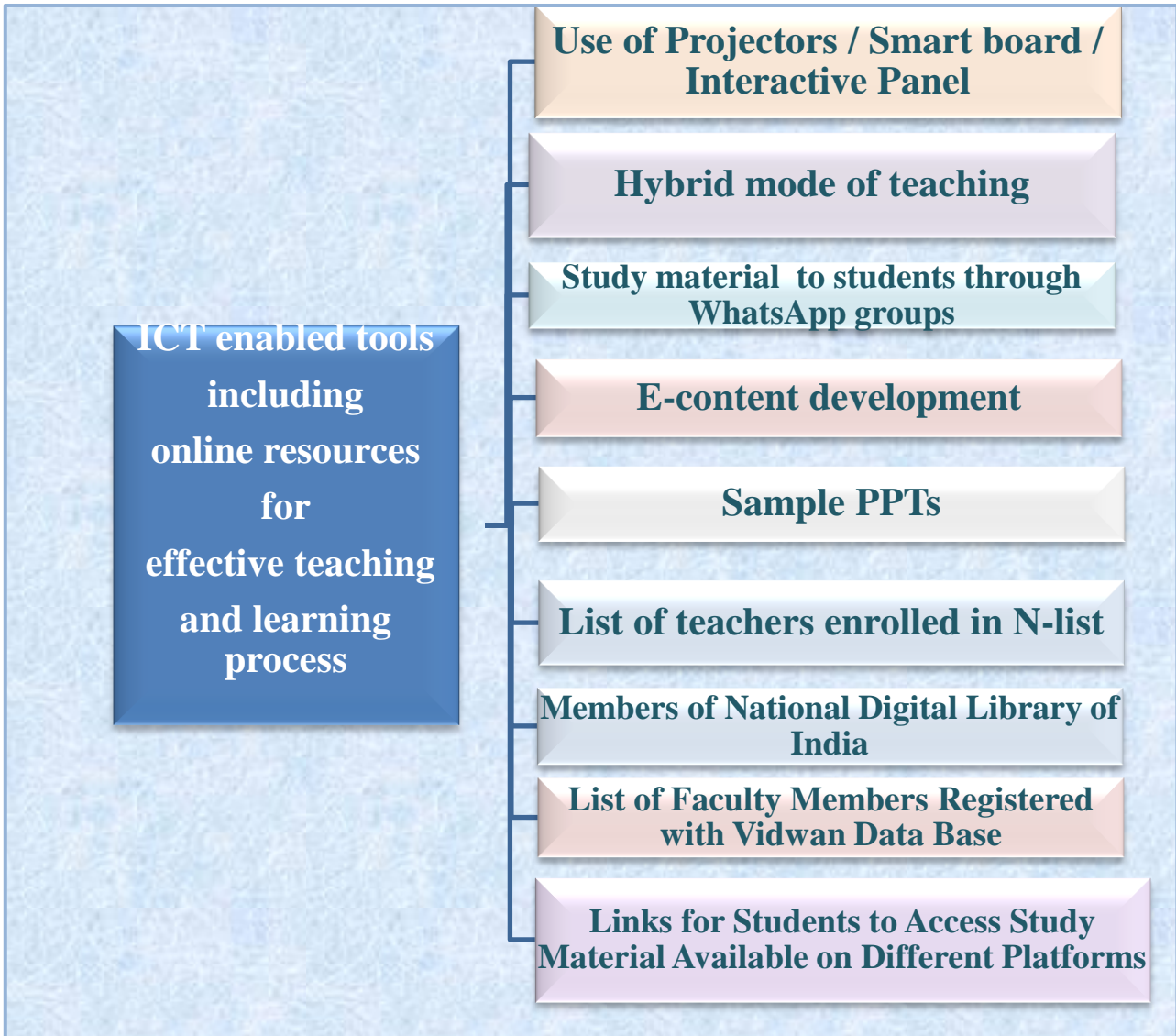




# Internal Quality Assurance Cell

Government Arts and Science College

Ratlam (M.P.) 457001



# Use of Projector and Interactive Board













## Hybrid Mode of Teaching

### Google meet link /YouTube Links


Department	Link
<b>Physics Department</b>	<p><b>Google Meet Link :</b> <a href="https://meet.google.com/ucd-bptq-wrs">https://meet.google.com/ucd-bptq-wrs</a> <a href="https://meet.google.com/fxz-sdox-ara">https://meet.google.com/fxz-sdox-ara</a> <a href="https://meet.google.com/jcc-gqrb-prr">https://meet.google.com/jcc-gqrb-prr</a> <a href="https://meet.google.com/gru-gcxf-jqj">https://meet.google.com/gru-gcxf-jqj</a> <a href="https://meet.google.com/euv-kiyo-fex">https://meet.google.com/euv-kiyo-fex</a> <a href="https://meet.google.com/hja-sadu-tpq">https://meet.google.com/hja-sadu-tpq</a> <a href="https://meet.google.com/aqr-bxvo-apr">https://meet.google.com/aqr-bxvo-apr</a> <a href="https://meet.google.com/amo-mqdm-kdo">https://meet.google.com/amo-mqdm-kdo</a> <a href="https://meet.google.com/zxz-wuyz-nuk">https://meet.google.com/zxz-wuyz-nuk</a> <a href="https://meet.google.com/hut-dkiv-xxv">https://meet.google.com/hut-dkiv-xxv</a></p> <p><b>YouTube Link :</b> <a href="https://youtu.be/Bh0ZTbKFUEk">https://youtu.be/Bh0ZTbKFUEk</a> <a href="https://youtu.be/HZQ1DI3V9IY">https://youtu.be/HZQ1DI3V9IY</a> <a href="https://youtu.be/DNqEHZ91_ec">https://youtu.be/DNqEHZ91_ec</a> <a href="https://youtu.be/bk3o1yEea18">https://youtu.be/bk3o1yEea18</a> <a href="https://youtu.be/Hy97qt81_p8">https://youtu.be/Hy97qt81_p8</a> <a href="https://youtu.be/zJuEW1oiYkY">https://youtu.be/zJuEW1oiYkY</a> <a href="https://youtu.be/LLzyp3Vye3E">https://youtu.be/LLzyp3Vye3E</a> <a href="https://youtu.be/4VMrt5Ai95E">https://youtu.be/4VMrt5Ai95E</a> <a href="https://youtu.be/GKBBPwIe8z4">https://youtu.be/GKBBPwIe8z4</a></p> <p><b>YouTube link for video lectures of a faculty member:</b> <a href="https://youtube.com/@dr.l.s.chongad9081?si=dXRNXOcQYQeQljbA">https://youtube.com/@dr.l.s.chongad9081?si=dXRNXOcQYQeQljbA</a></p>



Zoology Department	CLASS	GOOGLE LINK
	MSc	<a href="https://meet.google.com/vdp-upfs-qvz">https://meet.google.com/vdp-upfs-qvz</a>
MSc	<a href="https://meet.google.com/tuo-ikfu-tmq">https://meet.google.com/tuo-ikfu-tmq</a>	
MSc	<a href="https://meet.google.com/wra-kkxv-yzz">https://meet.google.com/wra-kkxv-yzz</a>	
BSc	<a href="https://meet.google.com/wra-kkxv-yzz">https://meet.google.com/wra-kkxv-yzz</a>	
MSc	<a href="https://meet.google.com/daq-ifqs-viq">https://meet.google.com/daq-ifqs-viq</a>	
BSc	<a href="https://meet.google.com/daq-ifqs-viq">https://meet.google.com/daq-ifqs-viq</a>	
MSc	<a href="https://meet.google.com/cpt-fizf-cvm">https://meet.google.com/cpt-fizf-cvm</a>	
BSc	<a href="https://meet.google.com/hsh-gtfy-sww">https://meet.google.com/hsh-gtfy-sww</a>	
MSc	<a href="https://meet.google.com/jfv-zokr-iaqz">https://meet.google.com/jfv-zokr-iaqz</a>	
BSc	<a href="https://meet.google.com/jfv-zokr-iaqz">https://meet.google.com/jfv-zokr-iaqz</a>	

Offline and Online Class Time Table M.A. 3rd Sem. ( Pol. Sc.)				
समय	प्रश्न-पत्र	प्राध्यापक	कमरा न.	लिंक
10:20 - 11:00	भारत में राज्यों की राजनीति	डॉ. भारती लुणावत	Hall	<a href="https://meet.google.com/oan-oiga-ku">https://meet.google.com/oan-oiga-ku</a>
11:00 - 11:40	भारतीय शासन एवं राजनीति	डॉ. इन्दु कटारिया	Hall	<a href="https://meet.google.com/rqv-ptxx-zwo">https://meet.google.com/rqv-ptxx-zwo</a>
11:40 - 12:20	अंतर्राष्ट्रीय कानून	डॉ. स्वाति पाठक	Hall	<a href="https://meet.google.com/wqb-qiut-zo">https://meet.google.com/wqb-qiut-zo</a>
12:20 - 1:00	भारत की विदेश नीति	डॉ. सुशीला आर्य	Hall	<a href="https://meet.google.com/gmo-dakc-ic">https://meet.google.com/gmo-dakc-ic</a>

**कक्षाएँ सोमवार से शनिवार प्रत्येक कार्यदिवस को संचालित होंगी।**

  
**डॉ. सुशीला आर्य**  
 विभागाध्यक्ष  
 राजनीति विज्ञान विभाग  
 शासकीय कला एवं विज्ञान स्नातकोत्तर महाविद्यालय, रतलाम (म.प्र.)

## English Department

[11/11/2021, 11:32 AM] Dr. Rohit Prabhakar Patil: To join the meeting on Google Meet, click this link:  
<https://meet.google.com/cmz-vpgm-jsn>

Or open Meet and enter this code: cmz-vpgm-jsn

FC-English

To join the meeting on Google Meet, click this link:  
<https://meet.google.com/buu-pbkk-mhc>

Or open Meet and enter this code: buu-pbkk-mhc

FC-English Language

Time-11.40 am.

[10/14/2021, 11:12 AM] Dr. Rohit Prabhakar Patil: To join the meeting on Google Meet, click this link:  
<https://meet.google.com/jii-ztfi-dqd>

Or open Meet and enter this code: jii-ztfi-dqd

FC-English Language

[10/21/2021, 11:00 AM] Dr. Rohit Prabhakar Patil: To join the meeting on Google Meet, click this link:  
<https://meet.google.com/hqd-bqmw-mjb>

Or open Meet and enter this code: hqd-bqmw-mjb

FC-English Language

[10/28/2021, 10:59 AM] Dr. Rohit Prabhakar Patil: To join the meeting on Google Meet, click this link:  
<https://meet.google.com/onc-tycu-yjn>

Or open Meet and enter this code: onc-tycu-yjn

FC-English Language

[11/11/2021, 11:33 AM] Dr. Rohit Prabhakar Patil: To join the meeting on Google Meet, click this link:  
<https://meet.google.com/cmz-vpgm-jsn>

Or open Meet and enter this code: cmz-vpgm-jsn



### Links of Online Classes

Class -B. A. -II Literature  
Paper-I- Drama  
Faculty- Dr. ROHIT PRABHAKAR PATIL

[9/17/2021, 11:28 AM] Dr. Rohit Prabhakar Patil: To join the meeting on Google Meet, click this link:  
<https://meet.google.com/piz-behi-omq>

Or open Meet and enter this code: piz-behi-omq  
[10/8/2021, 12:52 PM] Dr. Rohit Prabhakar Patil: To join the meeting on Google Meet, click this link:  
<https://meet.google.com/uiio-vyqy-dwa>

Or open Meet and enter this code: uiio-vyqy-dwa  
[10/22/2021, 12:18 PM] Dr. Rohit Prabhakar Patil: To join the meeting on Google Meet, click this link:  
<https://meet.google.com/bao-utox-qsc>

Or open Meet and enter this code: bao-utox-qsc  
[10/23/2021, 12:33 PM] Dr. Rohit Prabhakar Patil: To join the meeting on Google Meet, click this link:  
<https://meet.google.com/wvf-igye-otk>

Or open Meet and enter this code: wvf-igye-otk  
[10/29/2021, 12:39 PM] Dr. Rohit Prabhakar Patil: To join the meeting on Google Meet, click this link:  
<https://meet.google.com/zif-onzo-zgc>

Or open Meet and enter this code: zif-onzo-zgc  
[10/30/2021, 12:50 PM] Dr. Rohit Prabhakar Patil: To join the meeting on Google Meet, click this link:  
<https://meet.google.com/owe-ukxd-yro>

Or open Meet and enter this code: owe-ukxd-yro  
[11/12/2021, 12:50 PM] Dr. Rohit Prabhakar Patil: To join the meeting on Google Meet, click this link:  
<https://meet.google.com/ckk-beuo-czs>

Or open Meet and enter this code: ckk-beuo-czs  
[11/13/2021, 12:48 PM] Dr. Rohit Prabhakar Patil: To join the meeting on Google Meet, click this link:

## Mathematics Department

S.No.	Name of Class	Faculty Name	Google Meet Link
1	B.Sc. I	Prof. W.D. Barange	<a href="https://meet.google.com/cup-onmo-hro">https://meet.google.com/cup-onmo-hro</a>
2	B.Sc. II	Prof. Anil Kumar	<a href="https://meet.google.com/cob-bjvb-kof">https://meet.google.com/cob-bjvb-kof</a>
3	B.Sc. III	Dr. Amrish Handa	<a href="https://meet.google.com/abx-fxxn-sdu">https://meet.google.com/abx-fxxn-sdu</a>
4	M.SC. I	Dr. P.C. Patidar	<a href="https://meet.google.com/asn-mrut-gkd">https://meet.google.com/asn-mrut-gkd</a>
5	M.SC. I	Prof. W.D. Barange	<a href="https://meet.google.com/qyb-ptce-cvu">https://meet.google.com/qyb-ptce-cvu</a>
6	M.SC. I	Dr. Bhavana Deshpande	<a href="https://meet.google.com/nhg-yzjt-zpc">https://meet.google.com/nhg-yzjt-zpc</a>
7	M.SC. I	Prof. Anil Kumar	<a href="https://meet.google.com/yaf-xedc-mqm">https://meet.google.com/yaf-xedc-mqm</a>
8	M.SC. I	Dr. Amrish Handa	<a href="https://meet.google.com/wct-znpe-qvj">https://meet.google.com/wct-znpe-qvj</a>
9	M.SC. III	Dr. Bhavana Deshpande	<a href="https://meet.google.com/nhg-yzjt-zpc">https://meet.google.com/nhg-yzjt-zpc</a>
10	M.SC. III	Prof. Anil Kumar	<a href="https://meet.google.com/dnj-htkh-pjf">https://meet.google.com/dnj-htkh-pjf</a>
11	M.SC. III	Prof. W.D. Barange	<a href="https://meet.google.com/vyv-ktee-sfs">https://meet.google.com/vyv-ktee-sfs</a>
12	M.SC. III	Dr. Amrish Handa	<a href="https://meet.google.com/itd-ecuo-hig">https://meet.google.com/itd-ecuo-hig</a>
13	M.SC. III	Dr. P.C. Patidar	<a href="https://meet.google.com/yxz-pwxf-zaw">https://meet.google.com/yxz-pwxf-zaw</a>

<b>Chemistry Department</b>		S.No	Name	Class	Subject	Link
		1	Dr.Riyaj Mansoori	M.Sc-III	Heterocyclic chemistry	<a href="https://meet.google.com/htt-djhe-oxs">https://meet.google.com/htt-djhe-oxs</a>
		2	Dr.Kuldeep Singh		Environmental chemistry	<a href="https://meet.google.com/rps-zqpu-qdk">https://meet.google.com/rps-zqpu-qdk</a>
		3	Dr.Nisha Jain		Biochemistry	<a href="https://meet.google.com/yeq-yeww-itx">https://meet.google.com/yeq-yeww-itx</a>
		4	Vijendra Solanki		polymer chemistry	<a href="https://meet.google.com/xsb-yqhy-ggY">https://meet.google.com/xsb-yqhy-ggY</a>
		5	Dinesh Biurasi		Photochemistry	<a href="https://meet.google.com/xkv-ygms-mib">https://meet.google.com/xkv-ygms-mib</a> <a href="https://meet.google.com/wbq-wdfs-vtf">https://meet.google.com/wbq-wdfs-vtf</a>
		6	Dr.Meenal Gupta		Spectroscopy	<a href="https://meet.google.com/mwy-kyqw-bos">https://meet.google.com/mwy-kyqw-bos</a>
		1	Dr.Riyaj Mansoori	M.Sc-I	Mathematics For Chemist	<a href="https://meet.google.com/bnh-hmew-toy">https://meet.google.com/bnh-hmew-toy</a>
		2	Dr.Nisha Jain		Inorganic Chemistry	<a href="https://meet.google.com/yeq-yeww-itx">https://meet.google.com/yeq-yeww-itx</a>
		3	Vijendra Solanki		Group theory and spectroscopy	<a href="https://meet.google.com/tjy-knxd-sxh">https://meet.google.com/tjy-knxd-sxh</a>
		4	Dr.Meenal Gupta		Group theory and spectroscopy	<a href="https://meet.google.com/pxi-bjbr-psf">https://meet.google.com/pxi-bjbr-psf</a>
		5	Meenakshi Harod		Biology for Chemist	<a href="https://meet.google.com/ysm-gzqu-pfh">https://meet.google.com/ysm-gzqu-pfh</a>
		6	Gr.Vandana Rajawat		Group theory and spectroscopy	<a href="https://meet.google.com/bcu-kuzx-dzi">https://meet.google.com/bcu-kuzx-dzi</a>
		1	Vijendra Solanki	B.Sc-II Year	Chemistry	<a href="https://meet.google.com/fze-emiy-crw">https://meet.google.com/fze-emiy-crw</a>
		2	Dr.Kavita Thakur	B.Sc-III Year	Chemistry	<a href="https://meet.google.com/njp-qtes-eqh">https://meet.google.com/njp-qtes-eqh</a>
		3	Dr.Riyaj Mansoori	B.Sc-III Year	Chemistry	<a href="https://meet.google.com/wxp-jrtv-utq">https://meet.google.com/wxp-jrtv-utq</a>

<b>Microbiology Department</b>		S.No.	Class	link
		1.	B.Sc. I year Microbiology	<a href="http://meet.google.com/bhj-cjkr-ahq">http://meet.google.com/bhj-cjkr-ahq</a>
		2.	B.Sc. II year Microbiology	<a href="http://meet.google.com/eph-hrfh-zca">http://meet.google.com/eph-hrfh-zca</a>
		3.	B.Sc. III year Microbiology	<a href="http://meet.google.com/ahi-wzro-pwj">http://meet.google.com/ahi-wzro-pwj</a>
		4.	M.Sc. I sem General Microbiology & Microbial Diversity	<a href="http://meet.google.com/sgr-cdup-yco">http://meet.google.com/sgr-cdup-yco</a>
		5.	M.Sc. I sem Microbial Genetics	<a href="http://meet.google.com/sgr-cdup-yco">http://meet.google.com/sgr-cdup-yco</a>
		6.	M.Sc. I sem Biochemistry And Microbial Physiology	<a href="http://meet.google.com/pvm-onry-wbq">http://meet.google.com/pvm-onry-wbq</a>
		7.	M.Sc. I sem Environmental Microbiology	<a href="http://meet.google.com/bhj-cjkr-ahq">http://meet.google.com/bhj-cjkr-ahq</a>
		8.	M.Sc. I sem Biological Techniques And Instrumentation	<a href="http://meet.google.com/pvm-onry-wbq">http://meet.google.com/pvm-onry-wbq</a> <a href="http://meet.google.com/bhj-cjkr-ahq">http://meet.google.com/bhj-cjkr-ahq</a>
		9.	M.Sc. III sem Microbial Technology	<a href="http://meet.google.com/fah-vbmr-ahi">http://meet.google.com/fah-vbmr-ahi</a>
		10.	M.Sc. III sem Immunology	<a href="http://meet.google.com/mmo-zxwc-udp">http://meet.google.com/mmo-zxwc-udp</a>
		11.	M.Sc. III sem Food And Industrial Microbiology	<a href="http://meet.google.com/bhj-cjkr-ahq">http://meet.google.com/bhj-cjkr-ahq</a>

<b>Biotechnology Department</b>		S.No.	Class	link
		1.	B.Sc. I year Biotechnology	<a href="http://meet.google.com/ypb-fzyp-mcz">http://meet.google.com/ypb-fzyp-mcz</a> <a href="http://meet.google.com/bhj-cjkr-ahq">http://meet.google.com/bhj-cjkr-ahq</a>
		2.	B.Sc. II year Biotechnology	<a href="http://meet.google.com/cew-uzcn-oci">http://meet.google.com/cew-uzcn-oci</a>
		3.	B.Sc. III year Biotechnology	<a href="http://meet.google.com/xnj-uynd-hyr">http://meet.google.com/xnj-uynd-hyr</a>



	4.	M.Sc. I sem Cell & Molecular Biology	<a href="http://meet.google.com/dwc-xoyi-jvf">http://meet.google.com/dwc-xoyi-jvf</a>
	5.	M.Sc. I sem Immunology And Molecular Diagnostics	<a href="http://meet.google.com/jze-mxpz-thd">http://meet.google.com/jze-mxpz-thd</a>
	6.	M.Sc. I sem Molecular Endocrinology And Reproductive Technology	<a href="http://meet.google.com/zaf-yxsi-phi">http://meet.google.com/zaf-yxsi-phi</a>
	7.	M.Sc. I sem Microbiology	<a href="http://meet.google.com/ypb-fzyp-mcz">http://meet.google.com/ypb-fzyp-mcz</a>
	8.	M.Sc. III sem Genetics Engineering	<a href="http://meet.google.com/aev-hpsg-tjt">http://meet.google.com/aev-hpsg-tjt</a>
	9.	M.Sc. III sem Bioprocess Engineering and Bioinformatics	<a href="http://meet.google.com/fyo-nkjj-rod">http://meet.google.com/fyo-nkjj-rod</a>
	10.	M.Sc. III sem Part – I Industrial Biotechnology Part – II Animal Cell Culture	<a href="http://meet.google.com/wyy-dptk-jax">http://meet.google.com/wyy-dptk-jax</a>
	11.	M.Sc. III sem Plant Biotechnology	<a href="http://meet.google.com/fyo-nkjj-rod">http://meet.google.com/fyo-nkjj-rod</a>

## Geography Department

### ऑनलाइन क्लास समय सारणी

एम. ए. प्रथम सेमेस्टर

क्रमांक	प्रश्नपत्र	समय	प्राध्यापक	Link for Online Class
1	भू-आकृति विज्ञान (Geomorphology)	प्रातः 11:00 बजे से	डॉ. मायारानी देवड़ा	<a href="https://meet.google.com/ygi-dofv-mya">https://meet.google.com/ygi-dofv-mya</a>
2	आर्थिक भूगोल (Economic Geography)	प्रातः 11:40 बजे से	डॉ. एम. एल. बड़गोत्या	<a href="https://meet.google.com/mrx-sche-cix">https://meet.google.com/mrx-sche-cix</a>
3	भारत का भूगोल (Geography of India)	दोपहर 12:20 बजे से	प्रो. नीरज आर्य	<a href="https://meet.google.com/oby-zjsv-wzp">https://meet.google.com/oby-zjsv-wzp</a>
4	भौगोलिक चिंतन का इतिहास (History of Geographical Thoughts)	दोपहर 01:00 बजे से	डॉ. जी.एस. खराड़ी	<a href="https://meet.google.com/kho-khxm-zuc">https://meet.google.com/kho-khxm-zuc</a>

दिन - गुरुवार, शुक्रवार, शनिवार ।

### ऑनलाइन क्लास समय सारणी

एम. ए. तृतीय सेमेस्टर

क्रमांक	प्रश्नपत्र	समय	प्राध्यापक	Link for Online Class
1	समुद्र विज्ञान (Oceanography)	प्रातः 11:00 बजे से	डॉ. एम. एल. बड़गोत्या	<a href="https://meet.google.com/aa-y-pizh-our">https://meet.google.com/aa-y-pizh-our</a>
2	पर्यटन भूगोल (Geography of Tourism)	प्रातः 11:40 बजे से	डॉ. मायारानी देवड़ा	<a href="https://meet.google.com/qqa-etzu-umk">https://meet.google.com/qqa-etzu-umk</a>
3	नगरीय भूगोल (Urban Geography)	दोपहर 12:20 बजे से	डॉ. जी. एस. खराड़ी	<a href="https://meet.google.com/npo-pkdv-gbi">https://meet.google.com/npo-pkdv-gbi</a>
4	कृषि भूगोल (Agricultural Geography)	दोपहर 01:00 बजे से	प्रो. नीरज आर्य	<a href="https://meet.google.com/iai-epth-qhk">https://meet.google.com/iai-epth-qhk</a>

दिन- सोमवार, मंगलवार, बुधवार ।

## Botany Department

Prof. Hitesh sankhala: Google Meet link  
<https://meet.google.com/ior-pdci-cdq>

Prof.Sukhlal muwel : Google Meet link:  
<https://meet.google.com/ior-pdci-cdq>  
<https://meet.google.com/vcg-ctsc-ddo>

Prof Mukesh evne : Google Meet link:  
<https://meet.google.com/vcg-ctsc-ddo>

Prof.Rashmi khedar: Google Meet link:  
<https://meet.google.com/xyi-jcwa-iux>

Smt.Manju dawar : Google Meet link:  
<https://meet.google.com/xyi-jcwa-iux>


## Hindi Department

Dr. Archana Bhatta  
<https://meet.google.com/mtu-dina-zpa>  
<https://meet.google.com/fof-cyaa-ibe>  
<https://meet.google.com/rta-nrza-bjc>  
<https://meet.google.com/huk-uizo-vwp>

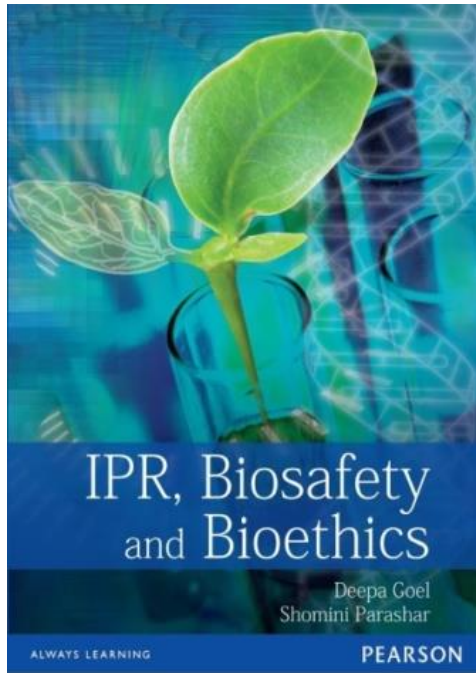
Dr. Lalita Lodha  
<https://meet.google.com/gxu-xbcs-mqi>  
<https://meet.google.com/awj-yixu-wtj>  
<https://meet.google.com/ufh-xnye-mhg>

## Statistics Department

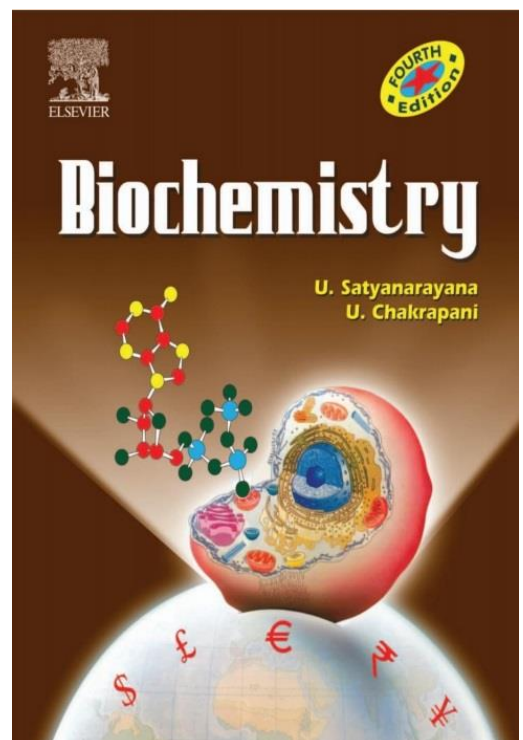
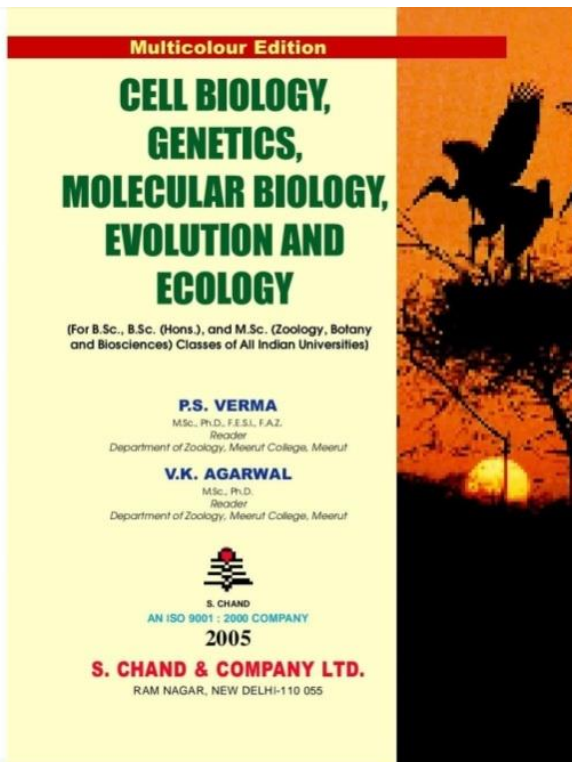
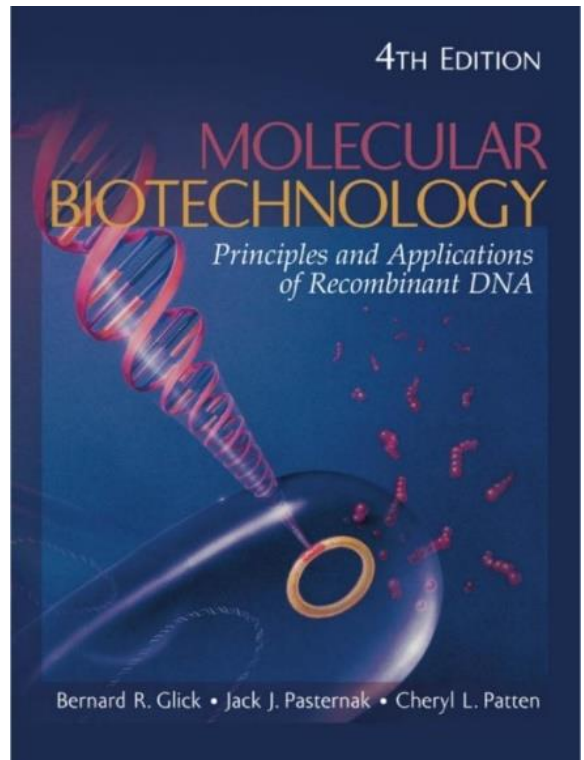
**Links of Prof. V.Shastrī**  
**BSc I :** <https://meet.google.com/peg-jqmo-jhe>  
**MSc I :** <https://meet.google.com/vax-izsm-icr>  
**MSc III :** <https://meet.google.com/ndv-wohe-hix>

<b>Sanskrit Department</b>	<a href="https://meet.google.com/wzb-vxys-fpa">https://meet.google.com/wzb-vxys-fpa</a>												
<b>Economics Department</b>	<p>अर्थशास्त्र विभाग, शा. कला एवं विज्ञान महाविद्यालय, रतलाम (म.प्र.)</p> <p>Google Link</p> <ol style="list-style-type: none"> <li>1. <a href="https://meet.google.com/uqv-jhun-dop">https://meet.google.com/uqv-jhun-dop</a> BA-I</li> <li>2. <a href="https://meet.google.com/oeq-qcwu-qrh">https://meet.google.com/oeq-qcwu-qrh</a> BA-II</li> <li>3. <a href="https://meet.google.com/vrz-udbn-jyd">https://meet.google.com/vrz-udbn-jyd</a> BA-III</li> <li>4. <a href="https://meet.google.com/yow-cbxx-dcv">https://meet.google.com/yow-cbxx-dcv</a> MA-P</li> <li>5. <a href="https://meet.google.com/yow-cbxx-dcs">https://meet.google.com/yow-cbxx-dcs</a> MA-F</li> </ol> <p style="text-align: right;">           विभागाध्यक्ष          अर्थशास्त्र विभाग          शासकीय कला एवं विज्ञान          महाविद्यालय, रतलाम (म.प्र.)       </p>												
<b>Philosophy Department</b>	<a href="https://meet.google.com/vym-Zuts.doc">https://meet.google.com/vym-Zuts.doc</a>												
<b>History Department</b>	<a href="https://meet.google.com/ftb-rxeo-pad">https://meet.google.com/ftb-rxeo-pad</a> <a href="https://meet.google.com/gge-inhs-yqe">https://meet.google.com/gge-inhs-yqe</a> <a href="https://meet.google.com/aro-moip-syc">https://meet.google.com/aro-moip-syc</a>												
<b>Computer Department</b>	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>S. No.</th> <th>Faculty Name</th> <th>Link</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">1</td> <td>Mr. Nitesh Pathak</td> <td><a href="https://meet.google.com/ixw-frep-vrq">https://meet.google.com/ixw-frep-vrq</a></td> </tr> <tr> <td style="text-align: center;">2</td> <td>Mrs. Neelam Mehta</td> <td><a href="https://meet.google.com/mku-mirq-skw">https://meet.google.com/mku-mirq-skw</a></td> </tr> <tr> <td style="text-align: center;">3</td> <td>Mrs. Pooja Parmar</td> <td><a href="https://meet.google.com/fuv-ezoc-wqu">https://meet.google.com/fuv-ezoc-wqu</a></td> </tr> </tbody> </table>	S. No.	Faculty Name	Link	1	Mr. Nitesh Pathak	<a href="https://meet.google.com/ixw-frep-vrq">https://meet.google.com/ixw-frep-vrq</a>	2	Mrs. Neelam Mehta	<a href="https://meet.google.com/mku-mirq-skw">https://meet.google.com/mku-mirq-skw</a>	3	Mrs. Pooja Parmar	<a href="https://meet.google.com/fuv-ezoc-wqu">https://meet.google.com/fuv-ezoc-wqu</a>
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2	Mrs. Neelam Mehta	<a href="https://meet.google.com/mku-mirq-skw">https://meet.google.com/mku-mirq-skw</a>											
3	Mrs. Pooja Parmar	<a href="https://meet.google.com/fuv-ezoc-wqu">https://meet.google.com/fuv-ezoc-wqu</a>											
<b>Microbiology Department</b>	<p><b>YOU TUBE LINK OF LECTURES:</b></p> <p> <a href="https://youtu.be/IjVLhoyfGAM">https://youtu.be/IjVLhoyfGAM</a>  <a href="https://youtu.be/gZAw7pahzMM">https://youtu.be/gZAw7pahzMM</a>  <a href="https://youtu.be/8tYgCbDV3j4">https://youtu.be/8tYgCbDV3j4</a>  <a href="https://youtu.be/k4AI4UipziI">https://youtu.be/k4AI4UipziI</a>  <a href="https://youtu.be/8_f-8ISZ164">https://youtu.be/8_f-8ISZ164</a>  <a href="https://youtu.be/gvYJaPxsSZg">https://youtu.be/gvYJaPxsSZg</a>  <a href="https://youtu.be/a1orHT1AqZI">https://youtu.be/a1orHT1AqZI</a>  <a href="https://youtu.be/0h5Jd7sgQWY">https://youtu.be/0h5Jd7sgQWY</a>  <a href="https://youtu.be/DwAFZb8juMQ">https://youtu.be/DwAFZb8juMQ</a> </p>												
<b>Biotech Department</b>	<p><b>YOU TUBE LINK OF LECTURES :-</b></p> <p> <a href="https://youtu.be/IjVLhoyfGAM">https://youtu.be/IjVLhoyfGAM</a>  <a href="https://youtu.be/gZAw7pahzMM">https://youtu.be/gZAw7pahzMM</a>  <a href="https://youtu.be/8tYgCbDV3j4">https://youtu.be/8tYgCbDV3j4</a>  <a href="https://youtu.be/k4AI4UipziI">https://youtu.be/k4AI4UipziI</a>  <a href="https://youtu.be/8_f-8ISZ164">https://youtu.be/8_f-8ISZ164</a>  <a href="https://youtu.be/gvYJaPxsSZg">https://youtu.be/gvYJaPxsSZg</a> </p>												

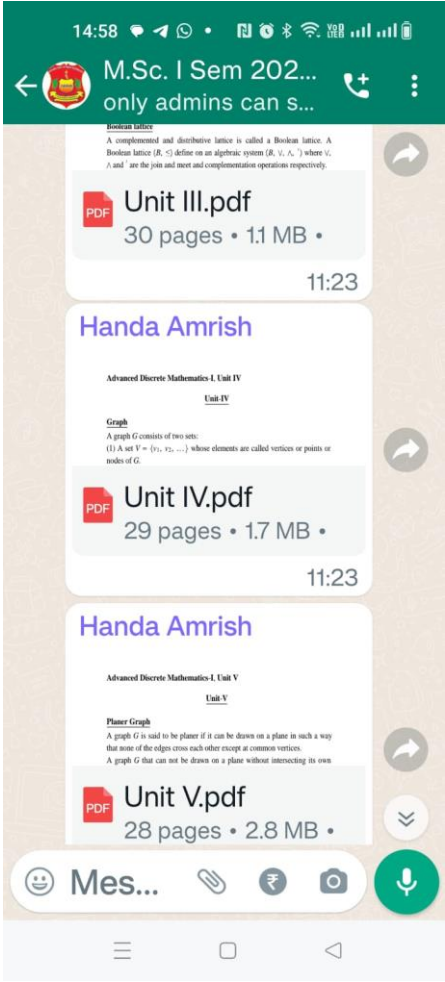
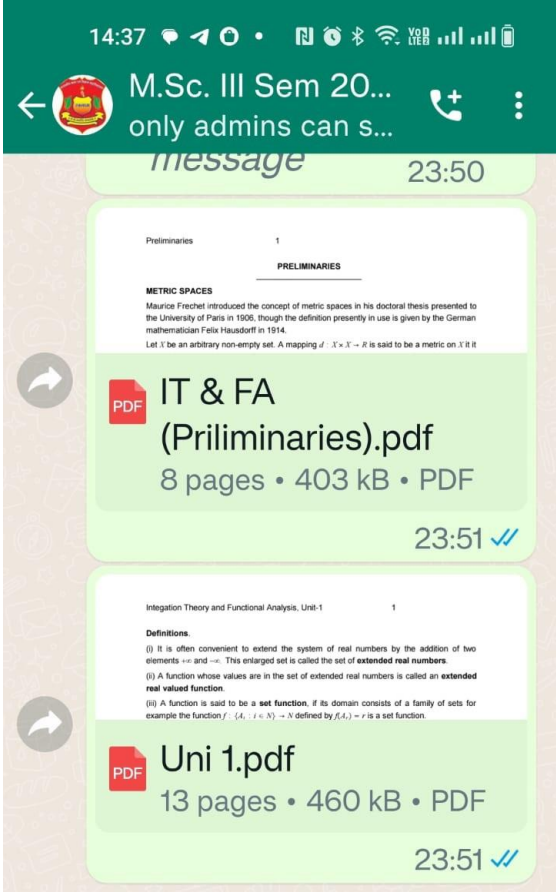




IPR, Biosafety and Bioethics

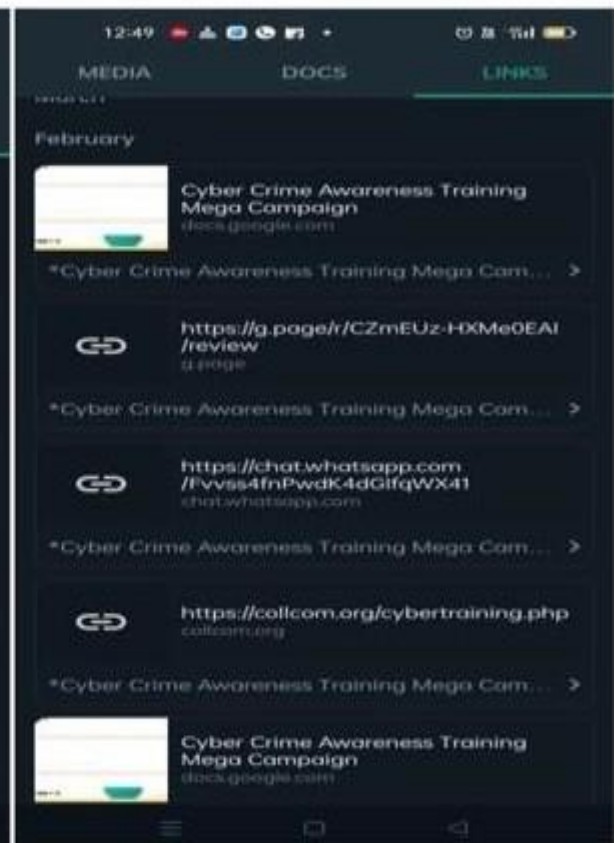
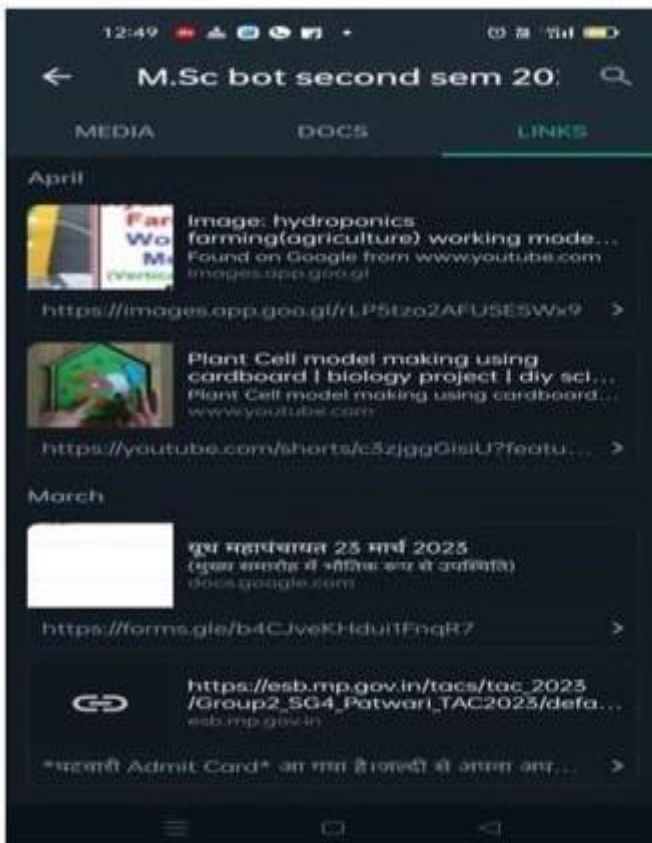
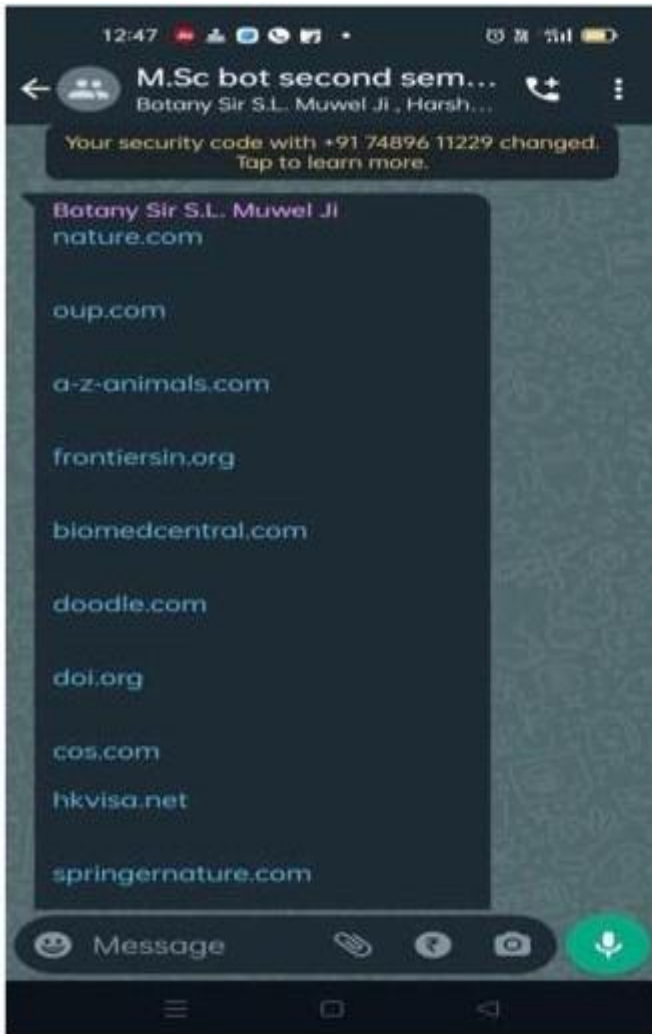


# Notes through WhatsApp

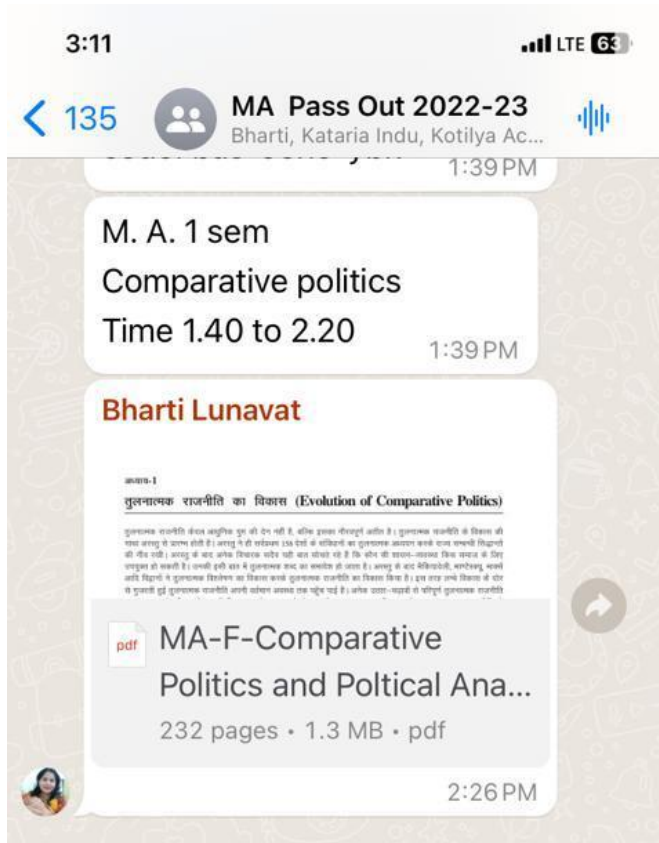














## E-content

Department of Higher Education (M.P.)

Session 2021-22

S.no.	Faculty Name	Subject	Class	Paper Name	Unit	Topic
1	<b>Dr. Alka Kulshrestha</b>	Zoology	B.sc.1st year	Major 1	4.4	Phylum mollusca
2	<b>Dr. Anis Mohammed</b>	Zoology	B.sc.1st year	Elective	2.4	Modern Beekeeping
3	<b>Dr. Rajendra Singh Jamod</b>	Zoology	B.sc.1st year	Major 1	5.4	Phylum Hemichordata
4	<b>Dr.Shweta Tevani</b>	Political Science	B.A.1st year	Major 2 Indian Constitution	2.1	Central Legislative: Indian Parliament- Composition and Functions of Lok Sabha
5	<b>Mrs. Poonam Choudhary</b>	Political Science	B.A.1st year	Elective Indian Political System	1.6	Federal System
6.	<b>Dr. Meenal Gupta</b>	Chemistry/ Biochemistry	B.Sc. I	Major-I Unit-5	5.2	Measurement of radioactivity: methods based on gas ionization

**Session 2022-23**

S.no.	Faculty Name	Subject	CLass	Paper Name	Unit	Topic
1	<b>Dr. Bharti Lunawat</b>	Political Science	B.A. 2nd year	Major 1st Westen Political Thought	4.1,4.2	Thomas Hill Green: Views on Freedom and Right
2	<b>Dr. Shweta Tevani</b>	Political Science	B.A.2nd year	Generic Elective: Human Right	1.1	Meaning of Human Rights and It's Coreletion with other Rights
3	<b>Mrs. Poonam Choudhary</b>	Political Science	B.A.2nd year	Major 1st Westan Political Thought	1.4	Plato-Philosopher King
4.	<b>Dr. Meenal Gupta</b>	Chemistry	B.Sc. II year	Major-II Unit-IV	4.7	Standard electrode potential, Electrochemical Series and its applications. Electrochemical cells: Nernst equation, calculation of EMF of a cell

**Link for the mentioned contents:**

<https://www.eshiksha.mp.gov.in/>


## Certificates of FDP on E-Content Developments


### उच्च शिक्षा विभाग, मध्यप्रदेश शासन


क्रमांक: econtent/polscl/13 सत्यापन मंडल द्वारा प्रमाणन दिनांक: 20/03/2022


यह प्रमाणित किया जाता है कि :


- (1) सत्यापन मंडल द्वारा कक्षा बी.ए. प्रथम वर्ष के विषय *राजनीति विज्ञान* के प्रश्नपत्र *भारतीय संविधान की इकाई 11* के मॉड्यूल 2.1 *केंद्रीय विधायिका : संसद लोक सभा संगठन एवं कार्य* से संबंधित ई-कॉन्टेंट के सम्पादन/मूल्यांकन का कार्य किया गया है।
- (2) उक्त ई-कॉन्टेंट के निर्माता *डॉ. श्वेता टेवानी (सहायक प्राध्यापक)* संस्था *शासकीय कला एवं विज्ञान ज्ञातकोत्तर महाविद्यालय, रतलाम (म.प्र.)* से हैं। इनके द्वारा इस ई-कॉन्टेंट के मौलिक होने का घोषणापत्र प्रदान किया गया है।
- (3) यह ई-कॉन्टेंट विषयवस्तु तथा प्रस्तुतिकरण के आधार पर उच्च शिक्षा विभाग, मध्यप्रदेश के LMS पोर्टल पर विद्यार्थियों के हितार्थ प्रदर्शित करने योग्य है।


  
**डॉ. मनीष दुबे**  
सहायक प्राध्यापक  
शासकीय एल-बी-एस ज्ञातकोत्तर  
महाविद्यालय, गंव बत्तीवा


  
**डॉ. एन. पी. दुल्ला**  
सहायक प्राध्यापक  
शासकीय ज्ञातकोत्तर महाविद्यालय, टीवा

  
**डॉ. श्वेता प्रभात (संयोजक)**  
शासकीय ज्ञातकोत्तर महाविद्यालय, कटनी

  
**डॉ. एन.पी. कुमार मिश्रा**  
(सह-संयोजक)  
शासकीय स्वामी ज्ञातकोत्तर  
महाविद्यालय, किरवाड़ा

  
**डॉ. मणवत सिंह पात**  
सहायक प्राध्यापक  
शासकीय एल-बी-एस  
ज्ञातकोत्तर महाविद्यालय, सिरोरा

  
**डॉ. सोनम बोर**  
सहायक प्राध्यापक  
शासकीय महाविद्यालय,  
बिड़ुवा, किरवाड़ा



## Government of Madhya Pradesh

### मध्य प्रदेश शासन

## Department of Higher Education

### उच्च शिक्षा विभाग

सम्पादक/ मूल्यांकनकर्ताओं द्वारा देय प्रमाण-पत्र


प्रमाणित किया जाता है कि


**Dr. Meenal Gupta, Assitt Professor, Govt. Arts & Science College, Ratlam (M.P.)**


द्वारा कक्षा बी.एससी. प्रथम वर्ष के विषय *जैव रसायन विज्ञान* के प्रश्न पत्र प्रथम *जैव रसायनिक तकनीक की इकाई 5* के मॉड्यूल 5.2 से सम्बंधित E-content सत्र 2021 – 22 उच्च शिक्षा विभाग, मध्यप्रदेश के लिये तैयार किया गया है।


1. E-content का सम्पादन / मूल्यांकन, रसायन शास्त्र के सत्यापन मंडल द्वारा किया गया है।
2. यह E-content न तो रूपांतरित है न ही संकलित है तथा प्रस्तुत E-content पूर्ण रूप से अप्रकाशित है।
3. उक्त E-content के निर्माण में कॉपीराइट/ प्लेजिज्म सम्बंधित समस्त नियमों का पालन हुआ है एवं यह उच्च शिक्षा विभाग, मध्यप्रदेश के LMS पोर्टल के अंतर्गत प्रकाशन के योग्य है।


प्रमाणित किया जाता है कि उपरोक्त विवरण प्राप्त जानकारी के अनुसार पूर्णतः सत्य एवं सही है।


  
**डॉ. अंजलि आचर्या**  
(संयोजक)

  
**डॉ. किशोर अरोरा**  
(सह-संयोजक)

  
**डॉ. शालिनी सक्सेना**  
(सदस्य)

  
**डॉ. अखिलेश शेण्डे**  
(सदस्य)

  
**डॉ. धीरेन्द्र कुमार पटेल**  
(सदस्य)

  
**डॉ. पूजा गुप्ता**  
(सदस्य)



## उच्च शिक्षा विभाग, मध्यप्रदेश शासन

सत्यापन मंडल द्वारा प्रमाणन

दिनांक: 04/02/2022

यह प्रमाणित किया जाता है कि :

- (1) सत्यापन मंडल द्वारा कक्षा बी.एससी. के विषय Zoology के प्रश्नपत्र Open Elective Two की इकाई 02 के मॉड्यूल Modern Beekeeping Equipments. (2.4) से संबंधित ई-कंटेंट के सम्पादन/मूल्यांकन का कार्य किया गया है।
- (2) उक्त ई-कंटेंट के निर्माता Dr. Anis Mohammed संस्था Government PG Arts & Science College Ratlam (M.P) से हैं। इनके द्वारा इस ई-कंटेंट के मौलिक होने का घोषणापत्र प्रदान किया गया है।
- (3) यह ई-कंटेंट विषयवस्तु तथा प्रस्तुतिकरण के आधार पर उच्च शिक्षा विभाग, मध्यप्रदेश के LMS पोर्टल पर विद्यार्थियों के हितार्थ प्रदर्शित करने योग्य है।

Dr. Ruchira Chaudhary,  
**Coordinator**  
Professor  
Institute for Excellence  
in Higher Education  
(IEHE), Bhopal (M.P.)

Dr. K. K. Mishra,  
**Co-coordinator**  
Professor  
Govt. Dr. S.P.M  
Science and  
Commerce College,  
Bhopal (M.P.)

Dr. Namrata Khurana,  
**Member**  
Assistant Professor  
Maharaja Bhoj Govt. PG  
College Dhar (M.P.)

Dr. Pratistha Dwivedi,  
**Member**  
Assistant Professor  
Govt. Nehru College,  
Sabalgarh (M.P.)

Dr. Nitin Batav,  
**Member**  
Assistant Professor  
Govt. College Bhopur  
(M.P.)

Mr. Vishal Vashisth,  
**Member**  
Assistant Professor  
Govt. Swami  
Vivekanand Degree  
College  
Berasia, Bhopal (M.P.)

## उच्च शिक्षा विभाग, मध्यप्रदेश शासन

सत्यापन मंडल द्वारा प्रमाणन

दिनांक: 12/12/2021

यह प्रमाणित किया जाता है कि :

- (1) सत्यापन मंडल द्वारा कक्षा बी.एससी. के विषय Zoology के प्रश्नपत्र Major की इकाई 5 के मॉड्यूल Phylum Hemichordata : General Characters Of The Phylum Hemichordate And Relationship With Non-chordates And Chordates (5.4) से संबंधित ई-कंटेंट के सम्पादन/मूल्यांकन का कार्य किया गया है।
- (2) उक्त ई-कंटेंट के निर्माता Shri. Rajendra Singh Jamod संस्था Govt. Arts and Science College Ratlam, (M.P) से हैं। इनके द्वारा इस ई-कंटेंट के मौलिक होने का घोषणापत्र प्रदान किया गया है।
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Mr. Vishal Vashisth,  
**Member**  
Assistant Professor  
Govt. Swami  
Vivekanand Degree  
College  
Berasia, Bhopal (M.P.)

**OFFICE OF THE COMMISSIONER  
HIGHER EDUCATION, MADHYA PRADESH  
FACULTY DEVELOPMENT PROGRAM  
ON  
E-CONTENT DEVELOPMENT**

(Power Point based Video Lectures)

SNO: B1-0G128

**Certificate of Participation**

This is to certify that **Dinesh Bourasi, Asst. Professor, Dept. of Chemistry  
Govt. Arts And Science College, Ratlam**  
has participated and successfully completed 36 contact hours in  
Six Days Online Faculty Development Program on  
**E-CONTENT DEVELOPMENT  
(PowerPoint Based Video Lectures)**  
from 19th Dec. to 24th Dec, 2022.

**Dr. Dharendra Shukla**  
Coordinator

**Dr. Diwa Mishra**  
Nodal officer

**Karmveer Sharma**  
Commissioner

**OFFICE OF THE COMMISSIONER  
HIGHER EDUCATION, MADHYA PRADESH  
FACULTY DEVELOPMENT PROGRAM  
ON  
E-CONTENT DEVELOPMENT**

(Power Point based Video Lectures)

SNO: B3-044

**Certificate of Participation**

This is to certify that **Dr Meenal Gupta, Assistant Proferssor, Dept. of Chemistry  
Govt Arts And Science College, Ratlam**  
has participated and successfully completed 36 contact hours in  
Six Days Online Faculty Development Program on  
**E-CONTENT DEVELOPMENT  
(PowerPoint Based Video Lectures)**  
from 6th June to 11th June, 2022.

**Dr. Dharendra Shukla**  
Coordinator

**Dr. Diwa Mishra**  
Nodal officer

**Deepak Singh**  
Commissioner

**OFFICE OF THE COMMISSIONER  
HIGHER EDUCATION, MADHYA PRADESH  
FACULTY DEVELOPMENT PROGRAM  
ON  
E-CONTENT DEVELOPMENT**

(Power Point based Video Lectures)

SNO: B1-0G100

**Certificate of Participation**

This is to certify that **Vijendra Solanki, Asst. Professor, Dept. of Chemistry  
Govt Art'S And Science College Ratlam**  
has participated and successfully completed 36 contact hours in  
Six Days Online Faculty Development Program on  
**E-CONTENT DEVELOPMENT  
(PowerPoint Based Video Lectures)**  
from 19th Dec. to 24th Dec, 2022.

**Dr. Dharendra Shukla**  
Coordinator

**Dr. Diwa Mishra**  
Nodal officer

**Karmveer Sharma**  
Commissioner

**OFFICE OF THE COMMISSIONER  
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FACULTY DEVELOPMENT PROGRAM  
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SNO: B1-0G15

**Certificate of Participation**

This is to certify that **Dr. Riyaj Ahemd Mansoori, Asst. Professor, Dept. of Chemistry  
Govt. Arts & Science College, Ratlam (M.P)**  
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**Dr. Dharendra Shukla**  
Coordinator

**Dr. Diwa Mishra**  
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SNO: B2-0G30

**Certificate of Participation**

This is to certify that **Wasudeo Barange, Asst. Professor, Dept. of Mathematics  
Government Arts And Science College Ratlam**  
has participated and successfully completed 36 contact hours in  
Six Days Online Faculty Development Program on  
**E-CONTENT DEVELOPMENT  
(PowerPoint Based Video Lectures)**  
from 26th Dec. to 31st Dec, 2022.

**Dr. Dharendra Shukla**  
Coordinator

**Dr. Diwa Mishra**  
Nodal officer

**Karmveer Sharma**  
Commissioner

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ON  
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SNO: B2-0G29

**Certificate of Participation**

This is to certify that **Dr. Amrish Handa, Asst. Professor, Dept. of Mathematics  
Govt. Arts And Science College Ratlam (M.P.)**  
has participated and successfully completed 36 contact hours in  
Six Days Online Faculty Development Program on  
**E-CONTENT DEVELOPMENT  
(PowerPoint Based Video Lectures)**  
from 26th Dec. to 31st Dec, 2022.

**Dr. Dharendra Shukla**  
Coordinator

**Dr. Diwa Mishra**  
Nodal officer

**Karmveer Sharma**  
Commissioner

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FACULTY DEVELOPMENT PROGRAM  
ON  
E-CONTENT DEVELOPMENT**

(Power Point based Video Lectures)

SNO: B3-0107

**Certificate of Participation**

This is to certify that **Anil Kumar , Asst. Professor, Dept. of Mathematics  
Govt. Arts And Science College Ratlam**  
has participated and successfully completed 36 contact hours in  
Six Days Online Faculty Development Program on  
**E-CONTENT DEVELOPMENT  
(PowerPoint Based Video Lectures)**  
from 2nd Jan. to 7th Jan, 2023.



**Dr. Dharendra Shukla**  
Coordinator



**Dr. Diwa Mishra**  
Nodal officer



**Karmveer Sharma**  
Commissioner

# विद्युत् रासायनिक श्रेणी एवं इंसर्के उपयोग

**B.SG. II YEAR 2022-23 (MINOR/ELECTIVE)**

डॉं मीनल गुप्ता

सहायक प्राध्यापक

(रसायन शास्त्र)

शासकीय कला एवं विज्ञान महाविद्यालय, रतनाम (म. प्र .)





# विद्युत् रासायनिक श्रेणी एवं इंसर्के उपयोग

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# Electrochemical series and its application

इस विषय के अध्ययन से विद्यार्थी ज्ञानवर्धक जिज्ञासा सीखेंगे,  
जैसे

दैनिक जीवन में धातुओं के रंगों का  
रसायन

इलेक्ट्रोकेमिकल सेल बनाने के लिए  
धातुओं का चुनाव

• रासायनिक अभिक्रियाओं का ज्ञान –  
ऑक्सीकरण, अपचयन, धातुओं की सक्रियता  
एवं धातु का मुक्त होना आदि ।

# विद्युत् रासायनिक श्रेणी के लक्षण

Equilibrium (Oxidants $\leftrightarrow$ Reductants)	$E^{\circ}$ (volts)
Lithium: $\text{Li}^+(\text{aq}) + \text{e}^- \leftrightarrow \text{Li}(\text{s})$	-3.03
Potassium: $\text{K}^+(\text{aq}) + \text{e}^- \leftrightarrow \text{K}(\text{s})$	-2.92
Calcium: $\text{Ca}^{2+}(\text{aq}) + 2\text{e}^- \leftrightarrow \text{Ca}(\text{s})$	-2.87
Sodium: $\text{Na}^+(\text{aq}) + \text{e}^- \leftrightarrow \text{Na}(\text{s})$	-2.71
Magnesium: $\text{Mg}^{2+}(\text{aq}) + 2\text{e}^- \leftrightarrow \text{Mg}(\text{s})$	-2.37
Aluminum: $\text{Al}^{3+}(\text{aq}) + 3\text{e}^- \leftrightarrow \text{Al}(\text{s})$	-1.66
Zinc: $\text{Zn}^{2+}(\text{aq}) + 2\text{e}^- \leftrightarrow \text{Zn}(\text{s})$	-0.76
Iron: $\text{Fe}^{2+}(\text{aq}) + 2\text{e}^- \leftrightarrow \text{Fe}(\text{s})$	-0.44
Lead: $\text{Pb}^{2+}(\text{aq}) + 2\text{e}^- \leftrightarrow \text{Pb}(\text{s})$	-0.13
Hydrogen: $2\text{H}^+(\text{aq}) + 2\text{e}^- \leftrightarrow \text{H}_2(\text{g})$	0.00
Copper: $\text{Cu}^{2+}(\text{aq}) + 2\text{e}^- \leftrightarrow \text{Cu}(\text{s})$	+0.34
Silver: $\text{Ag}^+(\text{aq}) + \text{e}^- \leftrightarrow \text{Ag}(\text{s})$	+0.80
Chlorine: $\text{Cl}_2 + \text{e}^- \leftrightarrow \text{Cl}^-$	+1.36
Gold: $\text{Au}^{3+}(\text{aq}) + 3\text{e}^- \leftrightarrow \text{Au}(\text{s})$	+1.50
Fluorine: $\text{F}_2 + \text{e}^- \leftrightarrow \text{F}^-$	+2.87

मानक अपचयन विभव का बढ़ता क्रम

अपचयित होने की प्रवृत्ति  $\downarrow$

ऑक्सीकारक क्षमता  $\downarrow$

धातु की सक्रियता  $\downarrow$

अम्ल से क्रिया कर हाइड्रोजन गैस मुक्त करना

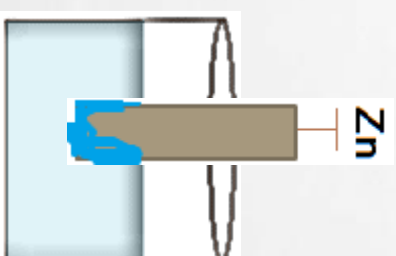
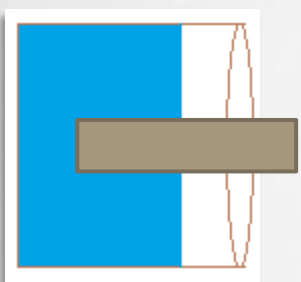
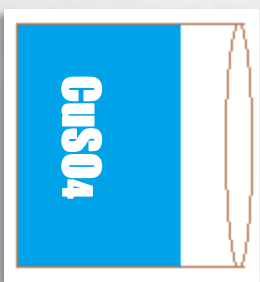
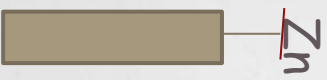
ऑक्सीकरण (Oxidation)



$$E^{\circ} = +0.76 \text{ V}$$

$$E^{\circ} = -0.76 \text{ V}$$

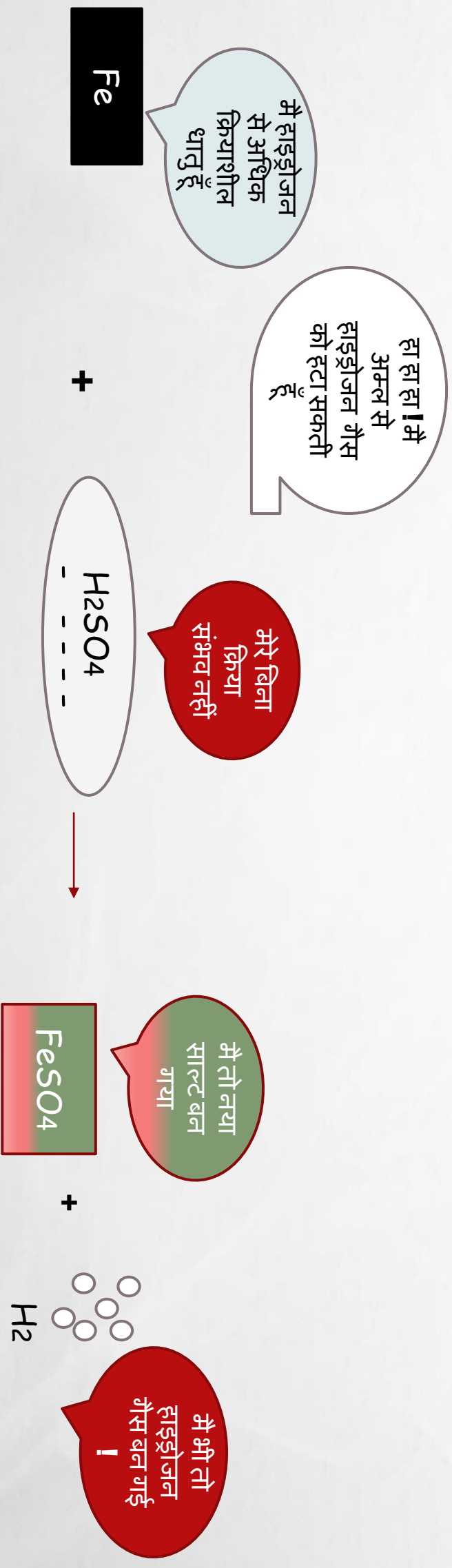
अनुप्रयोग : जिंक की छड़ को कॉपर सल्फेट में डाले तो -



जिंक की छड़ पर कॉपर धातु जमा हो जाती है।

जिंक **ECS** में कॉपर से ऊपर है, अधिक क्रियाशील है इस कारण जिंक का ऑक्सीकरण हो जायगा। और विलयन के कॉपर धनायनो को अपचयित कर देगी। परिणामतः कॉपर धातु छड़ पर एकत्रित हो जाती है। एवं जिंक आयन विलयन में आ जाते है, जिंक सल्फेट बन जाता है।

आयरन की सल्फुरिक अम्ल से क्रिया होती है तो-



किन्तु कॉपर कहती है कि, मैं सल्फुरिक एसिड से क्रिया कर हाइड्रोजन गैस नहीं बना सकती हूँ ।  
अर्थात आयरन **FeS** में हाइड्रोजन से उपर है, अधिकक्रियाशील है किन्तु कॉपर नीचे ।



इलेक्ट्रोकेमिकल सेल बनाने में

कमपटीशन्स

अधिक क्रियाशील धातु **EGS** में ऊपर रखी गई है, एवं इस धातु का इलेक्ट्रोड हमेशा ऑक्सीकरण करेगा ।

कम क्रियाशील धातु **EGS** में नीचे की ओर रखी गई है, एवं इस धातु का इलेक्ट्रोड हमेशा अपचयन करेगा ।

इस तरह दोनों इलेक्ट्रोड के संयोग से पूर्ण सेल बनेगा, यह एक रेडोक्स सेल होगा एवं हमको रासायनिक ऊर्जा से विद्युत् ऊर्जा प्रदान करेगा । उदाहरण – डैनियल सेल



## इलेक्ट्रोड विभव ज्ञात करने में-

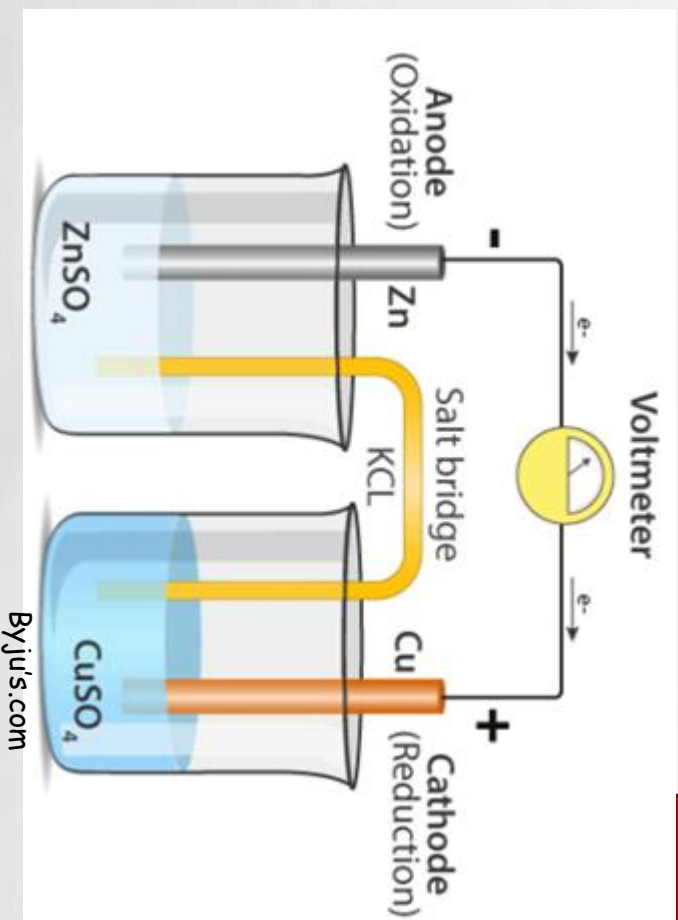
$$E^{\circ} \text{ cell} = E^{\circ} \text{ RHS} - E^{\circ} \text{ LHS}$$

$$E^{\circ} \text{ cell} = E^{\circ} \text{ reduction} - E^{\circ} \text{ oxidation}$$

$$E^{\circ} \text{ cell} = E^{\circ}_{\text{Cu}^{2+}/\text{Cu}} - E^{\circ}_{\text{Zn}^{2+}/\text{Zn}}$$

$$E^{\circ} \text{ cell} = 0.34 - (-0.76)$$

$$+1.10 \text{ V}$$



## डेनियल सेल



=

## सेल अभिक्रिया की संभावना ज्ञात करने में तथा मुक्त ऊर्जा पता करने में

1. विद्युत रासायनिक सेल का विद्युत वाहक बल का मान यदि धनात्मक आता है तो यह उस में होने वाली सेल अभिक्रिया फीजिबल होती है किंतु यदि ऋणात्मक आता है तो उस में होने वाली सेल अभिक्रिया को होना संभव नहीं है।
2. चूँकि मानक इलेक्ट्रोड विभव का संबंध मुक्त ऊर्जा से भी होता है अर्थात  
 $\Delta G = -nFE$  cell और इस कारण यदि मुक्त ऊर्जा में कमी आती है अर्थात ऋणात्मक मान को बताता है तो सेल का बनना संभव है।

**$E$  सेल = [+] धनात्मक मान आना चाहिए।**

**$\Delta G = (-)$  ऋणात्मक मान आना चाहिए।**

## अग्रेष पठन (Further Reading)

1. Puri, Sharma and Pathania, Principles of Physical Chemistry, Vishal Publication.
2. Nptelhrd  
[https://youtu.be/12ENx\\_Y0dNU](https://youtu.be/12ENx_Y0dNU)
3. Nptel IIT Guwahati  
[https://youtu.be/kbDtm\\_3zN1A](https://youtu.be/kbDtm_3zN1A)



# Assessment

1. धातुओं की सक्रियता का घटता क्रम है-

**A** Zn , Cu, Ag, Fe

**B** Zn , Fe, Cu, Ag

**C** Zn ,Fe , Ag, Cu

**D** Cu, Zn, Ag, Fe

2. आयरन एवं मैग्नीशियम धातु के इलेक्ट्रोड लेकर विद्युत् रासायनिक सेल बनाने पर

**A** आयरन का ऑक्सीकरण होता है

**B** मैग्नीशियम का ऑक्सीकरण होता है

**C** यह एक रेडोक्स सेल है

**D** मैग्नीशियम का अपचयन होता है

3. प्रबल ऑक्सिकारक है-

अ

फ्लोरीन

ब

क्लोरीन

स

लिथियम

द

सोडियम

4. विद्युत् रासायनिक श्रेणी में सभी तत्वों के मानक इलेक्ट्रोड विभव के मान ..... से जोड़कर परिकल्पित किये हैं। (मानक हाइड्रोजन इलेक्ट्रोड)

5. यदि जिंक का अपचयन विभव का मान  $-0.76\text{ V}$  है तो इसके ऑक्सीकरण विभव का मान ... ( $+0.76\text{V}$ ) .....होगा

6. क्या होता है जब जिंक की छड़ को कॉपर सल्फेट के विलयन में रखा जाता है ?

**GOVT. ARTS & SCIENCE COLLEGE, RATLAM**

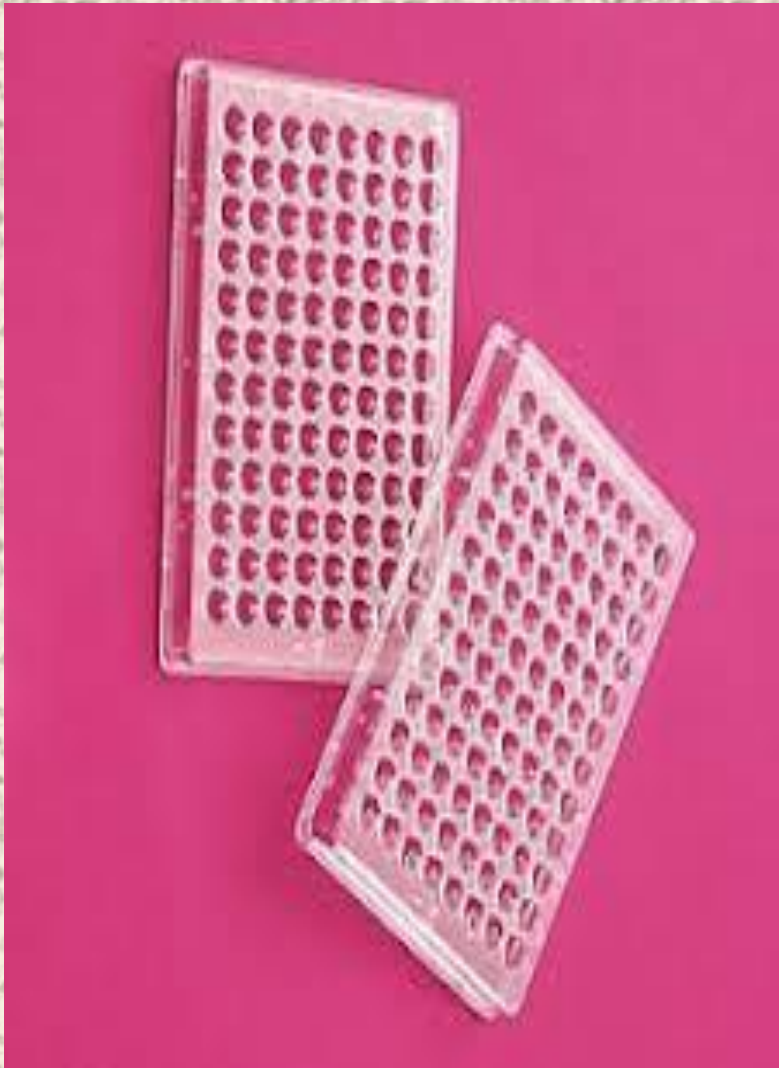


**M.Sc. III Sem MICROBIOLOGY**

**Topic: IMMUNOLOGY**

**PREETI MOYAL**

**FACULTY OF MICROBIOLOGY**



# ELISA



- ❖ **ELISA is known as Enzyme Linked immunosorbent Assay.**
- ❖ **It is the process use to detect antigen or antibodies.**
- ❖ **The enzyme-linked immunosorbent assay is a common laboratory technique which is used to measure the concentration of an analytic { usually antibodies or antigen } in solution.**

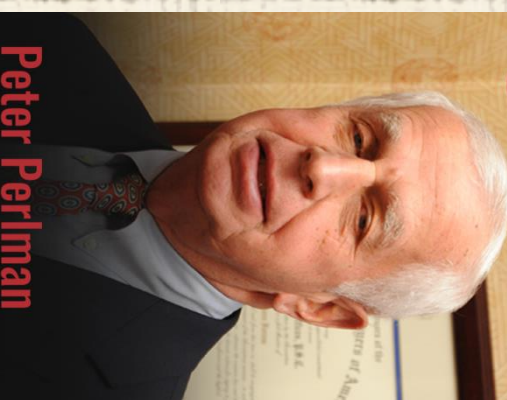
# Why Known as -?

## ENZYME linked Immunosorbent Assay

- ❖ Antigen / Antibody of interest is absorbed on to plastic surface ['sorbent'].
- ❖ Antigen is recognized by specific antibody ['immune'].
- ❖ This antibody is recognized by second antibody [immune] which has enzyme attached [enzyme-linked].
- ❖ Substrate reacts with enzyme to produce product, usually colored.

# History of ELISA

- ❖ Radioimmunoassay was first described in a scientific paper by **ROSALYAN SUSMAN YALOW** and **SOLOMON BERSON** published in 1960.
- ❖ In 1971, **PETER PERLMANN** and **EVA ENGVALL** independently published papers that synthesized this Knowledge into methods to perform ELISA.





# BASIC TERMS

❖ **SOLID PHASE** = usually a microtiter plate ,well, having 8\*12 well format.



❖ **ADSORPTION** = The process of adding an antigen/antibody, detected to the solid phase on incubation.

❖ **WASHING** = The simplest flooding and emptying of wells with a buffered solution to separated bound from un-bound reagents in ELISA.



❖ **ANTIGEN=**  
Any molecule that elicits the production of antibodies when introduced into body.

❖ **ANTIBODIES=**  
Proteins produce in response to antigenic stimuli.

❖ **ENZYME CONJUGATION=**An enzyme that is attached irreversibly to an antibody  
**EG=(HRPO)** Horse-Redish peroxidase.

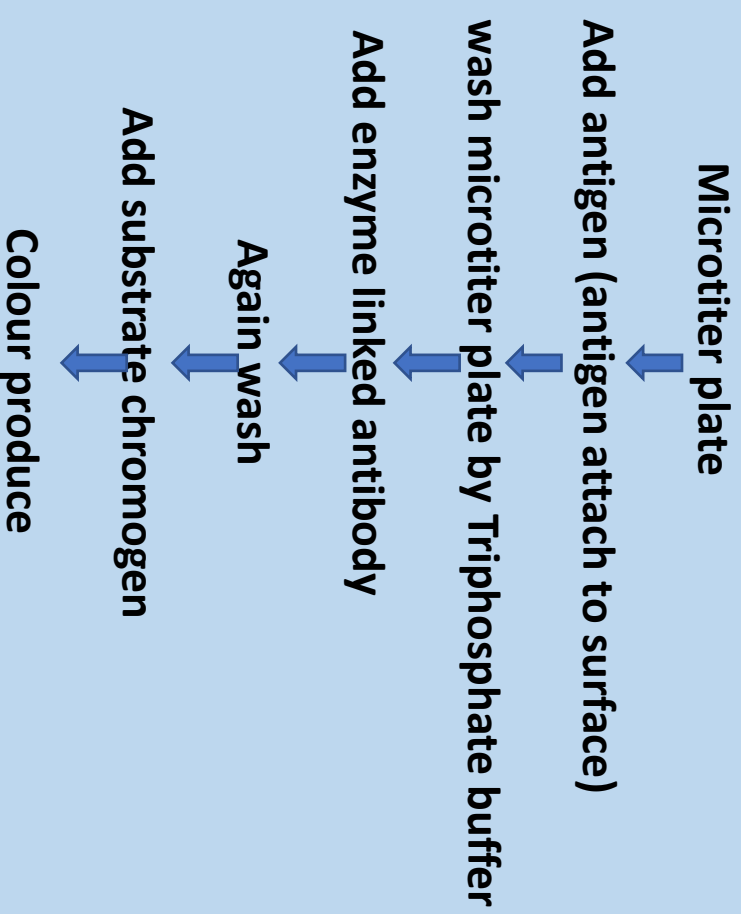
❖ **CHROMOGEN=**  
A chemical alters colour as a result of an enzyme interaction with substrate (colour reaction) used as signal.  
**EG= (TMB)**Trimethyl benzidine.

❖ **STOPPING=**  
The process of stopping the action of an enzyme on a substrate.

❖ **READING=**  
Spectrophotometric measurement of colour developed in ELISA.

# PRINCIPLE OF ELISA

- ❖ Based on basic immunology response
- ❖ Lock and key concept:-
  - 1] Antigen
  - 2] Antibody(Lock)
- ❖ As like key fits into lock.
- ❖ **AG + Enzyme linked AB** → ⊕ **Substrate chromogen system** → **Substrate bind to enzyme that induce chromogen to produce colour.**



# EQUIPMENTS

❖ **MICROWELL PLATE**=Flat bottom polystyrene plate , contain 8\*12 wells holding 350 $\Omega$ L each.



❖ **MULTIPIPETTE**=An 8-channel pipette is a good help for even small scale work.





❖ **WASHING DEVICE**= Manually operated washing device.

May be used particularly when there is a risk that the samples tested in ELISA contain infectious material, so must be collected for subsequent disinfection.



❖ **MICROPLATE WASHER**=There are very efficient with unusually low carry over contamination.





# REAGENTS USED

REAGENT	COMPOSITION
Coating buffer	0.01M phosphate buffer+0.15M NaCl (PBS)
Diluted/washing buffer	0.01M phosphate buffer+0.05MNacl+0.1%tween20.
Blocking buffer	Bovine Serum Albumin(BSA)
Enzyme	Horse- redish peroxide(HRPO)
Chromogenic substrate	Trimethyl benzidine(TMB)
Stop solution	0.5 M $H_2SO_4$

# Specimen sample of ELISA

**SERUM**

**CSF**

**SPUTUM**

**URINE**

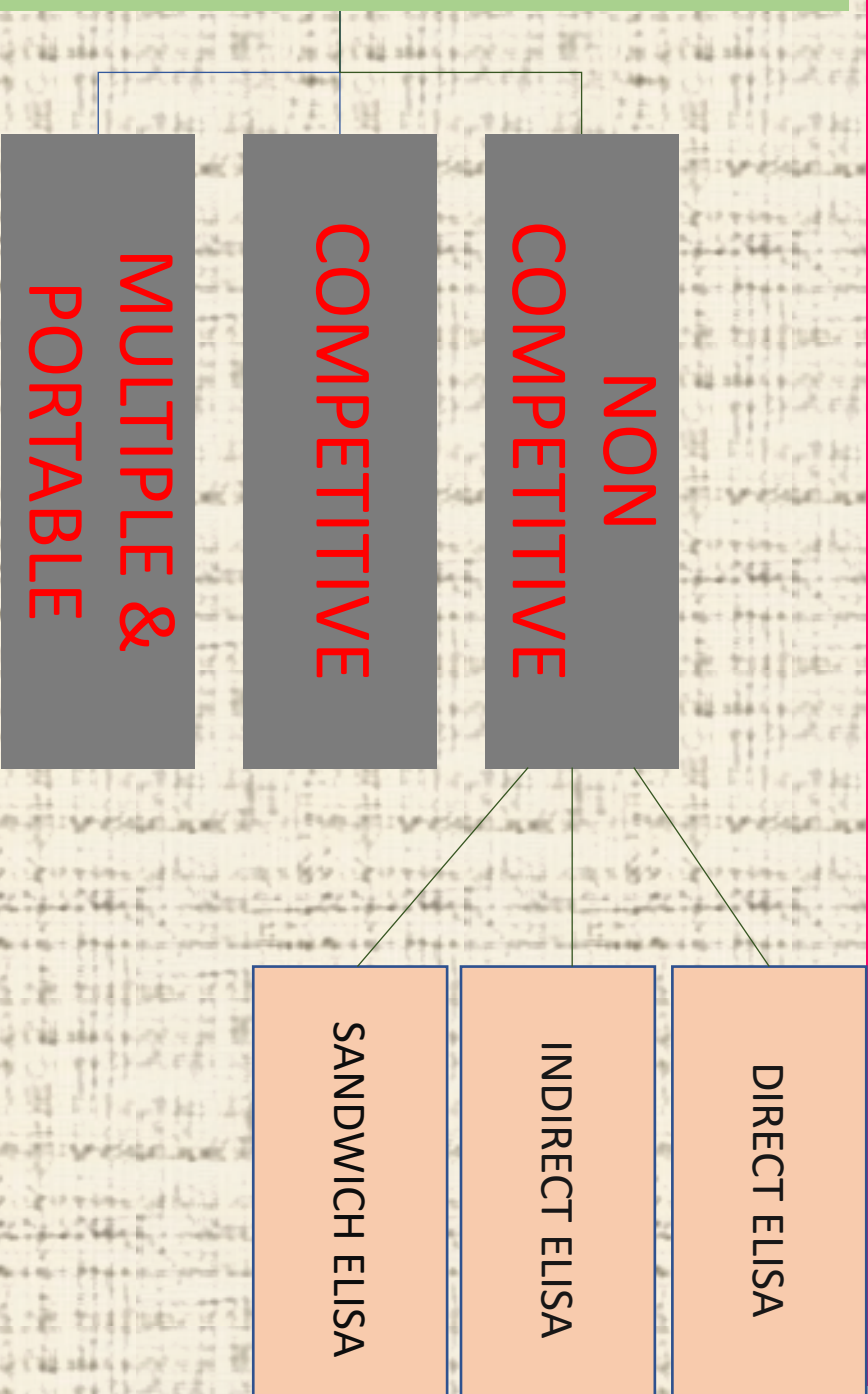
**SEMEN**

**Supernatant of culture**

**STOOL**

# TYPES OF ELISA

## ELISA

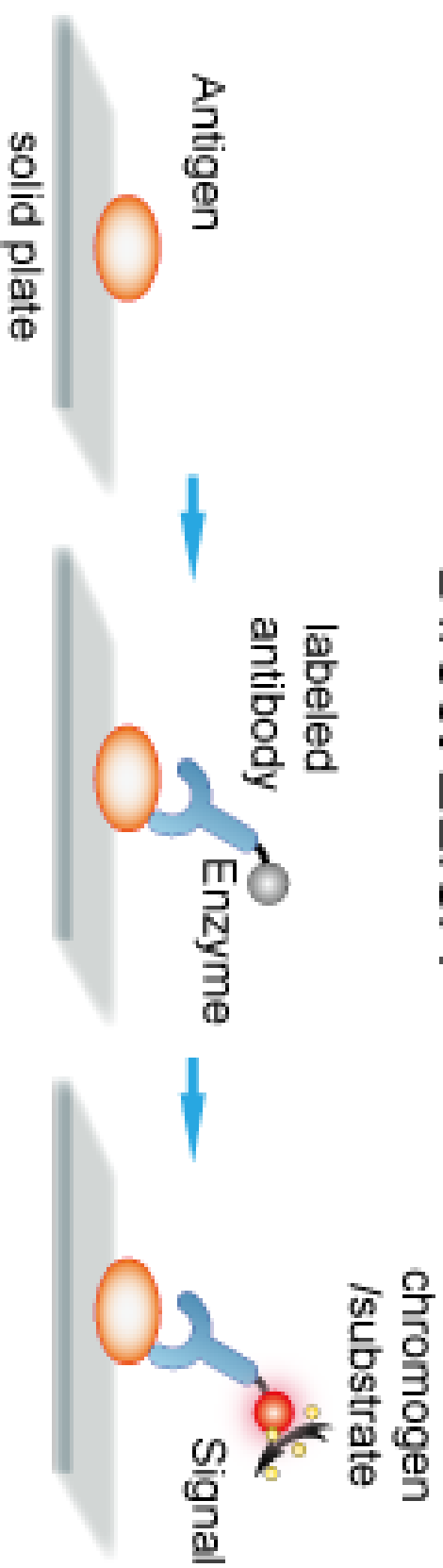


# DIRECT ELISA

FOR DETECTION OF ANTIGEN

Precoated Ag+ Enzyme linked Ab+ Substrate → color change

## Direct ELISA



1. Antigen is coated onto wells by passive adsorption
2. Antibody conjugated with enzyme is added and incubated with antigen and incubation.
3. Substrate / chromophore is added and colour develops.

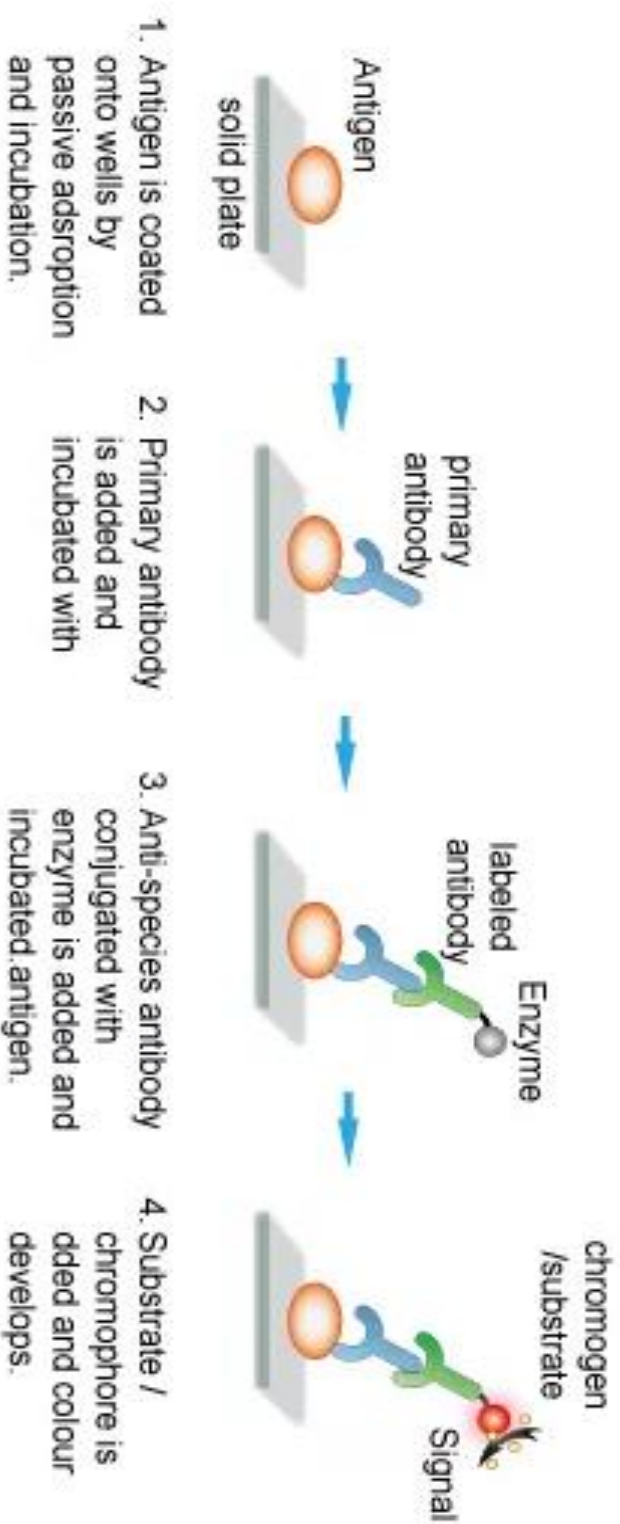


# INDIRECT ELISA

FOR DETECTION OF ANTIGEN OR ANTIBODIES

Primary Ab(not linked with enzyme)+Secondary Ab(linked with enzyme)+S.C.S → color change

## Indirect ELISA

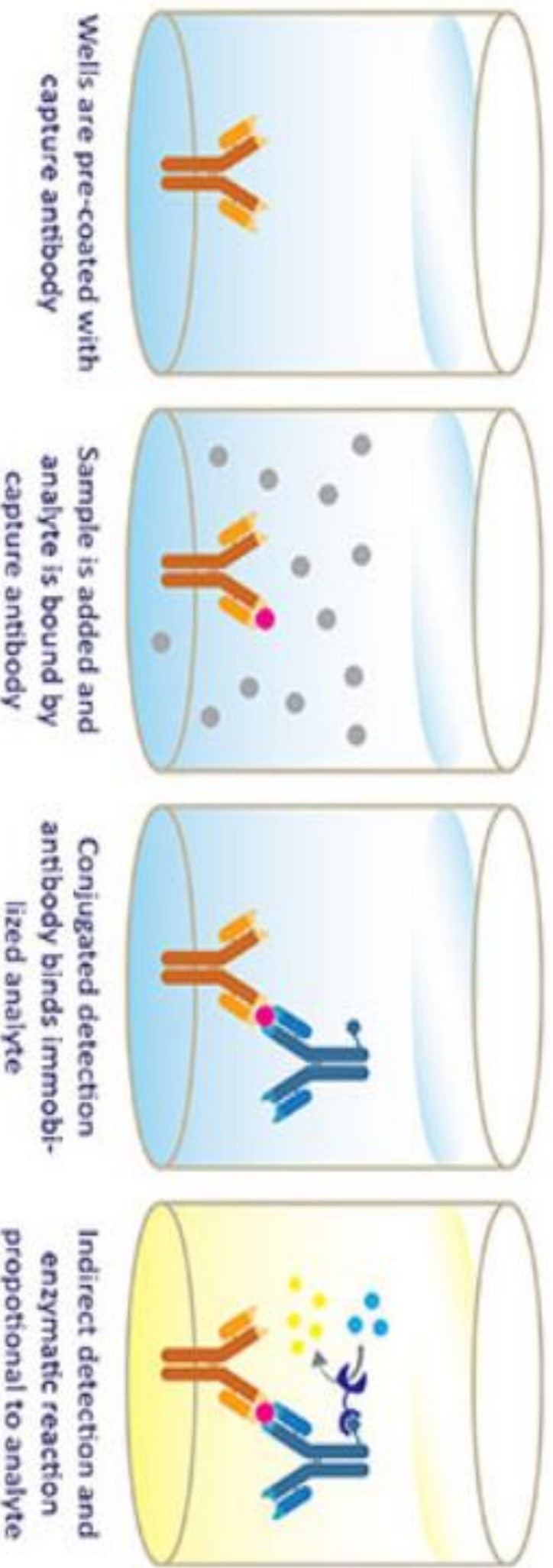


# SANDWICH ELISA

FOR DETECTION OF ANTIGEN

Primary Antibodies + Ag + secondary Ab(Enzyme linked) → colour produce

## Sandwich ELISA

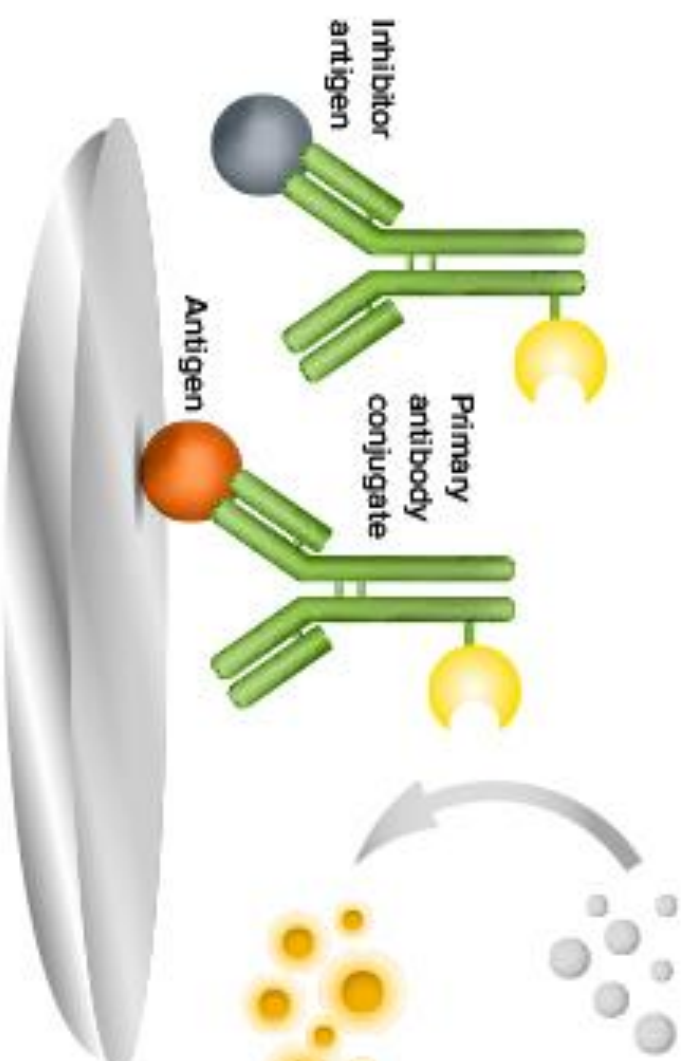


# COMPETITIVE ELISA

CONCENTRATION OF ANTIGEN IS VERY LOW

Ag is precoated.

Ag+ Ab  $\longrightarrow$  Ag-Ab + Free Ab





# COMPARISON BETWEEN DIFFERENT ELISA

## Advantages

## Disadvantages

### Direct ELISA

- Rapid
- Secondary antibody cross-reactivity eliminated

- Low sensitivity

- Specific antibody for each ELISA; time-consuming and expensive

### Indirect ELISA

- High sensitivity
- Cost-saving
- Flexible; can use many primary antibodies

- Risk of cross-reactivity between secondary antibodies

### Sandwich ELISA

- Minimal sample purification needed
- High sensitivity and specificity

- Must use 'matched pair' primary and secondary antibodies
- Time consuming and expensive

### Competitive ELISA

- Minimal sample purification needed
- Used to measure large range of antigens in a sample
- Used for small antigens
- Low variability

- Low specificity so cannot be used in dilute samples



# ADVANTAGES OF ELISA

- ❖ Reagents are relatively cheap and 've long self life.
- ❖ It is highly specific and sensitive(<1pg/ml).
- ❖ No radiation hazards occur during labelling or disposal of waste.
- ❖ Easy to perform & quick procedures.
- ❖ Equipment is widely available.
- ❖ It can be used to a variety of infections.
- ❖ It can be used on most type of biological samples like plasma, serum, urine, cell extracts.

# DISADVANTAGES OF ELISA

- ❖ Measurement of enzyme activity can be more complex than the measurement of activity of some type of radioisotopes.
- ❖ Enzyme activity may be affected by plasma constituents.
- ❖ Kits are not cheap.
- ❖ Very specific to particular antigen but won't recognize other antigen.
- ❖ False positive/negative possible, especially with mutated/altered antigen.

# APPLICATION


- ❖ **Serum antibody concentrations.**
- ❖ **Detecting potential food allergens**  
(milk, peanuts, walnuts, almonds, and eggs).
- ❖ **Disease outbreaks-tracking the spread of disease**  
E.G.- HIV, bird flu, common cold, cholera, STD etc.
- ❖ **Detection of antigens**  
E.G.- pregnancy hormone, drug allergen, GMO, mad cow disease
- ❖ **Detection of antibodies in blood sample for past exposure to disease**  
E.G.- Lyme disease, trichinosis, HIV, bird flu.

# LIMITATIONS OF ELISA

- ❖ Results may not be absolute.
- ❖ Antibody must be available.
- ❖ Concentration may be unclear.
- ❖ False positive possible[Ab already present].
- ❖ False negative possible.



# PRECAUTION

- ❖ Use of exchange type pipette (always use new tip).
- ❖ Washing.
- ❖ REAGENT.
  - use reservoir for each reagent.
  - label the reservoir
  - Don't use the same reservoir for multiple reagents.
  - Don't return the reagent to the stock.
- ❖ PLATE COVER.
  - During incubation, well plate should be covered using the plate cover.
  - Plate cover is effective only under suitable condition i.e room temperature, humidity >50%, air stream <0.2m/sec.
- ❖ COATING OF WELLS
  - It should be proper with the addition of blocking solution.
  - Improper coating  False positive result

# SUMMARY

- ❖ ELISA is a powerful method not only for general biomedical research but also as a diagnostic tool.
- ❖ It allows detection of all types of biological molecules at very low concentrations and quantities.
- ❖ Although it has its limitations, ELISA remains an important tool in both clinical and basic research, as well as in clinical diagnostics.

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