03 Lect. / Week

Credits: 02 **Total Marks: 50**

Course Outcomes:

Upon successful completion of this course, students will be able to

1. understand the principles of web design.
2. construct basic websites using HTML and Cascading Style Sheets.
3. build dynamic web pages with validation using JavaScript.
4. develop a modern web application that meets the current industry requirement.

Unit – I: Introduction to Internet, HTML, CSS and JavaScript **18 Hrs.**

1.1 Fundamentals

1.1.1 Introduction Internet.

1.1.2 WWW, Web Browsers, Web Servers.URL and URI.

1.2 Overview of different protocols

1.2.1 HTTP, SMTP, FTP.

1.3 HTML

1.3.1 Introduction,

1.3.2 Standard HTML Document Structure

1.3.3 Basic Text Formatting Elements <b>, , <i>, <s>, <emp>, <u>, <small>, <big>, <tt>.

1.3.4 Images <img>, Hypertext Links<a>, and ,Lists -Ordered and Unordered, <input> (Type – Text, Password, Button, Submit, Reset).

1.4 Cascading Style Sheets

1.4.1 Introduction

1.4.2 Types of CSS

1.4.3 Basic syntax

1.4.4 Selectors –element, id, class, group, universal.

1.4.5 Style Properties of color, font, text, size and border

1.5 Java Script

1.5.1 Introduction

1.5.2 Document Object Model

1.5.3 Variables, Datatypes and Operators

1.5.4 Control Statement – if, if-else, break

1.5.5 Looping Statements – while, for

1.5.6 Element Access in Java scripts – getElementByld() and getElementsByName()

1.5.7 Event and event handling – onClick(), onBlur(), onFocus(), onKeyPress()

1.5.8 dialog boxes – alert(), prompt(), confirm().

PRACTICAL PAPER – 1 (Maximum Marks: 50) (Credits 02)
Computer Science Practical Paper
Based on DSC-11A and DSC-11B , DSC-12A and DSC-12B .
Practical: Four lectures of 48 minutes (3.2 hrs) per week per batch.

Practical Experiments:

Based on Based on DSC-11A And DSC-11B .

1. Write a menu driven program to convert the given temperature from Fahrenheit to Celsius and vice versa depending upon user's choice.

2. WAP to calculate total marks, percentage and grade of a student. Marks obtained in each of the three subjects are to be input by the user. Assign grades according to the following criteria :

   Grade A: Percentage >=80

   Grade B: Percentage>=70 and <80

   Grade C: Percentage>=60 and <70

   Grade D: Percentage>=40 and <60

   Grade E: Percentage<40

3. Write a menu-driven program, using user-defined functions to find the area of rectangle, square, circle and triangle by accepting suitable input parameters from user.
4. WAP to display the first n terms of Fibonacci sequence.
5. WAP to print palindrome numbers between given range.
6. WAP to find sum of the following series for n terms: 1 – 2/2! + 3/3! - - - - - n/n!
7. WAP to sort given array in ascending as well as descending order.
8. WAP to calculate the sum and product of two compatible matrices.
9. WAP to check whether a given number is prime or not using nested function by introducing factorial function."P is prime number if and only if (P-1)! + 1 is divisible by P".
10. WAP to calculate factorial of given number using recursive function.
11. WAP to dynamically allocate memory of n items to an integer pointer, display their sum and average.
12. WAP to swap two numbers using function (call by reference).
13. WAP to dynamically allocate memory of n items to a character array, end it with '\0' and count number of vowels, consonants and spaces in it.
14. WAP to using user defined data type structure to store information of a student rollno, name, percentage. Create array of 10 students and display students having percentage > 70.
15. WAP to copy contain of text file into another text file.
16. WAP to count number of lines and characters of given text file.

B. Sc. Part – I Semester – II

COMPUTER SCIENCE (OPTIONAL)

DSC-11B Programming Skills Using 'C'.

Theory: 30 hrs. (37 lectures of 48 minutes)
Marks-50 (**Credits: 02**)

Unit – 1 Pointers and Functions: **(15 hrs.)**

(A)Pointers: Pointer Data Type, Pointer Declaration, Pointer Initialization, Arrays and Pointers, Pointers and One-Dimensional Arrays, Pointers and Two-Dimensional Arrays
(B)Programming for Functional Functions: Introduction, Function Declaration, Function Definition, Function Call, Nested Functions Recursion.

Unit – 2 Structures and File Handling: **(15 hrs.)**

(A)Structure and Dynamic Memory Allocation : User-Defined Data Types, Defining Structure, Nesting of Structure, Dynamic Memory Allocation,.
(B)File Handling: Defining and opening a file, File opening modes- read, write, append, closing a file, Input/Output Operations on file: getc(), putc(), getw(), putw(), fprintf(), fscanf(), ftell(), fseek(), rewind().

DSC-12B Relational Database Management System

Theory: 30 hrs. (37 lectures of 48 minutes)
Marks-50 (**Credits: 02**)

Unit – 1 Relational Data Model **(15 hrs.)**

Basic concept, Relational constraint: not null, unique, primary, foreign, check, Relational. algebra: Select, Project, Union, Intersection, Difference, SQL queries: DDL : create, alter, drop, DML : insert, update, delete, DQL : select. SQL operator: Logical, relational, in, between, like, not, is null. SQL Clauses: Where, Order by, Group by , Having. Aggregate Functions :SUM, MAX, MIN, COUNT, AVG.

Unit – 2 Database design **(15 hrs.)**

Entity Relationship (ER) : Basic Structures of Entity Relationship (ER), Symbols, Construction of ER Diagram, Example: Library Management System, EER to relational mapping: Concept of Extended Entity Relationship Diagram (EER), Specialization, Generalization, Aggregation. Functional dependencies: Key, Primary, Super Key, Candidate Key, Functional Decomposition. Normal forms : First NF (1NF), Second NF (2NF), Boyce-Codd NF (BCNF) Third NF (3NF).

B.Sc. Part – II Computer Science (Optional) (Semester – III)
Course Code: DSC-D12 Computer Science Paper – VIII
Course Title: Data Structure Using C++
Total Contact Hours: 36 Hrs (45 Lectures of 48 Min.)
Teaching Scheme: Theory – 03 Lect. / Week

Credits: 02 **Total Marks: 50**

Course Outcomes:

Upon successful completion of this course, students will be able to

1. understand the basic concepts such as Abstract Data Types, Linear and Non-Linear Data structures.
2. choose appropriate data structures to represent data items in real-world problems.
3. analyze the time and space complexities of algorithms.
4. design programs using a variety of data structures such as array, stacks, queues, and linked list.
5. analyze and implement various kinds of searching and sorting techniques.

Unit – 1: Introduction to Data Structures: Stack and Queue **18 Hrs.**

1.1 Concept of Abstract Data Types:
- 1.1.1 Definitions, Data types, Data Object, Data structure (D-Data, A-Axioms, C Operations),
- 1.1.2 Classification (Primitive, Non-Primitive: Array, Files, List: Linear, Non-Linear),
- 1.1.3 Basic Operations (Traversing, Searching, Insertion, Deletion, Sorting, Merging)

1.2 Sorting:
- 1.2.1Definition
- 1.2.2 Stable-Unstable Sorting
- 1.2.3 Adaptive-Non Adaptive Sorting
- 1.2.4 Order of Sorting (Increasing, Decreasing, Non Increasing, Non Decreasing)

1.3 Sorting Techniques: Bubble sort, Selection sort, Insertion sort, Quick sort

1.4 Searching: Linear and Binary Search

1.5 Stack:
- 1.5.1 Definition
- 1.5.2 Operations (Push, Pop, Peek, Isfull, Isempty),
- 1.5.3 Implementation using array

1.6 Applications of stack: Mathematical Expressions (Well-Parentheses, Notations: Infi Prefix, Postfix, Conversion from Infix to Postfix and Infix to Prefix)

1.7 Queue –
- 1.7.1 Definition of queue
- 1.7.2 Operations (Enqueue, Dequeue, Peek, Isfull, Isempty)
- 1.7.3 Types of queue (Linear, Circular, Priority)
- 1.7.4 Implementation Linear Queue using array(Compaction)
- 1.7.5 Applications of Queue

Unit – 2: Linked List and Trees **18 Hrs.**

2.1 Linked List:
- 2.1.1Concept of linked list
- 2.1.2 Types Of Linked List (Singly-Doubly, Linear-Circular)
- 2.1.3 Implementation of Linked list

B.Sc. Part – II Computer Science (Optional) (Semester – IV)
Course Code: DSC-D11 Computer Science Paper – XI
Course Title: Cyber Security Essentials
Total Contact Hours: 36 Hrs (45 Lectures of 48 Min.)
Teaching Scheme: Theory – 03 Lect. / Week

Credits: 02 Total Marks: 50

Course Outcomes:
Upon successful completion of this course, students will be able to

1. understand the concept of information security management.
2. learn different access control methods.
3. understand wireless network security.
4. learn cyber security laws and the importance of security audit.

Unit – 1: Computer Networks and Information Security 12 Hrs.

- **Basic Terminologies:** Network, Internet, Internet Protocols, IP Address, MAC Address, Domain Name Server (DNS), DHCP. Components of computer networks - files server, workstation. Network, devices - hub, repeater, bridge, router, gateway.
- **OSI Model, TCP/IP Model**
- **Information Security:** Network Security. Types of Network Security. Cyber Security. CIA Triad, Common Types of Attacks -Distributed denial of service (DDoS), Man in the middle, Email attacks, Password attacks, Malware attacks. DoS attack, Goals for Security, E-commerce Security, Security protocols, Computer Forensics, Security Management- Overview of Security Management, Information Classification Process, Security Policy, Risk Management, Security Procedures and Guidelines, Business Continuity and Disaster Recovery, Ethics and Best Practices.

Unit – 2: Network Security, Access Controls, Cyber Security and Cyber Laws 24 Hrs.

- **Wireless Network Security:** Components of wireless networks, Security issues in wireless, Firewall, types of firewall.
- **Access Controls:** Overview of Authentication and Authorization, Overview of Intrusion Detection Systems, Intrusion Detection Systems and Intrusion Prevention Systems.
- **Introduction to Cyber Security:** Firewalls, Intrusion Detection Systems, Response, Scanning, Security policy, Threat Management, Cyber Security Vulnerabilities and Cyber Security Safeguards Introduction to Cryptography, Network-based Intrusion detection, Intrusion prevention system, ethical hacking
- **Cyber Security:** Email security: PGP and SMIME, Web Security: web authentication, SSL and SET, Database Security.
- **Cyber Security Laws:** Cyber Crime, Security Assurance, Security Laws, Intellectual Property Rights, International Standards, Security Audit- Need, Importance.

References:

1. Computer Network -AS Tannenbum
2. Cyber Security for Beginners: Everything you need to know about it (Cyber security, Cyber war, Hacking) - Harry Colvin.
3. How NOT To Use Your Smartphone - Rodney D Cambridge.
4. Online Safety: Scams, SPAM, Viruses and Clouds (Cyber Security Community Book) - A.M. Perry.

Unit – 2: Object Oriented Programming 24 Hr

2.1 Class:
- 2.1.1 Difference between struct and class
- 2.1.2 Class specification: class declaration, class definition, adding data membersand member functions
- 2.1.3 Access modifiers/ visibility labels – private, public, protected members
- 2.1.4 Member function definition - inside the class and outside the class
- 2.1.5 Object definition and memory allocation of object
- 2.1.6 Use of this pointer
- 2.1.7 Static members - data members and member function
- 2.1.8 Scope of a variable - local, local to class, global

2.2 Friend function and friend class:
- 2.2.1 Characteristics of friend function, Declaration and Definition of friend function
- 2.2.2 Use of friend class

2.3 Constructor and Destructor:
- 2.3.1 Constructor - Definition, Characteristics, features
- 2.3.2 Types - Default, parameterized, copy
- 2.3.3 Destructor- Definition, Need of destructor

2.4 Operator overloading:
- 2.4.1 Concept, Rules
- 2.4.2 Definition of operator function:
  - 2.4.2.1 Using member function to overload unary and binary operators
    Example: unary operator --, ++ and Binary-Arithmetic Operator
  - 2.4.2.2 Using friend function to overload unary and binary operators
    Example: unary operator --, ++ and Binary-Arithmetic Operator

2.5 Inheritance:
- 2.5.1 Concept, Definition
- 2.5.2 Types: single, multilevel, multiple, hierarchical, hybrid
- 2.5.3 Defining derived class
- 2.5.4 Introducing protected members, visibility of derived members
- 2.5.5 Diamond problem with hybrid inheritance -virtual inheritance and virtual base cl

2.6 Polymorphism:
- 2.6.1 Concept, Definition
- 2.6.2 Types: Compile time/early binding/static binding and run time/ late binding / dynamic binding
- 2.6.3 Pointer to object
- 2.6.4 Virtual and pure virtual functions -abstract class, rules for virtual functions

Reference Books

1. Object - Oriented Programming in C++ by Rajesh K. Shukla - Wiley India Pvt. Ltd
2. Object Oriented Programming Using C++ by Poonam Ponde
3. Object-Oriented Programming with C++ by E Balagurusamy - McGraw Hill India
4. Mastering C++ by K. R. Venugopal - McGraw Hill Higher Education
5. C++ Programming by D. Ravichandran
6. A Tour of C++ (2nd Edition) - Bjarne Stroustrup.
7. The C++ Programming Language (4th Edition) - Bjarne Stroustrup.

B.Sc. Part – II Computer Science (Optional) (Semester – III)
Course Code: DSC-C12 Computer Science Paper –VI
Course Title: Object Oriented Programming Using C++
Total Contact Hours: 36 Hrs (45 Lectures of 48 Min.)
Teaching Scheme: Theory – 03 Lect. / Week

Credits: 02 **Total Marks: 50**

Course Outcomes:

Upon successful completion of this course, students will be able to

1. understand the principles of web design.
2. understand how C++ improves C with object oriented features
3. learn syntax and semantics of C++ programming language
4. learn how to write inline functions for efficiency and performance.
5. learn how to overload functions and operators in C++.
6. learn how to design C++ classes for code reuse.
7. learn how inheritance promotes code reuse in C++.
8. learn how inheritance and virtual functions implement dynamic binding with polymorphism.

Unit – I: Introduction to C++ **12 Hrs.**

1.1 Object oriented programming Concepts: Object, class, Encapsulation, Abstraction, Polymorphism, Inheritance

1.2 Procedure Oriented programming versus Object oriented programming

1.3 Basic C++ program:

1.3.1 Header file, using namespace std, main(), input:>> extraction using cin and output: << insertion using cout operator

1.3.2 C++ Tokens:

1.3.2.1 Keywords - bool, class, delete, namespace, friend

1.3.2.2 Identifiers, Constants, Strings

1.4 Structure of C++ Program

1.5 Benefits of C++ over C Language

1.6 C++ Data Types:

1.6.1 Built-in / Fundamental: void, char, int, float, double

1.6.2 User defined- struct, union, enum, class

1.6.3 Derived- array, function, pointer, reference

1.7 Variable:

1.7.1 Definition, Declaration, Initialisation

1.7.2 Dynamic Initialisation and reference variables

1.8 Operators in C++:

1.8.1 DMA operators: new, delete

1.8.2 Scope resolution operator::

1.8.3 Manipulators: setw, endl, setprecision

1.9 Function:

1.9.1 Function Call: by value, by pointer, by reference, return by reference

1.9.2 Default arguments, const arguments

1.9.3 Inline function

1.9.4 Function overloading

B.Sc. Part –III Computer Science Optional (Semester – V)
Course Code: BSE-22E
Computer Paper X
Course Title: C # Programming
Total Contact Hours: 36 Hrs. (45 Lectures of 48 Min.)
Teaching Scheme: Theory – 03 Lect. / Week

...s: 02
...e Outcomes:

Total Marks:40

This course will cover the practical aspects C#.NET framework. The goal of this course is to ...uce the students to the basics of OOPs and windows application program.

Unit	Content	Hours Allotted
I	**Introduction to .Net** • .NET Framework Architecture • An Overview • Components of .NET: CLR ,CLS • Microsoft Intermediate Language ("MSIL" or "IL"). • The Common Type System (CTS), Namespaces. • .NET Framework Base Classes, DLL and Exe. • An Overview of C# • History and Features of C#. • Data Types, Value and Reference Types, Boxing and • Unboxing • Properties : Set and Get • C# - Flow Control: Branching, Switching and Looping • Structure	12
II	**Object oriented Concepts** • C# Program compilation and execution • Command Line Arguments • Programming Examples using Console application , • Classes and Objects • Inheritance • Polymorphism • Abstract Classes • Sealed Classes • Partial Classes • Exception Handling	12
III	**Introduction to Windows Form Application Using C#** • IDE – (Integrated Development Environment) • Form Controls: Label, Button, Textbox, Checkbox, RadioButton, Timer, calendar, ListBox, Image and overview of remaining all common controls its properties and events	12

	• user defined packages-creating and accessing the package
III	**Multithreading, Exception Handling and Applets** • Creating threads, extending a thread class- declaring the class, run() method • Stopping and blocking threads • Life cycle of thread • Using thread method • Thread priority • Definition of exception • Syntax of exception handling code • Multiple catch statement • Using finally statement • Applets Definition • Building applet code • Applet life cycle • Adding applet code to HTML file • Introduction to Abstract Window Toolkit (AWT)

Reference Books:

1. Programming with JAVA, A Primer by E Balaguruswamy
2. Herbert Schildt, Java2: The Complete Reference, Tata McGraw-Hill
3. Java Programming- Rajendra Salokhe (Aruta Pub)
4. *The Java Tutorials: http://docs.oracle.com/javase/tutorial/)*
5. The Java Tutorials of Sun Microsystems Inc

Practical Based on DSE 21E(Lab course IV)

1. Java programs based on branching and looping statements.
2. Java programs based Type Casting
3. Java programs based on command line arguments
4. Java programs based on constructors
5. Java programs based on inheritance
6. Java programs based on method overloading
7. Java programs based on method overriding.
8. Java programs based on interfaces
9. Java programs based on packages
10. Java programs based on multithreading
11. Java programs based on exception handling
12. Java programs with applets.

B.Sc. Part –III Computer Science Optional (Semester– V)
Course Code: DSE-21E
Paper IX
Course Title: Core Java
Total Contact Hours: 36 Hrs. (45 Lectures of 48 Min.)
Teaching Scheme: Theory – 03 Lect. / Week

dits: 02

Total Marks: 40

jectives:

e objective of this course is to teach the learner how to use Object Oriented paradigm to develop code
d understand the concepts of Core Java and to cover-up with the pre-requisites of Core java.

urse Outcomes:

1.Object oriented programming concepts using Java.
2.Knowledgeof input, its processing and getting suitable output.
3.Understand, design, implement and evaluate classes and applets
4. Understand concept of Multiprogramming and Exception Handling

Unit	Content	Hours Allotted
I	**Introduction to java** • History of java • Features of Java • Comparison between C++ and java • Java Virtual Machine(JVM) • Tokens • Java Keywords • Data Types-integer(byte,short,int ,long),floating point(float, double),char, boolean • Operators-arithemetic,relational,logical,unary,ternary,bitwise • Branching and looping statement • Typecasting-Implicit and Explicit • Command line arguments • Writing simple java program • Compiling and executing Java program	12
II	**Object Oriented Programming using Java** • Introduction- Class, Object and method • staticKeywords,Constructors,and destructor • super and thisKey Word • Encapsulation and Abstraction • Inheritance- Definition and its types-single,multilevel,hierarchical • Polymorphism-Definition and concepts of overloading and overriding • Difference between Overloading and overriding • Abstract Classes and Interfaces • String- String and String Buffer class • Defining package • System Packages –java, lang, awt, javax, swing, net, io, util.	12

2.1.4 Operations on linear linked list (Insertion, Deletion, Display, Search)
2.1.5 Applichtion
2.1.5.1 Implementation of stack and queue using linked list.

2.2 Trees:
2.2.1 Definition
2.2.2 Terminologies (Root, Child, Parent, Siblings, Descendant, Ancestor, Leaf/External node, Branch node/Internal node, Degree, Edge, Path, Level, Depth, Height of node, Height of tree, Forest)

2.3 Binary Tree:
2.3.1 Definition
2.3.2 Types (Full/Proper/Plane, Complete, Perfect, Skewed, Balanced)

2.4 Binary Search Tree:
2.4.1 Definition
2.4.2 Representation
2.4.3 Operations (Insertion, Deletion, Search, Tree Traversal: Preorder, Inorder, Postorder)

Reference Books

1. Data Structures Using C and C++ by Yedidyah Langsam, Aaron M. Tenenbaum
2. Data Strucure using C++ - E Balagurusamy
3. Data Structures Through C++ by Yashavant Kanetkar
4. Data Strucure Using C++ by D. S. Malik

B.Sc. Part –III Computer Science Optional (Semester– VI)
Course Code: DSE-21F

Paper XIII

Course Title: Advanced Java
Total Contact Hours: 36 Hrs. (45 Lectures of 48 Min.)
Teaching Scheme: Theory – 03 Lect. / Week

lits: 02 Total Marks: 40
ectives:
ore advanced topic of Java programming for solving problems.
rse Outcomes:

1) The student will be able to develop distributed business applications, develop web pages Using advanced server-side programming through servlets and Java server pages.
2) Demonstrate approaches for performance and effective coding
3) To learn database programming using Java
4) To study web development concept using Servlet and JSP

Unit	Content	Hours Allotted
I	**Swing and JDBC** • Concept of swing • MVC architecture • Component of swing: JFrame,JComponent,JLable, JTextfields, JCheckbox, JPanel, JRadiobuttons, JTabbed Pane,JButton, JTree, JTable, JMenu • Difference between AWT and Swing • Introduction Java Data Base Connectivity (JDBC) • JDBC Connection Statements, ResultSet. • simple program • Executing commands and SQL queries • Updatable ResultSet • Forward Only ResultSet, • Scrollable ResultSet • PreparedStatement • Connection Modes, SavePoint.	12
II	**Servlet** • Introduction to Servlet • Hierarchy of Servlet • Life cycle of servlet • ServletConfig • ServletContext • Servlet API • packages- javax.servlet and javax.servlet.http • Servlet Communication • Handing get and post request (HTTP) • Handling a data from HTML to servlet • Retrieving a data from database to servlet	12

III	**Tuple** • Introduction • Accessing tuples • Operations • Working • Functions and Methods **Dictionaries** • Introduction • Accessing values in dictionaries • Working with dictionaries • Properties • Functions	12

Reference Books

1. Practical Programming: An introduction to Computer Science Using Python, second edition, Paul Gries, Jennifer Campbell, Jason Montojo, The Pragmatic Bookshelf.
2. Python for Informatics: Exploring Information, Charles Severance
3. Learning Python, Fourth Edition, Mark Lutz, O'Reilly publication
4. Introduction to Python for Computational Science and Engineering (A beginner's guide), Hans Fangohr
5. John V Guttag. "Introduction to Computation and Programming Using Python", Prentice Hall of India
6. R. Nageswara Rao, "Core Python Programming", Dreamtech

Prctical Based on DSE-24E

1. Python program to add two numbers
2. Python program for factorial of a number
3. Python program for simple interest
4. Python program to check if a string is palindrome or not
5. Python program to reverse words in a given string in python
6. Python program to find out ways to remove i'th character from string in python
7. Python program to check if a substring is present in a given string
8. Python program to interchange first and last elements in a list
9. Python program to swap two elements in a list
10. Python program to find out different ways to clear a list in Python
11. Python program to reversing a List
12. Python Program for Linear Search
13. Python Program for Insertion Sort
14. Python Program to demonstrated use of dictionaries by Key or Value
15. Python Program to remove a key from dictionary

B.Sc. Part –III Computer Science Optional (Semester– V)
Course Code: DSE-24E
Computer Paper XII
Course Title: Python Part I
Total Contact Hours: 36 Hrs. (45 Lectures of 48 Min.)
Teaching Scheme: Theory – 03 Lect. / Week

redits: 02

Total Marks: 40

bjective
aster the fundamentals of writing Python scripts

ourse Outcomes:
1. To understand why Python is a useful scripting language for developers
2. To learn how to write loops and decision statements in Python
3. To learn how to use lists, tuples, and dictionaries in Python programs

Unit	Contents	Hours Allotted
I	**Introduction** • History • Features • Setting up path • Working with Python • Basic Syntax • Keywords • Variable and Data Types • Operator • Input , output functions **Conditional Statements & Looping** • If • If- else • Nested if-else • For • While • Nested loops	12
II	**Control Statements** • Break • Continue • Pass **String Manipulation** • Accessing Strings • Basic Operations • String slices • Function and Methods **Lists** • Introduction • Accessing list • Operations • Working with lists • Function and Methods	12

B.Sc. Part –III Computer Science Optional (Semester– V)
CourseCode: DSE-23E
Computer Paper XI
Course Title: LINUX Part I
Total Contact Hours: 36 Hrs. (45 Lectures of 48 Min.)
Teaching Scheme: Theory – 03 Lect. / Week

Credits: 02

Total Marks:40

Course Outcomes

1. Upon completion of this course, students should have a good working knowledge of Linux.
2. Allowing them to easily use any Linux distribution.
3. This course shall help student to learn advanced subjects in computer science practically.

Unit	Contents	Hours Allotted
I	**Introduction to Linux** • History of Linux • Architecture of Linux • Operating System Services • Shell • Types of Shell • Kernel • Login, Logout • General Purpose Utilities (banner, cal, date, calendar, who, tty, uname, password, lock, echo, tput, bc, clear, script, wc, head, tail, echo, test, expr)	9
II	**File System, System Calls and Process** • Basic file system management • Files Types, Boot block, Super block, Inode table • Storage and Accessibility of files • Finding Information of commands • File and Directory Commands • File and Directory Manipulation commands • File ownership and permission • Open, Read, Write, Close • Mounting and Un-mounting File System • Process States and Transitions • Process Creation • Signal • Process Termination • Awaiting Process Termination • Invoking Other Programs • Process Management(ps, kill, background processing, no hang up, SPOOL, job scheduling using at command)	18
III	**Editors and Shell Scripting** • Types of editors • Modes of Operation	9

B.Sc. Part –III Computer Science Optional (Semester-VI) Course Code:DSE-23F

Computer Paper XV

Course Title: Linux Part II

Total Contact Hours: 36 Hrs (45 Lectures of 48 Min.)

Teaching Scheme: Theory – 03 Lect. / Week

Credits:02

Total Marks:40

Course Outcome:

1. This course covers design principles of Linux Operating System Memory management.
2. Structure of File system and virtual file system is also elaborated.
3. This course contains details of shell programming and introduces System administration.

Unit	Content	Hours Allotted
I	**Memory Management and Advanced vi** • Swapping • Demand Paging • ex Mode- handling Multiple Files • Named Buffer • Numbered Buffers • Entering control characters • Searching for a characters	9
II	**Filters and Advanced Shell Programming** • sed and sed options • grep and grep options • Line Addressing • Multiple Instruction(-E and -F) • Context Addressing • Writing Selected Lines to a File • Shell and subshell • Command Line Arguments • Exporting Shell Variables • Arrays • Shell Functions	18
III	**Networking Tools** • Introduction to TCP/IP • Network Management Tools- Firewall • The write command • The wall command • cron	9

	• Caching
III	**Database and ADO.Net** • Sql Server Database. • Data controls o Gridview o Listview o FormView o DetailsView. o Repeater • Introduction to ADO.Net o ADO.NET Architecture- Connection, command, data reader, data adapter, data set o Understanding connected layer of ADO.NET and disconnected layer of ADO.NET • Basics of Crystal reports

Reference Books:

- Beginning ASP.NET 4.5 in C# and VB, Wrox, 2012, ISBN-10: 1118311809
- Beginning ASP.NET 4.5 in C#, Apress, 2012, ISBN-10: 1430242515
- Pro C# with .NET 3.0, Andrew Troelsen, Apress, 2007, ISBN 978-1-59059-823-8

Practical Experiments based on DSE-F22:

1. Write an Asp.Net Program to print a Message on web form.
2. Write an Asp.Net Program to Create Simple Web Application using two or more web for
3. Write an Asp.Net Program to set a link for new Page.
4. Write an Asp.Net Program to demonstrate different common Control.
5. Write an Asp.Net program using while or for loop to print sum of first 100 ODD and Eve Numbers.
6. Write an Asp.Net Program to add the value of Text Box in to Dropdown List and List box Controls.
7. Write an Asp.Net Program to Delete Items from Dropdown list and List box.
8. Write an Asp.Net Program to set Image on Image Control according to selection of image from dropdown list.
9. Write an Asp.Net Program to demonstrate use of Master Page.
10. Program to demonstrate ADO.Net connected architecture.
11. Program to demonstrate ADO.Net disconnected architecture

B.Sc. Part –III Computer Science Optional (Semester–VI) CourseCode:DSE-22F

Computer Paper XIV

Course Title: ASP .NET

Total Contact Hours: 36 Hrs. (45 Lectures of 48 Min.)

Teaching Scheme: Theory – 03 Lect. / Week

Credits: 02

Total Marks:40

Course Outcomes:

This course will cover the practical aspects of multi-tier web based application development using the .NET framework. The goal of this course is to introduce the students to the basics of distributed Web application development.

Unit	Content	Hours Allotted
I	**Introduction to ASP.Net:** • Web browser, web server • HTTP request response structure • HTML form elements • GET/POST method • Client side and Server side programming. • Web form life cycle, page events, • Visual studio IDE. • **Server Controls:** Textbox, Listcontrols, FileUpload, Linkbutton, Imagemap, Image, Imagebutton, Calender, Literal control, Radiobutton, Checkbox, • Validation Controls • Navigation controls • Master Page.	14
II	**Asp.Net State Management** • Cross page postback property of button, • Response.Redirect, • Server.transfer, Response.Write, • Hiddenfield control, • View State, Cookies, Session, Application • Global.asax	10

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	• Session tracking - User Authorization, URL rewriting. Hidden form fields	
III	**Java Server Page (JSP)** • Concept of JSP • Life cycle of JSP • JSP v/s Servlet • Components of JSP: Directives, Tags • Scripting elements – Declarations, Expressions, Scriptlets, Comments • Implicit objects of JSP • Connecting to database • Simple application using JSP	12

Reference Books

1. Programming with JAVA, A Primer by E Balaguruswamy
2. Herbert Schildt, Java2: The Complete Reference, Tata McGraw-Hill
3. Java Programming- Rajendra Salokhe (Aruta Pub)
4. Java 2 Black Book –(DreamTech)
5. *The Java Tutorials: http://docs.oracle.com/javase/tutorial/)*
6. The Java Tutorials of Sun Microsystems Inc

Practical Based on DSE-21F

Practical Program List

1. Program on Swing
2. Simple program using servlet
3. Simple program using JSP
4. Program on Database Connection.
5. Develop a java application to store image in a database as well as retrieve image from databa
6. Create EMP table in Database and perform insert ,update ,and delete operation onEMP table u JSP.

β] Actinides

3.7 Position in periodic table.

3.8 Electronic configuration.

3.9 General methods of preparation of transuranic elements.

i. Neutron capture – followed by β decay.

ii. Accelerated projectile bombardment.

iii. Heavy ion bombardment.

3.10 IUPAC nomenclature of the super heavy elements with atomic number (Z) greater than 100.

Unit 4. Iron and Steel. **[07]**

4.1 Occurrence and ores of iron.

4.2 Definition of the Terms- Ore , Mineral, Slag, Flux, Gangue , Matrix, Calcinations, Reduction, Roasting, Smelting and Leaching.

4.3 Extraction of iron by Blast furnace.

4.4 Steel: Definition and types.

4.5 Conversion of cast iron into steel by

i. Bessemer process.

ii. L.D. process.

4.6 Heat treatment on steel.

Unit 5. Bio-inorganic Chemistry. **[05]**

5.1 Introduction.

5.2 Essential and trace elements in biological process.

5.3 Metalloporphyrins with special reference to hemoglobin and myoglobin.

5.4 Biological role of alkali and alkaline earth metal ions with special referenc to Na^+, K^+ and Ca^{2+}

Reference Books: (Use recent editions)

1. Concise Inorganic Chemistry (ELBS, 5th Edition) – J. D. Lee.

1.9 Kinetic Stability.

1.10 Relation between thermodynamic and kinetic stability.

1.11 Stepwise stability constant.

1.12 Factor affecting the stability of complexes.

1.13 Determination of Stability constant by Job variation, Mole ratio and Slope ratio method.

[05]

Unit 2. Nuclear Chemistry

2.1 Nuclear reactions and energetic of nuclear reactions.

2.2 Types of nuclear reactions

i. Artificial transmutation.

ii. Artificial radioactivity.

iii. Nuclear fission and its application in heavy water nuclear reactor.

iv. Nuclear fusion.

2.3 Use of Thorium, Uranium and Plutonium in atomic energy

2.4 Applications of radio-isotopes as tracers.

i. Chemical investigation – Esterification.

ii. Structural determination – Phosphorus pentachloride.

iii. Analytical Chemistry – Isotopic dilution method for determination of volume of blood.

iv. Age determination – Dating by C^{14}.

[09]

Unit 3. Chemistry of f- Block Elements

A] Lanthanides

3.1 Introduction.

3.2 Occurrence.

3.3 Electronic Configuration.

3.4 Oxidation State.

3.5 Lantahnide contraction.

3.6 Separation of Lanthanides by Ion exchange method.

B.Sc. Part III (CBCS) SEMESTER -VI
Paper No. DSE-F5, Chemistry Paper No. –XIII
(Inorganic Chemistry)
(Theory Credits: 02, 30 hours, 38 lectures)

Expected Learning Outcome

Name of the topic	Expected Learning Outcome
1.Coordination Chemistry	The topic focused on the mechanism of the reactions involved in inorganic complexes of transition metals. The students can understand the thermodynamic and kinetic aspects of metal complexes.
2.Nuclear Chemistry	The generation of nuclear power with the help of nuclear reactions is highlighted. Role of radio isotopes in medicinal, industrial and Archaeology fields is explained.
3.Chemistry of f-block Elements	The characteristics, properties and separation of lanthanides and Actinides are discussed. Synthesis and IUPAC Nomenclature of trans uranic elements (TU) explained.
4.Iron and Steel	The techniques involve in ore dressing and extraction of cast iron from its ore are discussed.
5.Bio –inorganic Chemistry	Role of various metals and non metals in our health are discussed.

Unit 1. Coordination Chemistry **[12]**

A. Inorganic Reaction mechanism

1.1 Introduction.

1.2 Classification of Mechanism: Association, dissociation, interchange and the rate determining steps.

1.3 S_N^1 and S_N^2 reactions for inert and labile complexes.

1.4 Mechanism of substitution in cobalt (III) octahedral complexes.

1.5 Trans effect and its theories.

1.6 Applications of trans effect in synthesis of Pt (II) complexes.

B. Thermodynamic and Kinetic aspects of metal complexes.

1.7 Introduction.

1.8 Thermodynamic stability.

B.Sc. Part –III Computer Science Optional (Semester–VI) CourseCode:DSE-24F
Computer Paper XVI
Course Title: Python Part II
Total Contact Hours: 36 Hrs. (45 Lectures of 48 Min.)
Teaching Scheme: Theory – 03 Lect. / Week

Credits:02

Total Marks:40

Course Outcomes:

1. To learn how to write functions and pass arguments in Python
2. To learn how to build and package Python modules for reusability
3. To learn how to use exception handling in Python applications for error handling

Unit	Content	Hours Allotted
I	**Functions** • Defining a function • Calling a function • Types of functions • Function Arguments • Anonymous functions • Global and local variables	12
II	**Modules** • Importing module • Math module • Random module • Packages • Composition **Input-Output** • Printing on screen • Reading data from keyboard • Opening and closing file • Reading and writing files • Functions	12
III	**Exception Handling** • Exception • Exception Handling • Except clause • Try , finally clause • User Defined Exceptions **Object Oriented Programming Concepts** • Class and object • Attributes • Inheritance • Overloading • Overriding • Data hiding	12

Reference Books:

1. Practical Programming: An introduction to Computer Science Using Python, second edition, Paul Gries, Jennifer Campbell, Jason Montojo, The Pragmatic Bookshelf.
2. Python for Informatics: Exploring Information, Charles Severance
3. Learning Python, Fourth Edition, Mark Lutz, O'Reilly publication
4. Introduction to Python for Computational Science and Engineering (A beginner's guide), Hans Fangohr
5. John V Guttag, "Introduction to Computation and Programming Using Python", Prentice Hall of India
6. R. Nageswara Rao, "Core Python Programming", Dreamtech

New Syllabus

Shivaji University, Kolhapur
B. Sc. Part – I Semester-I(NEP-2020)
PHYSICS PART-I
DSC A1 MECHANICS-I
Theory: 30 Hours Marks-50 (Credits: 02)

Unit-I

1. **Vector Algebra and Elementary Calculus** : (9 Hours)

Revision– (Vector Algebra: Components of Vectors and Unit Vector, Addition and Subtraction of Vectors), Scalar product, Vector product and their properties, Scalar triple product and its physical significance, Properties of scalar triple product, Vector triple product, properties of vector triple product. Derivatives of a vector with respect to a parameter (velocity and acceleration).

2. **Ordinary Differential Equations:** (6 Hours)

Differential equation, degree, order, linearity and homogeneity of differential equation, Types of Differential Equations: Ordinary and Partial differential equations, First order homogeneous differential equations, Second order homogeneous differential equations with constant coefficients, Examples.

Unit -II

1. **Conservation Theorems :** (9 Hours)

Single particle: Conservation theorem for linear momentum of a particle, Conservation theorem for angular momentum of a particle, work-energy theorem, Conservation theorem for energy of a particle.

System of particles: Center of mass, Conservation theorem for linear momentum, Conservation theorem for angular momentum, Conservation theorem for energy.

2. **Rotational Motion:** (6 Hours)

Angular velocity, Angular momentum, Torque, Kinetic energy of rotation, Moment of Inertia, Moment of inertia of a spherical shell about its diameter, Moment of inertia of solid cylinder about its axis of symmetry.

Reference Books:

1. Mathematical Physics -B. S. Rajput, 25th edition 2013, PragatiPrakashan, Meerut.
2. Mechanics – D. S. Mathur, 2009, S. Chand & Company Ltd., New Delhi.
3. Mathematical Physics – B. D. Gupta, 3rd edition, 2009, Vikas Publishing House Pvt. Ltd., New Delhi.
4. Mathematical Physics – P. P. Gupta, R. P. S. Yadav, G. S. Malik, 4th edition 1983-84, KedarNath Ram Nath, Meerut, Delhi.
5. University Physics. FW Sears, MW Zemansky and HD Young, 13/e, 1986, Addison - Wesley.
6. Mechanics Berkeley Physics course, V.1: Charles Kittel, et. Al. 2007, Tata McGraw Hill.
7. Physics – Resnick, Halliday& Walker 9/e, 2010, Wiley Eastern Ltd, New Delhi.
8. Engineering Mechanics, Basudeb Bhattacharya, 2nd edn., 2015, Oxford University Press.

iii) Magnetic character
iv) Colored ions
v) Complex formation.

Unit-5. Inorganic semi-micro qualitative analysis **(08)**

5.1 Theoretical principles involved in qualitative analysis.
5.2 Applications of solubility product and common ion effect in separation of cations into groups.
5.3 Application of complex formation in
a) Separation of II group into IIA and IIB sub-groups.
b) Separation of Copper from Cadmium.
c) Separation of Cobalt from Nickel.
d) Separation of Cl^-, Br^-, I^-.
e) Detection of NO_2^-, NO_3^- (Brown ring test).
5.4 Application of oxidation and reduction in
a) Separation of Cl^-, Br^-, I^- in mixture b) Separation of NO_2^- and NO_3^- in mixture.
5.5 Spot test analysis.

Reference Books :

1. Inorganic chemistry, Principles of structure and reactivity by J.E. Huheey and etal
2. Inorganic Chemistry by Shriver and Atkins 5th edition
3. Vogels text book of Qualitative Inorganic analysis by A. I. Vogel .3rd and 6th edition
4. Advanced Inorganic Chemistry by Agrawal Keemtilal (Pragati Prakashan)
5. Theoretical Inorganic chemistry by C.Day & J.Selbin IInd edition
6. Principles of inorganic chemistry by Puri Sharma & Kalia
7. Modern Inorganic chemistry by R.D.Madan (S.Chand)
8. Inorganic Chemistry by J.D.Lee
9. Basic Inorganic Chemistry by F.A.Cotton,G.Wilkilson & B.L.Gaus wiley
10. Chemistry for Degree students by R.L.Madan (S.Chand Publication)

B.Sc.Part II (CBCS) Sem IV

Paper No. DSC- D4 - Chemistry paper No. VIII (Organic Chemistry)

(Theory Credits: 02 : 30 hours, 38 lectures)

Expected learning Outcomes :

Name of the topic	Expected Learning Outcome
Carboxylic acids and their derivatives.	To impart knowledge about the synthesis, reactivity and applications of carboxylic acids.
Amines and Diazonium Salts	Knowledge about classification, preparation and applications of amines and diazonium salts.
Carbohydrates	Understanding the classification, configuration and structure of carbohydrates.
Carbonyl Compounds- Aldehydes and Ketone	Student will be capable of understanding the nomenclature and reactivity of aldehydes and ketones.
Stereochemistry	Student will learn the basic knowledge conformational analysis of organic compounds

Unit 1: Carboxylic acids and their derivatives. **[8L]**

iv. Addition of halogens.

v. Addition of water.

vi. Addition of hypohalous acids (HO-X).

vii. Hydroxylation (formation of 1,2-diols).

viii. Hydroboration-oxidation (formation of alcohol).

ix. Hydrogenation (formation of alkane).

x. Ozonolysis (formation of aldehydes & ketones).

B. Addition to Carbon-Carbon triple (−C≡C−) bond:

3.4 Introduction.

3.5 Examples of addition reactions.

3.6 Mechanism of electrophilic addition to−C≡C−bond.

i. Addition of halogens.

ii. Addition of halogen acids.

iii. Addition of hydrogen.

iv. Addition of water.

v. Formation of metal acetylides.

Reference books:

1. Organic Reactions and Their Mechanisms P. S. Kalsi 3rd Revised edition.

2. Advanced organic Chemistry by B.S. Bahl & Arun Bhal (Reprint in 1997)

3. Organic Chemistry by Morrison and Boyd 6th edition.

Unit 4. Natural Products **[08]**

A] Terpenoids:

4.1 Introduction, Occurrence, Isolation, General Characteristic, Classification.

4.2 General Methods for structure determinations.

4.3 Isoprene rule.

4.4 Analytical evidences and synthesis of Citral.

B] Alkaloids:

4.5 Introduction, Occurrence, Isolation, Classification, Properties.

4.6 General Methods for structure determination.

B.Sc. Part III (CBCS) SEMESTER-VI

Paper No. DSE-F6 Chemistry Paper No. XIV

(Organic Chemistry)

(Theory Credits: 02, 30 hours, 30 Lectures)

Expected learning Outcomes:

Name of the topic	Expected Learning Outcome
1. Reagents and Reactions in Organic Synthesis	Knowledge of reagents used in organic transformations and various reactions used in organic synthesis.
2.Retrosynthesis	Knowing basic terms used in retrosynthetic analysis, retrosynthesis of some organic compounds.
3.Electrophilic addition to >C=C< and –C≡C– bond	Student will learn addition reaction across >C=C< bond w.r.t. hydrohalogenation, hydration hydroxylation, ozonolysis and addition of halogen, halogen acid, hydrogen, water, etc. across –C≡C–bond.
4.Natural Products	Knowledge of terpenoids and alkaloids w.r.t. occurrence, isolation, characteristics and classification. Analytical and synthetic evidences of Citral and Nicotine.
5.Pharmaceuticals	Understanding classification of drugs, Qualities of ideal drug. Synthesis and uses of some representative drugs and Drug action of sulpha drugs.

Unit 1. Reagents and Reactions in Organic Synthesis **[10]**

A] Reagents

Preparation and Applications of following reagents.

1. Lithium aluminium hydride $LiAlH_4$.
2. Raney Nickel.
3. Osmium tetraoxide.

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SHIVAJI UNIVERSITY, KOLHAPUR
CBCS (NEP) Syllabus with effect from June, 2023
B.Sc. Part-II Semester-III PHYSICS Paper-V
DSC-C1 THERMAL PHYSICS AND STATISTICAL MECHANICS
Theory: 36 Hours
Marks-40 (Credits: 02)

Unit I: **(18 hrs)**

Laws of Thermodynamics

Thermodynamic system, thermodynamic variables, equation of state, thermodynamic equilibrium, Zeroth Law of thermodynamics, Internal energy, First law of thermodynamics, conversion of heat into work, specific heats C_P & C_V, Applications of First Law (Isothermal process, Adiabatic process, Isochoric, Isobaric), relation between C_P & C_V, work done during isothermal and adiabatic processes, reversible & irreversible processes, Second law of thermodynamics, Carnot's ideal heat engine, Carnot's cycle (Working, efficiency), Carnot's theorem, Entropy (concept & significance), Entropy changes in reversible & irreversible processes, Third law of thermodynamics, Unattainability of absolute zero.

Unit II: **(18 hrs)**

1. Transport Phenomena (09 hrs)

Molecular collisions, Mean free path and collision cross-section, Estimation of molecular diameter and mean free path, Clausius and Maxwell's equation for mean free path (without derivation). Transport Phenomena: transport of momentum (viscosity), transport of thermal energy (conduction), Transport of mass (diffusion).

2. Thermometry (09 hrs)

Principle of thermometry, types of thermometers, Scales of temperature (Celsius, Kelvin, Fahrenheit and Rankine), Principle construction and working of a) mercury thermometer; b) platinum resistance thermometer and c) thermocouple thermometer. Thermistor.

Reference books

) Heat and Thermodynamics, M.W. Zemansky and R. Dittman, (8thEdn) McGraw Hill.
) Text Book of Heat- J.B. Rajam, S.Chand and Company Ltd.
) A Treatise on Heat- MeghnadSaha and B.N. Srivastava, Indian Press.
) Heat and Thermodynamics- Brijlal and N. Subramanyam, S.Chand and Company Ltd.
) Heat Thermodynamics and Statistical Physics- J.P. Agrawal, Satya Prakash, Pragati Publ.
6) Fundamentals of Heat - D.S.Mathur, S.Chand and sons.

Theory: 30 Hours
Marks-50 (Credits: 02)

UNIT I

1. **A.C. Circuits** **(07 Hours)**

Complex numbers and their application in solving a.c. series LCR circuit using j operator and phasor diagram, Resonance in LCR series circuit, Sharpness of resonance (qualitative treatment only), Resonance in LCR Parallel circuit, complex Impedance, Reactance, Admittance, and Susceptance, Examples of series and parallel resonance, A.C.Bridge - Owen's Bridge Q-factor (definition only).

2. **Network theorems** **(04 Hours)**

Review of network terminology(Circuit element, Active element, Passive element, Branch, Node or junction, Loop, Mesh, Voltage source, Current source, Ohms law, Resistances in series, Resistances in parallel), Thevenin theorem, Nortan theorem, Equivalnce between Thevenin theorem and Nortan theorem, solved problems.

3. **Ballistic Galvanometer:** **(04 Hours)**

Construction and working of B. G., expression for charge flowing through ballistic galvanometer, Correction for damping in galvanometer, Constants of ballistic galvanometer.

UNIT II

1. **Magnetism** **(08 Hours)**

Introduction to magnetization and intensity of Magnetization, Biot-Savart's law & its applications- straight conductor, circular coil, solenoid carrying current, Divergence and curl of magnetic field, Magnetic vector potential, Ampere's circuital law.

2. **Magnetic materials and their Properties** **(07 Hours)**

Magnetic intensity, magnetic induction, permeability, magnetic susceptibility. Hysteresis and hysteresis curve, diamagnetic, paramagnetic, ferromagnetic, ferrimagnetic and anti-ferromagnetic materials.

Reference Books

1. Electricity and Magnetism, Edward M. Purcell, 1986, McGraw-Hill Education.
2. Electricity and Magnetism, J.H. Fewkes& J. Yarwood. Vol.I, 1991, Oxford UniversityPress.
3. Electricity and Magnetism, D C Tayal, 1988, Himalaya Publishing House.
4. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
5. Electricity and Magnetism ,Khare and Shrivastav.Atma Ram & Sons, Delhi, 1976
6. University Physics 9th Edition ,Young and Freedman.
7. Foundations of Electromagnetic Theory ,Rritz and Milford. Pearson Publication
8. Electricity and Magnestism, Gupta,Kumar and Singal
9. Basic Electronics and Liner Circuits, N.N.Bhargava, D.C.Kulshrestha and S.S.Gupta, Tata McGraw-Hill
10. Electronic Fundamentals and Applications, J.D.Ryder, Prentice-Hall of India Pvt.Ltd
11. Network theory and Filter Design, V.K.Aatre, New Age International Publisher
12. Principals of Electronics, V.K.Mehata, S. Chand Publication, New Delhi

B. Sc. Part – I

PHYSICS PRACTICAL

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Theory: 30 Hours
Marks-50 (Credits: 02)

Unit-I

Vector Calculus

(15 Hours)

Introduction, Del operator, gradient of scalar field and its physical significance , divergence of vector field and its physical significance, curl of vector field, line integral, surface integral, volume integral (definitions only),Gauss divergence theorem(statements and proof), Statements of Stoke's theorem, Greens symmetrical theorem.

Unit-II

Electrostatics

(15 Hours)

Electrostatic field, electric flux, Gauss's theorem of electrostatics, electric potential as line integral of electric field, potential due to a point charge, electric dipole, uniformly charged spherical shell and solid sphere, calculation of electric field from potential, capacitance of an isolated spherical conductor, parallel plate, spherical and cylindrical condenser, energy per unit volume in electrostatic field, dielectric medium, polarization vector, displacement vector, Gauss's theorem in dielectrics, Parallel plate capacitor completely filled with dielectric.

Reference Books:

1. Electricity and Magnetism, Edward M. Purcell, McGraw-Hill Education, Cambridge University Press, (1985).
2. Electricity and Magnetism, J.H. Fewkes& J. Yarwood., Oxford Univ. Press.Vol. - I, (1991).
3. Electricity and Magnetism, D C Tayal, Himalaya Publishing House, 2nd Edition (1988).
4. University Physics, Ronald Lane Reese, Thomson Brooks/Cole Publishing Company, (2003).
5. D.J. Griffiths, Introduction to Electrodynamics, Cambridge University Press, Pearson,(1999).
6. Electricity and Magnetism – N. S. Khare and S. S. Shrivastav,Atma Ram & Sons, Delhi. 9th edition (1976).
7. Foundations of Electromagnetic Theory, John R Reitz, Frederick J. Milford, Addison-Wesley Publishing Company 4th edition (2008)
8. University Physics– Hugh D. Young and Roger A. Freedman, Addison- Wesley Publishing Company, Inc., 9th edition,(1996)
9. Concepts of Physics, H. C. Verma, BhartiBhawan publisher, Vol-2, (2016)
10. Mathematical Physics, B. D. Gupta, Vikas Publication House Pvt Ltd, 4th edition, (2009).
11. Electricity and Magnetism by R. Murugeshan, S. Chand & Co., New Delhi, (2008).

PHYSICS PART-IV
DSC B2 ELECTRICITY AND MAGNETISM – II

Theory: 30 Hours
Marks-50 (Credits: 02)

Unit-I

1. Gravitation **(9 Hours)**

Newton's Law of Gravitation, Motion of a particle in a central force field (motion in a plane, angular momentum is conserved), Kepler's Laws (statement only), Satellite in circular orbit and applications, Geosynchronous orbits, Weightlessness, Basic idea of global positioning system (GPS).

2. Oscillations **(6 Hours)**

Simple harmonic motion, Differential equation of SHM and its solutions, Kinetic and Potential Energy, Total energy and their time averages, Damped oscillations, Forced oscillations.

Unit-II

1. Elasticity **(9 Hours)**

(Revision Hooke's law, Stress-strain diagram, Definition of elastic constants (Y, η, K and σ)), Bending of beam, Bending moment, Cantilever (without considering weight of cantilever), Beam supported at both the ends (without considering weight of beam), Torsional oscillation and torsional couple per unit twist, Work done in twisting a wire, Torsional pendulum-Determination of rigidity modulus and moment of inertia, Determination of elastic constants (Y, η, and σ) by Searle's method.

2. Surface Tension **(6 Hours)**

Surface tension (definition), Molecular theory of surface tension, Angle of contact, Young equation and wettability, Relation between surface tension, excess of pressure and radius of curvature, Experimental determination of surface tension by Jaeger's method, Factors affecting surface tension, Applications of surface tension.

Reference Books:

1. University Physics. F W Sears, M W Zemansky and H D Young 13/e, 1986. Addison-Wesley
2. Mechanics Berkeley Physics course,v.1: Charles Kittel, et. Al. 2007, Tata McGraw - Hill.
3. Physics – Resnick, Halliday& Walker 9/e, 2010, Wiley eastern Ltd, New Delhi.
4. Engineering Mechanics, Basudeb Bhattacharya, 2nd edn., 2015, Oxford University Press
5. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
6. Physics – S.G. Starling and WoodallLongmams and Green Co. Ltd.
7. Elements of properties of matter – D.S. Mathur, Shamlal Charitable trust New Delhi.
8. A text Book of properties of matter–N.S. Khare and S. Kumar, Atmaram and sons, New Delhi.
9. Concepts of Physics –Vol.1 H.C. Verma -BharatiBhavan Publishers.

PHYSICS PART-III
DSC B1 ELECTRICITY AND MAGNETISM-I

SHIVAJI UNIVERSITY, KOLHAPUR

B.Sc. Part-III Physics CBCS Syllabus with effect from June 2020

B.Sc. Part-III Semester-V

PHYSICS Paper-IX

DSE-E1 Mathematical Physics

Theory: 36 Hours (45 Lectures of 48 minutes)

Marks -50 (Credits: 02)

UNIT-I

1. **Partial Differential Equation** **(8 hours)**

Introduction to differentialequations, Method of separation of variables for solving second order partial differential equations, Form of two dimensional Laplace differential equation in Cartesian coordinates and its solution, Three dimensional partial differential equation in Cartesian coordinates and its solution, The differential equation of progressive wave and its solution.

2. **Frobenious Method and Special Functions** **(10hours)**

Singular points of second order differential equations, Application of singularity to Legendre and Bessel differential equation, Series solution method of solving second order linear differential equation(Frobenious method) and its application to Legendre differential equation.

UNIT-II

1. **Some Special Integrals** **(6 hours)**

Gamma function, Properties of Gamma function, Beta function, Properties of Beta function,Relation between Beta and Gamma functions, Error function (Probability Integral).

2. **Complex Analysis** **(12 hours)**

Revision of complex numbers and their graphical representation: Geometrical representation, Equal complex numbers, Addition, Subtraction, Multiplication and Division of complex number by geometry. Types of complex numbers, square roots of complex numbers, Logarithmic function of complex variables, Euler's formula, De'Moivre's theorem, Cauchy-Riemann conditions.

SHIVAJI UNIVERSITY KOLHAPUR
CBCS (NEP) Syllabus with effect from June, 2023
B.Sc. Part-II Semester-IV PHYSICS Paper-VIII
DSC-D2 WAVES AND OPTICS-II
Theory: 36 Hours Marks-100 Credits-02

Unit - I (18 hrs)

1. Cardinal Points (7 hrs)

Cardinal points of an optical system (definitions only), graphical construction of image using cardinal points, Newton's formula, relation between f and f' for any optical system, relation between lateral, axial and angular magnifications.

2. Resolving Power of Optical Instruments (5 hrs)

Resolution, resolving power (RP) of optical instruments, Rayleigh's criterion for the limit of resolution, Modified Rayleigh's criterion, comparison between magnification and resolution, RP of plane diffraction grating, RP of a prism.

3. Polarization of Light (6 hrs)

Idea of polarization, polarization by double refraction, Huygens explanation of double refraction through uniaxial crystal, Nicol prism (construction, working), production of circularly and elliptically polarized light, optical rotation - laws of rotation of plane of polarization, polarimeter.

Unit-II (18 hrs)

1. Interference (10 hrs)

Principle of Superposition, Coherence and condition for interference, Division of amplitude and division of wave front, Lloyds single mirror (determination of wavelength of light of monochromatic source), Interference in thin parallel films (reflected light only), Wedge shaped films, Newton's rings and its application for determination of wavelength and refractive index of light.

2. Diffraction (8 hrs)

Fraunhoffer diffraction- Elementary theory of plane diffraction grating, Determination of wavelength of light using diffraction grating, Theory of Fresnel's half period zones, Zone plate (construction, working and its properties), Fresnel's diffraction at straight edge.

Reference books

1) Optics – Ajoy Ghatak, 2021, McGraw Hill.
2) A Textbook of Optics-N. Subrahnmanyam,Brij Lal, M.N. Avadhanulu, S.Chand.
3) A Textbook of Light- D.N. Vasudeva, Atma ram and Sons.
4) Waves and Optics – M. N. Avadanulu , TVS Arun Murthy, S. Chand.
5) Fundamentals of Optics – Devraj Singh PHI Learning.

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SHIVAJI UNIVERSITY KOLHAPUR

CBCS (NEP) Syllabus with effect from June 2023

B.Sc. Part-II Semester-IV PHYSICS Paper-VIII

DSC-D1 THERMAL PHYSICS AND STATISTICAL MECHANICS-II

Theory: 36 Hours

Marks-40 (Credits: 02)

Unit I **(18 hrs)**

1. Thermodynamic Potentials (10 hrs)

Enthalpy, Gibbs function, Helmholtz function, Internal Energy, Maxwell's thermodynamical relations, Joule-Thomson effect, Clausius- Clapeyron equation, Expression for $(C_P - C_V)$, C_P/C_V, TdS equations.

2. Theory of Radiation (8 hrs)

Blackbody radiation and its importance, Experimental study of black body radiation spectrum, Concept of energy density, Derivation of Planck's law, Deduction of Wien's displacement law, Rayleigh-Jeans Law, Stefan Boltzmann Law and Wien's displacement law from Planck's law.

Unit II **(18 hrs)**

1. Classical Statistics (12 hrs)

Phase space, Microstate and Macrostate, Accessible microstates, apriori probability, thermodynamic probability, probability distribution, Maxwell-Boltzmann (MB) distribution law, evaluation of constants α and β, Entropy and Thermodynamic probability, Distribution of molecular speeds.

2. Quantum Statistics (6 hrs)

Bose-Einstein (BE) distribution law, Fermi-Dirac (FD) distribution law, comparison of M.B., B.E., and F.D. statistics.

Reference books

1) Heat and Thermodynamics-M.W.Zemasky and R. Dittman, McGraw Hill.
2) Physics for Degree Students B.Sc. second year- Arora, Hemne, S. Chand.
3) Concepts of Modern Physics- Arthur Beiser, McGraw-Hill.
4) Thermal Physics, S. Garg, R. Bansal and C. Ghosh, 1993, Tata McGraw-Hill.
5) Thermodynamics, Kinetic theory & Statistical Thermodynamics, F.W.Sears G.L.Salinger. 1988, Narosa.
6) University Physics- Ronald Lane Reese, Thomson Brooks/Cole.
7) Heat Thermodynamics and Statistical Physics, N. Subramanyam, Brij Lal, P. Hemne, 2008, S. Chand.

SHIVAJI UNIVERSITY KOLHAPUR
CBCS (NEP) Syllabus with effect from June, 2023
B.Sc. Part-II Semester-III PHYSICS Paper-VI
DSC-C2 WAVES AND OPTICS-I
Theory: 36 Hours Marks-40 Credits-02

Unit I: **(18 hrs)**

1.Superposition of Harmonic Oscillations (6 hr)

Linearity and superposition principle, Superposition of two collinear harmonic oscillations for oscillations having equal frequencies: Analytical method, oscillations having different frequencies (Beats), Superposition of two perpendicular harmonic oscillations: for oscillations having equal frequencies (Analytical method).Oscillations having different frequencies (Lissajous figures), Uses of Lissajous figures.

2. Coupled Oscillations (4 hr)

Frequencies of coupled oscillatory systems, normal modes and normal co-ordinates, energy of coupled oscillations, energy transfer in coupled oscillatory system.

3. Wave Motion and Ultrasonic Waves (8 hr)

Wave Motion: Transverse waves on a string, travelling and standing waves on a string, Normal modes of a string, Group velocity and Phase velocity, Plane waves, Spherical waves. Ultrasonic waves: Piezo-electric effect, Production of ultrasonic waves by Piezo-electric oscillator, Detection of ultrasonic waves, Properties of ultrasonic waves, Applications of ultrasonic waves.

Unit II: **(18 hr)**

1. Sound and Acoustics of Buildings (7 hr)

Sound: Transducers and their characteristics, Pressure microphone, Moving coil loudspeaker, Intensity and loudness of sound, Decibels, Intensity levels, Acoustics of buildings: Reverberation and time of reverberation, Absorption coefficient, Sabine's formula for reverberation time, Acoustic aspects of halls and auditoria.

2. Viscosity (11hr)

Rate flow of liquid in a capillary tube - Poiseuille's formula, experimental determination of coefficient of viscosity of a liquid by Poiseuille's method, effect of temperature on viscosity of a liquid, Viscosity of liquid by rotating cylinder method, Searle's viscometer, viscosity of gases by Rankine's method (qualitative treatment only), Lubrication.

Reference books:

1. The Physics of Waves and Oscillations- N. K. Bajaj, Tata McGraw-Hill Reprint 2022.
2. Physics of Degree Students- C. L. Arora and Dr. P. S. Hemne, S Chand & company
3. A Text Book of Sound- Khanna and Bedi, Atma Ram & Sons, Delhi.
4. Waves and Oscillations-N Subrahmanyam, BrijLal. Vikas 2nd edition, Reprint 2022
5. Elements of Properties of Matter-D.S. Mathur, S. Chand.
6. Electronic Instrumentation – H.S. Kalasi McHraw , Hill

B.Sc. Part-III Semester-VI

PHYSICS Paper-XIII

DSE-F1 Nuclear and Particle Physics

Theory: 36 Hours (45 Lectures of 48 minutes)

Marks -50 (Credits: 02)

Unit-I

1. General Properties of Nuclei and Nuclear Model **(10 hours)**

Constituents of nucleus and their intrinsic properties, Quantitative facts about size, mass, chargedensity (matter energy), binding energy, average binding energy and its variation with mass number.Liquid drop model approach, Semi empirical mass formula, Magic numbers.

2. Particle Accelerators **(8 hours)**

Need of accelerators,Cyclotron- construction, working, theory and its limitations,Principle of phase stable orbit, Synchrocyclotron - construction and working, Synchrotrons- electron synchrotron and proton synchrotron, Betatron - principle, construction and workingcondition, expression of energy gain.

Unit-II

1. Nuclear Detectors **(10 hours)**

Ionization chamber, Geiger Muller counter- construction, working and theory, dead time and recoverytime, quenching mechanism, Construction of photo-multiplier tube (PMT), Scintillation detector-principle, construction and working, Wilson cloud chamber, Semiconductor detector, Cerenkovradiations, Cerenkov detector.

2. Particle Physics **(8 hours)**

Particle interactions, Classification of elementary particles, Symmetries and conservation laws-energy,momentum, angular momentum and parity, Baryon number, Lepton number, Concept of quark model.

B.Sc. Part III-Semester-V

PHYSICS Paper-XII

DSE-E4 Digital and Analog Circuits and Instrumentation

Theory: 36 Hours (45 Lectures of 48 minutes)

Marks -50 (Credits: 02)

Unit-I

1.Digital Electronics (08 hours)

Review of basic logic gates, Derived logic gates (NOR, NAND, XOR and XNOR gates), NAND and NOR gates as universal gates, De Morgan's theorems, R-S flip flop, J-K flip-flop, Half adder, Full adder, 4 bit parallel binary adder.

2.TransistorsAmplifier and Sinusoidal Oscillators (10 hours)

Transistor Amplifier: Single stage transistor CE amplifier, D.C. and A.C. equivalent circuits, load line analysis-d.c. load line, a.c. load line and Q point.

Oscillator: Feedback in amplifiers and its types,theory of feedback oscillator, Barkhausen's criterion for sustained oscillations,Oscillatory circuit (tank circuit),essentials of transistor oscillator, sinusoidal oscillators-phase shift oscillator, Colpitts oscillator, Hartley oscillator, Crystal oscillator using transistors.

Unit-II

1. **Cathode Ray Oscilloscope** (8 hours)

Introduction to CRO, Block diagram of CRO, Principle, Construction and working of CRT, Applications of CRO: measurement of A.C. and D. C. voltages, periodic time, frequency and phase difference, Lissajous figures.

2. **Operational Amplifier and Timer** (10 hours)

Operational Amplifier: Differential amplifier and its type, Op-Amp, Block diagram of an Op- Amp. Op-Ampparameters, Characteristics of an ideal and practical Op-Amp (IC 741), Applications of Op-Amps: Inverting amplifier and Non-inverting amplifier, Adder, Subtractor, Differentiator, Integrator.

Timer IC: Block diagram of IC555, IC 555 Pin configuration, Applications of IC 555 as astable and monostablemultivibrator.

B.Sc. Part-III Semester-V

PHYSICS Paper-XI

DSE-E3 Classical Mechanics and Classical Electrodynamics

Theory: 36 Hours (45 Lectures of 48 minutes)

Marks -50 (Credits: 02)

UNIT-I

1.Lagrangian Formulation **(10 hour)**

Constraints. Degrees of freedom, Generalized coordinates, Principle of virtual work, D'Alembert's principle, Lagrange's equation from D'Alembert's principle, Applications of Lagrange's equation to a particle in space, Atwood's machine and a bead sliding on uniformly rotating wire under force free condition.

2.Techniques of Calculus of Variation **(8 hour)**

Hamilton's principle, Deduction of Hamilton's principle from D'Alembert's principle, Deduction of Lagrange's equation from Hamilton's principle, Applications-shortest distance between two points in a plane,Brachistochrone problem.

UNIT- II

1.Special Theory of Relativity **(12 hours)**

Inertial and non-inertial reference frames, Galilean transformation equations, Michelson-Morley experiment, postulates of special theory of relativity, Lorentz transformation equations, Relativistic addition of velocities, Length contraction, Time dilation, Variation of mass with velocity, Mass-energy relation.

2. Charged Particles Dynamics **(6 hours)**

Poisson's and Laplace's equations and their physical significance, Laplace's equation in one dimension and its solutions, Motion of charged particle - in uniform electric field E, magnetic field B, Crossed uniform electric field E and magnetic field B.

B.Sc. Part-III Semester-V

PHYSICS Paper-X

DSE-E2 Quantum Mechanics

Theory: 36 Hours (45 Lectures of 48 minutes)

Marks -50 (Credits: 02)

Unit-I

1. Matter Waves **(08 hours)**

Wave particle duality, De-Broglie hypothesis of matter waves, Derivation of wavelength of matter wave, Concept of wave packet, Relation between group velocity - phase velocity and group velocity-particle velocity, Davisson and Germer experiment, Uncertainty principle (statements only): position–momentum and energy- time, Application of uncertainty principle- non existence of free electrons in the nucleus.

2. Schrodinger's Wave Equation **(10 hours)**

Wave function and its physical interpretation, Condition of physically acceptable wave function, Normalized and orthogonal wave function, Schrödinger time dependent and time independent (steady state) wave equations in 1D and 3D, Probability current density(continuity equation), Eigen values and Eigen functions, Expectation values of dynamic variables.

Unit-II

1. Operators in Quantum Mechanics **(08 hours)**

Definition of an operator, Position operator (x), Linear momentum operator (p), Commutation relation in quantum mechanics, Commutation relation between x and p, Kinetic energy operator (T), Hamiltonian operator (H), Parity operator (π), Angular momentum operator (L) – components of angular momentum operator in Cartesian coordinate system, Ladder operators, Eigen values of L_z and L^2 (use equations for L^2 and Lz in spherical polar coordinates).

2. Applications of Schrodinger Equation **(10 hours)**

Particle in a rigid box (infinite potential well) in one dimension and three dimension, Step potential- reflection and transmission coefficients, Potential barrier- tunneling effect (qualitative treatment), One dimensional simple harmonic oscillator (operator method)- energy levels, zero point energy, Schrodinger equation for Hydrogen atom in spherical polar coordinates, Separation of radial and angular parts, Solution of radial part of Schrodinger's equation - Energy Eigen values.

SEMESTER- I
Paper – I (DSC 25 A)
Introduction to Microbiology
Credits - 2; Total hours – 30

arning Objectives:

1. To develop a good knowledge of the development of the discipline of Microbiology and the contributions made by prominent scientists in this field.
2. To develop a very good understanding of the characteristics of different types of microorganisms, methods to organize/classify these into and basic tools to study these in the laboratory.
3. To explain the useful and harmful activities of the microorganisms and scope of different branches of Microbiology.
4. To describe characteristics of bacterial cells, cell organelles and various appendages like capsules, flagella or pili.

dit I	History and mile stones in Microbiology	No. of hours: 15
	A. History of Microbiology 1. Spontaneous generation *vs.* biogenesis. 2. Contributions of - a. Antony von Leeuwenhoek, b. Edward Jenner, c. Louis Pasteur, d. Robert Koch, e. Ivanowsky, f. Joseph Lister, g. Alexander Fleming, h. Martinus W. Beijerinck and i. Sergei N. Winogradsky. B. Introduction to types of Microorganisms: 1. General characteristics of different groups: a. Acellular microorganisms-Viruses, Viroids and Prions b. Cellular microorganisms- Bacteria, Algae, Fungi and Protozoa - with emphasis on distribution and occurrence, morphology, mode of reproduction and economic importance. c. Ultra-structure of Prokaryotic and eukaryotic cell, difference between prokaryotic and eukaryotic microorganisms. C. Bacterial Nomenclature and Classification:	

B.Sc. Part-III Semester-VI

PHYSICS Paper-XVI

DSE-F4 Energy Studies and Materials Science

Theory: 36 Hours (45 lectures)

Marks 50 (Credits: 02)

UNIT-I

1. Energy and Wind Energy (8 hrs)

Energy, Forms of energy, Man and environment, Energy chains, Classification of energy resources, Energy demands, Age of renewable and alternatives, Wind energy, Wind energy chains, Wind energy quantum, Planning of wind farm, Wind power density, Efficiency factor of wind turbine (P-H graph), Power of wind turbine for a given incoming wind velocity, Types of a wind turbine generator unit, Horizontal axis propeller type wind turbine generator unit.

2. Solar Energy (8 hrs)

Solar energy, Solar energy spectrum (UV,Visible and IR), Utilization of solar energy-thermal route, photovoltaic route, Essential subsystems in solar energy plant, Solar constant, Clarity index, Solar insolation, Solar energy from satellite station through microwave to earth station, Solar photovoltaic systems, Merits and limitations of solar PV systems, Prospects of solar PV systems, Power of a solar cell and solar PV panel.

3. Biomass Energy (2 hrs)

Origin of biomass, Biomass energy resources (biomass from cultivated crops, biomass from waste organic matter), Biomass conversion process (biochemical conversion-anaerobic digestion and fermentation)

UNIT-II

1. Superconductivity (6 hrs)

Idea of superconductivity, Critical temperature, Critical magnetic field, Meissner effect, Type-I and Type-II superconductors, London equation and penetration depth, Isotope effect, Application (magnetic levitation)

2. Nanotechnology (12 hrs)

Introduction tonanoscience and nanotechnology, Length scales relevant to nanoscience, Nanostructures: 1D, 2D and 3Dnanostructures, Size effects in nanosystems, Quantum

B.Sc. Part-III Semester-VI

PHYSICS Paper-XV

DSE-F3 Atomic and Molecular Physics and Astrophysics

Theory: 36 Hours (45 Lectures of 48 minutes)

Marks -50 (Credits: 02)

UNIT-I

1. Atomic Spectra **(09 hours)**

Observed hydrogen fine structure, Spectral notations and optical spectral series for doublet structure, Spectrum of sodium and its doublet fine structure, Selection and intensity rules for fine structure doublets, Normal order of fine structure doublets, Electron spin-orbit interaction,Normal and anomalous Zeeman effect and their explanation from vector atom model, Lande's g factor.

2. Molecular Spectra **(09 hours)**

Molecular bond, Electron sharing, H_2^+ molecular ion, The hydrogen molecule, Rotational energy levels, Rotational spectra, Vibrational energy levels, Vibrational spectra, Vibration – rotation spectra, Electronic spectra of diatomic molecules.

UNIT-II

1 Raman Spectra **(4 hours)**

Raman Effect,Characteristic properties of Raman lines, Classical and quantum theory of Raman Effect,Difference between Raman spectra and infrared spectra.

2. Structure of Universe: **(08 hours)**

Big-Bang theory, Steady state theory, Oscillating theory,Hubble law, Cosmological tests, Milky Way galaxy, Origin of solar system - Condensation theory; arguments for and against the theory.

3. Stellar Evolution **(06 hours)**

The H–R Diagram,Evolution of main sequence stars - Red giants and White dwarfs, Evolution of more massive stars- Supernova, Neutron star, Black hole,Surface of the Sun, Sunspots, Sunspot cycle.

B.Sc. Part-III Semester-VI

PHYSICS Paper-XIV

DSE-F2 Solid State Physics

Theory: 36 Hours (45 lectures of 48 min)

Marks-50 (Credits: 02)

Unit-I

1. Crystal Structure **(10 Hours)**

Solids: amorphous, polycrystalline and crystalline materials; lattice, basis, unit cell- primitive, non-primitive unit cell, symmetry operations, symmetry elements of cube, Bravais lattice in two and three dimensions, Miller indices, Miller indices andinter-planer spacing, Simple crystal structures: SC, BCC, FCC and HCP(Co-ordination number, atomic radius, atoms per unit cell and packing fraction)

2. X-Ray Diffraction **(08 hours)**

Reciprocal lattice and its properties, Brillouin zone, Diffraction of X-rays by crystals, Ewald construction, Bragg's law in reciprocal lattice, Experimental methods in X-ray diffraction (Laue method,rotating crystal method,powder photograph method),Analysis of cubic crystal by powder method.

Unit-II

1. Magnetic Properties of Matter **(10 hours)**

Classical Langevin theory of diamagnetic and paramagnetic materials, Quantum mechanical treatment of paramagnetism, Curie's law, Weiss theory of ferromagnetism and ferromagnetic domains, Explanation of B-H curve, Hysteresis and energy loss.

2. Elementary Band Theory of Solids **(8 hours)**

Concept of density of states, Bloch theorem (statement only), Kroning–Penny model, Origin of energy gap, Velocity of electrons according to band theory, Effective mass of an electron, Distinction between metals, semiconductors and insulators, Hall Effect - Hall voltage and Hall Coefficient.

B.Sc. Part II (Microbiology) Level-5

SEMESTER-III

Paper V	C8-DSC- 5 Microbial Physiology & Metabolism (CREDITS:02; TOTAL HOURS : 30) **Learning Objectives:** 1) To make the students to learn concepts of microbial physiology. 2) To develop a good understanding regarding effect of environmental factors growth of microorganisms 3) To understand the mechanism of transport across microbial cell membrane 4) To clear the basic concept of microbial metabolism.	
Unit I / Credit I	**Microbial Physiology & Metabolism**	No. of hours per Unit / Credit
	A) Growth : Growth phases, measurement of growth, continuous growth, synchronous growth and diauxic growth B) Effect of environmental factors on microbial growth : i. Temperature : Mesophiles, psychrophiles, thermophiles and hyperthermophiles. Thermal destruction of bacteria – D, F and Z values, TDP and TDT ii. pH: Neutrophiles, Acidophiles and Alkalophiles iii. Osmotic pressure -Isotonic, hypotonic and hypertonicenvironments, xerophiles and halophiles. iv. Heavy metals v. Radiations- U.V. rays C) Transport across cell membrane - Diffusion, active transport andgroup translocation	
Unit II / Credit II	**Microbial Metabolism**	
	A) Catabolism of glucose - EMP, HMP, ED and TCA cycle B) Fermentation - Homolactic & Heterolactic fermentation. C) Bacterial electron transport chain – Components, flow of electrons &mechanism of ATP generation - Chemiosmotic hypothesis	
Paper VI	C9-DSC- 6 : Applied Microbiology (CREDITS:02; TOTAL HOURS : 30) **Learning Objectives:** 1) To develop the knowledge regarding air microflora and its role and analysis.	No. of hours per Unit / Credit

	C. Lipids: a. Simple lipids – Fats and oils, waxes b. Compound lipids – Phospholipid, Glycolipids c. Derived lipids – Cholesterol D. Enzymes: a. Definition b. Structure- Concept of apoenzyme, coenzyme, cofactor and active site. c. Types- Extracellular, Intracellular, Constitutive and Inducible. d. Features of enzyme - substrate reaction. E. Nucleic Acids: a. DNA – structure and composition (Watson and Crick Model) b. RNA – Types (mRNA, tRNA, rRNA), structure and functions.	
t II	**Microbial Metabolism**	**No. of hours: 15**
	A. Concept of Catabolism and anabolism with examples B. Fundamental principles of energetics- a. Exergonic and endergonic reactions, b. High energy compounds. C. Modes of ATP generation in bacteria by: a. Fermentation b. Respiration c. Photosynthesis D. Biochemical Mechanisms of ATP generation: a. Substrate level phosphorylation. b. Oxidative phosphorylation - Respiration electron transport chain, aerobic and anaerobic respiration. c. Bacterial Photophosphorylation – Cyclic and Non-cyclic. E. Catabolism of glucose – EMP, TCA cycle (schematic presentation and significance).	

a. Components of media
b. Natural and Synthetic media
c. Chemically defined media
d. Complex media, Selective
e. Differential
f. Enriched
g. Enrichment media.

D. Cultivation of microorganisms:
a. Use of culture media for cultivation
b. Conditions required for growth of the microorganisms.

Isolation, Cultivation and Preservation of Microorganisms.	**No. of hours: 15**

A. Isolation of Microorganisms from natural habitats:
a. Pure culture techniques – Streak plate, Spread plate, Pour Plate and micromanipulator
b. Isolation and cultivation of anaerobic organisms by using media components and by exclusion of air/O2

B. Preservation of microbial cultures:
a. Sub culturing
b. Overlaying of cultures with mineral oils
c. Storage at low temperature
d. Lyophilisation

C. Systematic study of pure cultures:
a. Morphological characteristics.
b. Cultural characteristics:
i. Colony characteristics on solid media
ii. Growth in liquid media
iii. Growth on agar slants

D. Biochemical Characteristics –
a. Sugar fermentation
b. Production of metabolites - H_2S gas
c. Production of enzymes - Amylase, Caseinase and Catalase.

	a. Taxonomic ranks b. Common or Vernacular name c. Scientific or International name d. Whittaker's five kingdom and Carl Woese's three kingdom classification systems. D. An overview of Scope of Microbiology: 1.Beneficial and harmful activities of microorganisms Introduction to applied branches of Microbiology: a. Air, b. Water, c. Sewage, d. Soil, e. Dairy, f. Food, g. Medical, h. Industrial, i. Biotechnology and j. Geomicrobiology.	
I	**Bacterial Cell Structure and Functions**	No. of hours: 15
	A. Cell size, shape and arrangement B. Cytology of Bacteria: i. Cell wall: Composition and detailed structure of Gram-positive and Gram-negative bacterial cell walls ii. Cell Membrane: Structure, function & chemical composition of bacterial cell membranes. iii. Structure and functions of Capsule and slime layer. iv. Structure and functions of Flagella v. Structure and functions of Pilli. C. Structure and functions of Cytoplasmic Components: a. Ribosomes b. Mesosomes c. Inclusion bodies d. Nucleoid e. Chromosome f. Plasmids g. Endospore: Structure, stages of sporulation h. Reserve food materials - Nitrogenous and non-nitrogenous	

f) Liquid impingement – Bead-bubbler device

B) Water Microbiology:

a) Sources of microorganisms in water.

b) Fecal pollution of water, Indictors of fecal pollution of water- *E. coli*

c) Routine Bacteriological analysis of water.

1) SPC & 2) Tests for coliforms -

i. Qualitative-Detection of coliforms - Presumptive test, Confirmed Test, Completed test.Differentiation betweencoliforms - IMViC test, Eijkman test.

ii. Quantitative – MPN, Membrane filter technique

d) Municipal water purification process and its significance.

C) Dairy Microbiology:

a) Sources of microorganisms in milk.

b) General composition of Milk.

c) Microbiological examination of Milk – DMC, SPC and dyereduction test- MBRT test

d) Pasteurization - Definition, Methods – LTH ,HTST ,UHT, Efficiency of Pasteurization- Phosphatase test (Qualitative) Water Microbiology

Paper VII: Basics in Medical Microbiology & Immunology (CREDITS:02: TOTAL HOURS:

Learning Objectives:

1) To give basic about basic concept of medical microbiology.
2) To make aware students about disease.
3) To understand the defense mechanism of vertebrate body.
4) To learn about concept of antigen and antibody.

Unit I / Credit I	**Medical Microbiology**
	a) Definitions – Host, Parasite, Saprophytes, Commensal, Infection, Etiological agent, Disease, Pathogen, Opportunistic pathogen, True pathogen, Virulence, Pathogenicity, Fomite, Incubation period, Carriers, Morbidity rate, Mortality rate, epidemiology, etiology, Prophylaxis, Antigen, Antibody, Hapten, Vaccine, Immunity. b) Virulence factors (production of endotoxins, exotoxins, enzymes, escaping of phagocytosis) c) Types of diseases – i) Epidemic, ii) Endemic, iii) Pandemic, iv) Sporadic. d) Types of infections – Chronic, acute, primary, secondary, reinfection, Iatrogenic, congenital, local, generalized, Covert, Overt, Simple, Mixed, Endogenous, Exogenous, Latent, Pyogenic, Nosocomial. e) Modes of transmission of diseases 1. Transmission by air, water & food 2. Contact transmission 3. Vector borne transmission f) General principles of prevention and control of microbial diseases Normal flora of human body & its significance

SEMESTER-IV

Paper VII	C-5-:DSC- 7 : Microbial Genetics & Molecular Biology(CREDITS:02; TOTAL HOURS : 30) **Learning Objectives:** 1) To learn the basic concepts of Microbial genetics. 2) To gain knowledge regarding types of mutation. 3) To demonstrate the model of gene transfer in bacteria. 4) To gain the knowledge about DNA repair and Lac operon.	
Unit I / Credit I	**Microbial Genetics**	15
	A) Basic concepts - a) Forms of DNA. b) Gene, genome, genotype, phenotype, mutagen ,recon, muton , cistron c) Split genes. d) Genetic code – definition and properties of genetic code. **B) DNA damage by Mutations –** a) Basic Concepts of Mutation: Base pair substitutions, Frame shift , Missense , nonsense, neutral, silent , pleiotropic and suppressor mutations. b) Spontaneous mutation – Definition and basic concept. c) Induced mutations – Definition , Mechanism of mutagenesis by – i. Base analogues : 5-Bromouracil and 2- aminopurines ii. Mutagens modifying nitrogen bases - a. Nitrous acid b. Hydroxylamine c. Alkylating agents iii. Mutagens that distort DNA - a. Acridine dyes b. UV light	
Unit II / Credit II	**Molecular Biology**	15
	A) Gene transfer in bacteria. a.Fate of exogenote in recipient cell. b.Modes of gene transfer - Transformation, Conjugation, Transduction B) Plasmids – a. Natural – Properties, types , structure and applications b. Artificial – pBR 322- structure and applications C) DNA repair : i) Photoreactivation ii) Dark repair mechanism (Excision repair) D) Lac operon – structure and working	

	To study water microbiology, water analysis and its purification and disinfection. 2) To study milk microbiology and quality control of milk. 3) To learn the basic understanding of industrial microbiology.			
Unit I / Credit I	**Applied Microbiology**			15
	A) Air Microbiology: a) Sources of microorganisms in air. b) Definitions of - Infectious dust, Droplets & Droplet nuclei c) Sampling methods for microbial examination of air i) Solid impaction - Sieve device ii) Liquid Impingement – Bead-bubbler device			

COURSE XI : DSE - E 51 FOOD AND INDUSTRIAL MICROBIOLOGY

(Credit-2, Total Lectures- 45)

UNIT – I / CREDIT - I

lectures - 22

1) Food Microbiology

a) Food as a substrate for microorganisms: Intrinsic and extrinsic factors
b) Sources of microorganisms to food
c) Food spoilage: spoilage wine and beer, spoilage of vinegar
d) General Principles and methods of food preservation
e) Determination of: TDP, TDT, D, F, and Z values
f) Food poisoning:
   a. Role of microorganisms in food poisoning
   b. Food poisoning: i) Staphylococcal
      ii) Fungal (aflatoxin)
g) Food infections: food infection: Salmonellosis.
h) Probiotics: Concept and applications

2) Industrial Microbiology

A) Strain Improvement
B) Scale up of fermentations
C) Microbiological assays

UNIT – II / CREDIT - II

lectures - 23

1) Industrial Microbiology

A. Preservation of industrially important microorganisms: Methods & Culture collection centers.
B. Industrial production of:
   a. Alcohol: - Organisms used, Inoculum preparation, Fermentation media, Fermentation conditions, Extraction and Recovery.
   b. Grape wine: - Definition, types, production of table wine (Red and White) and microbial defects of wine
   c. Penicillin: - Organisms used, Inoculum preparation, Fermentation media, Fermentation conditions, Extraction and Recovery. Concept of semi synthetic penicillin
C. Down stream processing & product recovery : Centrifugation, flocculation, filtration, solvent extraction, distillation, precipitation, crystallization and chromatography.
D. Testing of sterility, pyrogen, carcinogenicity, toxicity and allergens

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COURSE X : DSE - E 50 - IMMUNOLOGY

(Credit-2, Total Lectures- 45)

UNIT – 1 / CREDIT - 1 Lectures - 22

A) Cells and organs of the immune system:

I) Cells of the immune system

i. Hematopoiesis- Characteristics and Types of stem cells
ii. Classification of cells of immune system-Lymphoid and myeloid cells
iii. Structure and functions of Lymphoid cells- T cells and T cell subsets, NK cells, B cells and dendritic cells
iv. Structure and functions of myeloid cells – Granulocytes, Monocytes and macrophages

II) Organs of the immune system

Primary and secondary lymphoid organs - Structure and functions of Thymus, bone marrow, spleen , lymph node and Mucosa associated lymphoid tissue(MALT)

B) Molecular mechanism of antibody production:

i. Processing and presentation of antigen by Antigen presenting cell.
ii. Interaction of APC with T_H cell
iii. Interaction of B cell and T_H cell
iv. Proliferation and differentiation of activated B cells
v. Role of follicular dendritic cells in selection of high affinity B cells
vi. Role of cytokines in proliferation and differentiation

C) Complement:

i. Nature, Properties, Complement activation by classical and alternate pathway.
ii. Biological consequences of complement activation

D) Monoclonal antibodies:

i. Concepts of Polyclonal and monoclonal antibodies
ii. Production of mouse monoclonal antibodies by hybridoma technology.
iii. Types of monoclonal antibodies- Mouse, Chimeric, Humanized and Human antibodies
iv. Applications of monoclonal antibodies.

- Integration of λ genome into host genome

2) Reproduction of animal virus - Adenovirus.

3) Reproduction of plant virus - TMV

4) Oncogenesis:
   a) Definition of oncogenesis
   b) Types of cancers
   c) Characteristics of cancer cells.
   d) Hypothesis about cancer.
      i) Somatic mutation hypothesis
      ii) Defective immunity hypothesis
      iii) Viral gene hypothesis
      - Role of DNA viruses in cancer with special emphasis on Papova vir
      - Role of RNA tumor viruses
        - Provirus theory
        - Protovirus theory
        - Oncogene theory

BOOKS RECOMMENDED

1. General Microbiology - Stanier
2. Microbiology - Prescott, Klein
3. Microbiology - Davis
4. General Virology - Luria
5. Genetics of Bacteria and their Viruses - William Hayes.
6. General Microbiology Vol. II - Powar and Daginawala
7. Virology - Biswas and Biswas
8. Virology Vol. 4- Toply and Wilson
9. Principals of virology- S.J. Flint
10. Bacterial and Phage Genetics – Birge

B.SC.III MICROBIOLOGY

SEMESTER V

COURSE IX DSE - E 49 VIROLOGY

(Credit-2, Total Lectures- 45)

UNIT – I / CREDIT - I

Lectures - 23

1) The Structural properties of viruses : Capsids, Nucleic acids and envelope. Structure of T4 bacteriophage, TMV and HIV, Viroids and prions.
2) Reproduction of Bacteriophages :
   a) One step growth experiment.
   b) Reproduction of T4 phage.
3) Isolation, cultivation and Purification of viruses
   a) Isolation and cultivation of viruses:
      i) Animal virus - Tissue culture, chick embryo and live animals
      ii) Plant virus – Whole plant, Protoplasts, Insect cell culture
      iii) Bacteriophages - Plaque method
   b) Purification of viruses based on physico-chemical properties:
      i) Density gradient centrifugation
      ii) Precipitation
4) Methods of Enumeration of viruses
      i) Latex droplet method (Direct electron microscopic count)
      ii) Plaque and pock assay method.

UNIT – II / CREDIT - II

Lectures - 22

1) Lysogeny
   a) Introduction
      - Definition of lysogeny
      - Temperate phages
   b) Lysogeny by lambda phage
      - Adsorption and penetration of λ phage
      - Circularization of lambda genome
      - Genetic map for lysogenic interaction
      - Expression of λ genes
      - Establishment of repression
      - Maintenance of repression

COURSE XIV DSE F50: MICROBIAL BIOCHEMISTRY

(Credit-2, Total Lectures- 45)

UNIT – I / CREDIT I

Lectures - 22

1) Enzymes -

A) Definition, properties, structure, specificity, mechanism of action (Lock & Key, Induced fit hypothesis), Basics of enzyme classification.

B) Allosteric enzymes - Definition, properties, models explaining mechanism of action (Concerted and sequential models). Patterns of feed back inhibition.

2) Extraction and purification of enzymes.

A) Methods of extraction of intracellular and extracellular enzymes. i) Choice of source and biomass development

B) Methods of homogenization - cell disruption methods

C) Purification of enzymes on the basis of - a) Molecular size, b) Solubility differences c) Electrical charge, d) Adsorption characteristic differences e) Differences in biological activity

3) Assay of enzymes - Based on substrate and product estimation.

4) Ribozymes and Isozymes.

5) Immobilization of enzymes - Methods and applications

UNIT – II / CREDIT II

Lectures - 23

1) Factors affecting enzyme activity-

a) Factors affecting catalytic efficiency of enzymes- i) Proximity and orientation, ii) Strain and distortion, iii) Acid base catalysis, iv) Covalent catalysis

b) Environmental factors influencing enzyme activity- i) Substrate concentration, ii) Temperature, iii) pH, iv) Metal ions

2) Kinetics of single substrate-enzyme catalyzed reactions - Derivation of Michaelis-Menten equation, Lineweaver Burk Plot, Significance of Km and Vmax.

3) Microbial Metabolism

I) Basics in carbohydrate metabolism-

a) PP pathway, ED pathway, Phosphoketolase pathway

b) Pyruvate as a key intermediate

c) Glyoxylate bypass

II) Assimilation of -

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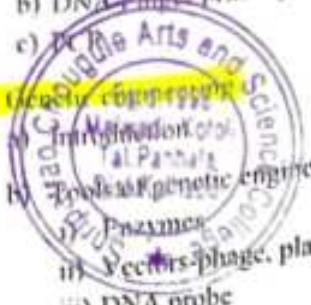
a) DNA sequencing (Sanger's method)
b) DNA Finger printing
c) PCR
d) Genetic engineering
e) Immunodiagnostics



f) Tools of genetic engineering –
   i) Enzymes
   ii) Vectors-phage, plasmid and cosmid
   iii) DNA probe
   iv) Linkers and adaptors
   v) Cloning organisms - (Bacteria and Yeasts)
   vi) Genomic library and cDNA library

c) Techniques –
   i) Isolation of desired DNA segment- Shotgun Method, cDNA synthesis, Chem synthesis
   ii) Construction of r-DNA using appropriate vector- Use of restriction enzymes, Linkers, Adaptors, Homopolymer tails
   iii) Transfer to cloning organisms (Bacteria and Yeasts)
   iv) Selection of recombinant bacteria and yeasts – Blue and white screening, Co hybridization technique.

d) Application of genetic engineering in –
   i) Medicine-
   ii) Agriculture
   iii) Industry
   iv) Environment

Books Recommended:

1. Genetics - Stickberger.
2. Genes - Benjamin Lewin IX ed.
3. Principles of gene manipulation - Primrose and Old
4. Genetic Engineering - Second Ed. Desmond S. T. Nicholl
5. Recombinant DNA - J. D. Watson
6. Biochemistry - Lehninger
7. Molecular Biology of Gene - J. D. Watson
8. Principles of Genetics - Herskowitz
9. General Microbiology - Stanier

B.SC.III MICROBIOLOGY

SEMESTER VI

Course XIII DSE F49: MICROBIAL GENETICS

(Credit-2, Total Lectures- 45)

UNIT – I/ CREDIT I Lectures - 22

1) Basic concepts of bacterial genome -
   a) Structural organization of *E. coli* chromosome - Folded Fiber model.
   b) One cistron - one polypeptide hypothesis.

2) Molecular mechanism of gene expression
   a) Concept of operon
   b) Pribnow box
   c) Genetic regulation in tryptophan operon

3) Mutations
   a) Expression of mutations -
      i) Time course of phenotypic expression.
      ii) Conditional expression of mutation.
   b) Suppressor mutations (with examples) - Genetic and non-genetic.

4) Methods of isolation and detection of mutants based on -
   a) Relative survival
   b) Relative growth
   c) Visual detection

UNIT – II / CREDIT II Lectures - 23

1) Genetic complementation - Cis-trans test

2) Extrachromosomal inheritance :
   a) Kappa particles.
   b) Transposable elements - general properties and types.

3) Techniques in Molecular Biology –

COURSE XII : DSE - E 52 - AGRICULTURAL MICROBIOLOGY

(Credit-2, Total Lectures- 45)

UNIT – I / CREDIT - I

Lectures - 23

1) Soil Microbiology
   a. Physical characters.
   b. Chemical characters.
   c. Types of microorganisms in soil and their role in soil fertility.
   d. Microbiological interactions - Symbiosis, Commensalism, Amensalism, Parasitism, and Predation.
2) Role of microorganisms in elemental cycles
   a. Carbon cycle.
   b. Nitrogen cycle
   c. Phosphorous cycle
3) Role of Microorganisms in reclamation of soil.
   I) Manure and Compost
      Methods of Production:
      a) Green manure and farm yard manure
      b) City compost- Windrow and pit method.
      c) Vermicompost
   II) Optimal conditions for composting with reference to - Composition of organic waste, Availability of microorganisms, Aeration, C:N:P ratio, Moisture content, Temperature, pH and Time.
   III) Standards of City Compost and Vermicompost as per Fertilizer Control Order.

UNIT – II / CREDIT - II

Lectures - 22

1) Types, production, methods of application and uses of :
   A) Biofertilizers
      i) Nitrogen fixing - Azotobacter, Rhizobium, and Azospirillum.
      ii) Phosphate Solubilizing Microorganisms.
   B) Biopesticides
      a) *Bacillus thuringiensis*
      b) *Tricoderma spp.*
      c) Beauveria bassiana
2) Biodegradation of :
   a) Cellulose
   b) Pesticides
3) Plant Pathology:
   a) Common symptoms produced by plant pathogens
   b) Modes of transmission of plant diseases.

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